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

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 to 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

Introduction

Cross-national differences in prescription drug prices have been a topic of much discussion in the media and in policy circles (Bright 2006; Baker 2004). 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 (Stuart et al 2000; Danzon and Chao 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 €1500 in most countries, or €3480 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 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. (2003) 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 (2005) 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 exhaustion 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

93 trade on price dispersion for prescription drugs is limited. Previous studies examined the effect
94 on prices for top-selling drugs in select markets, but not how prices have changed across the
95 European Union relative to changes in other countries (Enemark, Pederson, and Sorensen 2006;
96 Kanavos et al. 2004; Ganslandt and Maskus 2004). Therefore, we analyzed price dispersion of a
97 larger set of prescription drugs in the European Union over a 12-year period to address these
98 questions.
99

Methods

We obtained data for all prescription drugs in 36 therapeutic categories (see Appendix) 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, Conn.), 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 US 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 (Enemark et al. 2006; Kanavos et al. 2004).

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 to 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) to "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. Since 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] Since 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 through 1994, 1995 through 1999, and 2000 through 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 (Kanavos et al. 2004; Carlson and Pescatrice 1980; Brynjolfsson and Smith 2000; Sorensen 2000; Goldberg and Verboven 2004). If the law of one price holds, all should be equal to 0. We used Wilcoxon 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, since 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 US 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 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.

The Figure 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 the Figure, there was substantial price dispersion across all countries and within the European Union. There was a slight reduction over time in the number of 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

227 across all countries and in the European Union. In each set of countries over time, there was little
228 change in the magnitude of any of the measures of price dispersion, except for a marked increase
229 in the standard deviation. In European Union countries, the mean price differentials were
230 significantly different between the 1995-1999 period and the other time periods, but the
231 difference between the 1993-1994 and 2000-2004 periods was not statistically significant. The
232 maximum price differentials for European Union countries in the 2000-2004 period were
233 statistically different from the earlier periods and, in fact, increased over time. The mean
234 standard deviation of prices across countries actually increased between the period before
235 parallel trade and the more recent observations (all countries, 16.1 to 20.6; European Union
236 countries, 10.8 to 17.3).

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

242 Table 3 presents the results of the regression analysis. Each row contains the estimated
243 coefficient for the dummy variable for each year, with one column for the main effect and
244 another column for the interaction with the European Union dummy variable. Across all
245 specifications, the results indicate a reduction of price dispersion after 1995 for all countries
246 relative to the first year in the data set (1993); all coefficients after 1995 are negative and
247 statistically significant at the 1 percent level. However, the interaction with the European Union
248 variable is frequently positive and statistically significant, particularly for the most recent years.
249 In the post-1995 period, only in 2000 and 2001 did price differentials fall more for European

250 Union countries than for other countries. The qualitative results are the same across our choice of
251 average or minimum price differences and the inclusion or exclusion of the United States from
252 the data set.
253

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 2006).

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 2006). Important differences between the European Union and US 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 (Huskamp et al. 2003; Joyce et al. 2002). 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 US and Canadian competition laws would affect rationing. Given the relatively small size of the Canadian prescription drug market

297 (roughly one-tenth the size of the US market), it is unlikely that parallel trade from Canada alone
298 would have a large impact on prices in the United States (Porter 2004).

299 Our analysis has some limitations. First, we assessed pharmaceutical products in 36
300 therapeutic categories, but there may be different results in drug categories that we did not
301 examine. Second, parallel trade may have less effect in the European Union than it would in
302 higher-price markets like the United States, where pharmacists, insurers, and patients have
303 greater incentive to switch to less expensive prescription drugs. In any case, it is clear that the
304 development of a regulatory infrastructure for parallel trade does not automatically reduce
305 international price dispersion for prescription drugs.
306

Endnotes

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 prior to membership was imposed for both countries, which ended in 1995.

References

Arfwedson, J. 2004. "Re-importation (Parallel Trade) in Pharmaceuticals." Lewisville, Tex: Institute for Policy Innovation; July 2004. Policy Report 182.

Baker, C. 2004. "Would Prescription Drug Reimportation Reduce U.S. Drug Spending?" Economic and Budget Issue Brief. Washington, DC: Congressional Budget Office; April 29, 2004.

Bright, B. 2006. "Most Americans Support Legalizing Drug Imports From Canada, Poll Finds." *Wall Street Journal*. August 31, 2006.

Brynjolfsson, E., and M. Smith. 2000. "Frictionless Commerce? A Comparison of Internet and Conventional Retailers." *Management Science* 46(4): 563-585.

Carlson, J.A., and D.R. Pescatrice. 1980. "Persistent Price Distributions." *Journal of Economics and Business* 33(1): 21-27.

Danzon, P., and L. Chao. 2000. "Cross-National Price Differences for Pharmaceuticals: How Large and Why?" *Journal of Health Economics* 19(2): 159-195.

Danzon, P., M. Furukawa. 2003. "Prices and Availability of Pharmaceuticals: Evidence From Nine Countries." Health Affairs 2003;Suppl Web Exclusives: W3-521-536.

Danzon, P., M. Furukawa. 2006. "Prices and Availability of Biopharmaceuticals: An International Comparison." *Health Affairs* 25(5): 1353-1362.

Enemark, U., K. Pederson, and J. Sorensen. 2006. "The Economic Impact of Parallel Import of Pharmaceuticals." [accessed May 2, 2007]. Available at: http://www.cast.sdu.dk/pdf/Parallel_import_rapport_13_06_1430_opdateret_final.pdf.

European Commission, Directorate-General for Economic and Financial Affairs. 2001. "Price Levels and Price Dispersion in the EU." Economic Trends Supplement A, No. 7

[accessed July 30, 2007]. Available at: http://ec.europa.eu/economy_finance/publications/european_economy/2001/a2001_07_en.pdf.

Farquason, M., and V. Smith. 1998. *Parallel Trade in Europe*. London, UK: Sweet & Maxwell Publishers.

Ganslandt, M., and K. Maskus. 2004. "Parallel Imports and the Pricing of Pharmaceutical Products: Evidence From the European Union." *Journal of Health Economics* 23(5): 1035-1057.

Goldberg, P. K., and F. Verboven. 2005. "Cross-Country Price Dispersion and the Euro." *Economic Policy* 19(40): 484-521.

House of Commons Select Committee on Trade and Industry. 1999. Eighth Report [accessed August 14, 2007]. Available at: http://www.parliament.the-stationery-office.co.uk/pa/cm199899/cmselect/cmtrdind/380/38002.htm.

Huskamp, H.A., P.A. Deverka, A.M. Epstein, R.S. Epstein, K.A. McGuigan, and R.G. Frank. 2003. "The Effect of Incentive-Based Formularies on Prescription-Drug Utilization and Spending." *New England Journal of Medicine* 349(23): 2224-2232.

Jacobzone, S. 2000. "Pharmaceutical Policies in OECD Countries: Reconciling Social and Industrial Goals. Paris, France: OECD Directorate for Employment, Labour and Social Affairs; 2000. OECD Labour Market and Social Policy Occasional Papers 40.

Joyce, G.J., J.J. Escarce, M.D. Solomon, and D.P. Goldman. 2002. "Employer Drug Benefit Plans and Spending on Prescription Drugs." *Journal of the American Medical Association* 288(14): 1733-1739.

Kanavos, P., J. Costa-i-Font, S. Merkur, M. Gemmill. 2004. "The Economic Impact of Pharmaceutical Parallel Trade in European Union Member States: A Stakeholder Analysis." LSE Health and Social Care Special Research Paper [accessed May 2, 2007]. Available at: http://www.lse.ac.uk/collections/LSEHealthAndSocialCare/pdf/Workingpapers/Paper.pdf.

Kyle, M. 2006. "Strategic Responses to Parallel Trade." National Bureau of Economic Research Working Paper 12968 [accessed August 15, 2007]. Available at: http://www.nber.org/papers/w12968.

Mankiw, G. 2007. *Principles of Economics*, 4th edition. Mason, Ohio: Thomson Higher Education.

Maskus, K. E., and Y. Chen. 2002. "Parallel Imports in a Model of Vertical Distribution: Theory, Evidence, and Policy." *Pacific Economic Review*. 7(2): 319-334.

Medicine Equity and Drug Safety Act, Public Law No. 106-387, 114 Stat 1549 (2000) (codified at 21 USC § 384).

National Economic Research Associates. 1999. "The Economic Consequences of the Choice of Regime in the Area of Trademarks." London, UK: National Economic Research Associates.

Porter, E. 2004. "Importing Less Expensive Drugs Not Seen as Cure for U.S. Woes." *New York Times*. October 16, 2004: A1.

Ridley, D., H. Grabowski, and J. Moe. 2006. "Developing Drugs for Developing Countries." *Health Affairs* 25(2): 313-324.

Rubin, A.J. 2000. "Plan Dropped to Reimport U.S.-Made Medications." *Los Angeles Times*. December 27, 2000: A1.

Sorensen, A. 2000. “Equilibrium Price Dispersion in Retail Markets for Prescription Drugs.” *Journal of Political Economy* 108(4): 833-850.

Stuart, B., N. Brandt, N. Briesacher, et al. 2000. “Issues in Prescription Drug Coverage, Pricing, Utilization, and Spending: What We Know and Need to Know.” Report prepared for the US Department of Health and Human Services, Office of the Assistant Secretary for Policy and Evaluation, Office of Health Policy. Baltimore, Md.: University of Maryland; February 18, 2000.

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	2846.0

SD indicates standard deviation.

* 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 Appendix.

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

§ Conditional on parallel trade taking place.

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

Table 2. Summary Statistics

Variable	Period			*p*-Value*		
	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)	0.03	< 0.001	0.03
Mean price differential, percentage of all-countries mean (median)	50.61 (50.82)	48.70 (48.57)	51.50 (51.53)	< 0.001	< 0.001	0.10
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)	0.28	< 0.001	< 0.001
Mean price differential, percentage of EU mean (median)	43.56 (43.77)	40.97 (40.58)	42.65 (42.58)	< 0.001	0.003	0.24
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)	< 0.001	< 0.001	0.53
Mean price differential, percentage of non–EU mean (median)	51.92 (52.07)	51.98 (51.74)	54.11 (53.95)	0.48	< 0.001	0.005
Maximum price differential, percentage of EU mean (median)	151.47 (153.66)	161.80 (161.87)	169.98 (169.88)	< 0.001	0.002	< 0.001
Mean price differential, percentage of EU mean (median)	93.37 (91.81)	111.26 (112.69)	101.96 (98.01)	0.36	0.13	0.88
Coefficient of variation†	0.74	0.73	0.76			
Standard deviation‡	19.28	27.31	35.86			

EU indicates European Union.

* *p*-Values from Wilcoxon 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.

Table 3. Results From Regressions of Log Price Differentials

Year	Quantity-Weighted Average Price, Coefficient (Standard Error)				Minimum Price, Coefficient (Standard Error)			
	Non–EU Countries	EU Countries	Non–EU Countries, Excluding US	EU Countries	Non–EU Countries	EU Countries	Non–EU Countries, Excluding US	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	

EU indicates European Union.

* 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, Tex.).

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

Appendix. Therapeutic Classifications Included in the Analysis*

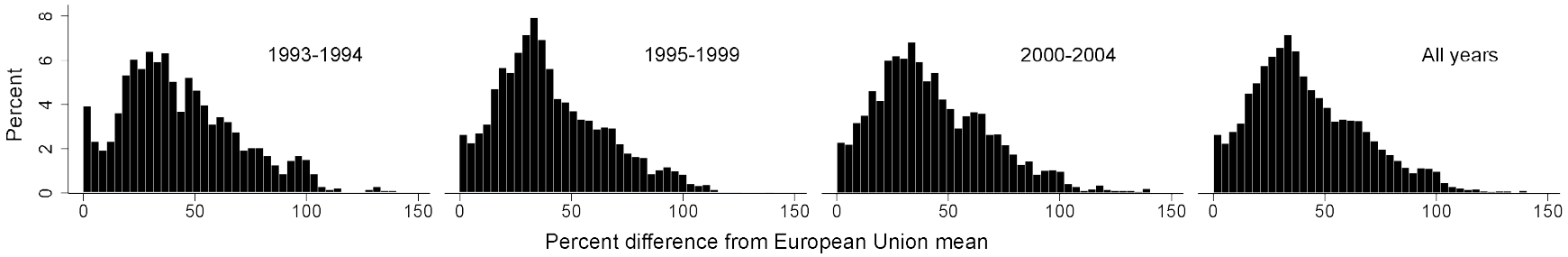
Category	Code	Therapeutic Classification
Alimentary tract and metabolism	A4A1	Serotonin antagonists antiemetics/antinauseants
	A4A9	Other antiemetics and antinauseants
Blood and blood forming organs	B1C1	Cyclo-oxygenase inhibitor platelet aggregation inhibitors
	B1C2	ADP (adenosine diphosphate) receptor antagonist platelet aggregation inhibitors
	B1C3	GP IIb/IIIa (glycoprotein) antagonist platelet aggregation inhibitors
	B1C4	Platelet cAMP enhancing platelet aggregation inhibitors
	B1C5	Platelet aggregation inhibitors, combinations
	B1C9	Other platelet aggregation inhibitors
	B1D	Fibrinolytics
Cardiovascular system	C3A1	Potassium-sparing agents plain
	C3A2	Loop diuretics plain
	C3A3	Thiazides and analogues plain
	C3A4	Potassium-sparing agents with loop diuretic combinations
	C3A5	Potassium-sparing agents with thiazides and/or analogue combinations
	C3A6	Other diuretics
	C7A	Beta-blocking agents, plain
	C7B1	Combinations with anti-hypertensives and/or diuretics
	C7B2	Combinations with other drugs of group C
	C7B3	Combinations with all other drugs except those of group C
	C8A	Calcium antagonists, plain
	C9A	ACE inhibitors, plain
	C9B1	ACE inhibitor combinations with antihypertensives (C2) and/or diuretics (C3)
	C9B2	ACE inhibitor/beta-blocker combinations
	C9C	Angiotensin-II antagonists, plain
	C9D	Angiotensin-II antagonists, combinations
Anti-infectives for systemic use	J1D2	Injectable cephalosporins
Antineoplastic and immunomodulating agents	L1A	Alkylating agents
	L1B	Antimetabolites
	L1C	Vinca alkaloids and other plant products
	L1D	Antineoplastic antibiotics
	L1X1	Adjuvant preparations for cancer therapy
	L1X2	Platinum compounds
	L1X3	Antineoplastic monoclonal antibodies
	L1X9	All other antineoplastics
	L3A1	Colony-stimulating factors
	L3A9	All other immunostimulating agents excluding interferons

* From the Anatomical Classification of Pharmaceutical Products developed and maintained by the European Pharmaceutical Marketing Research Association, as provided in the IMS Midas database.

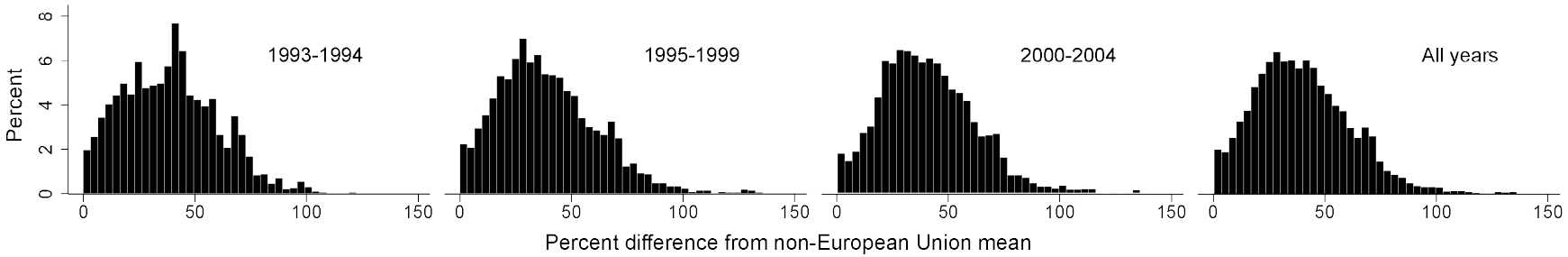
Figure Legend

Distributions of prescription drug price differentials by time period in European Union countries, non–European Union countries, and all countries.

European Union countries



Non-European Union countries



All countries