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Parallel Imports and Manufacturer Rebates: Evidence from Germany

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Abstract

In this paper, I study the effect of a change in the mandatory manufacturer rebate on wholesale prices for pharmaceuticals on competition by parallel imports. First, I analyze the effect of a manufacturer rebate on competition by parallel imports in a two-country model. An increase in the manufacturer rebate increases the market share of parallel imports. Second, I exploit a policy reform in Germany in 2010 that increased the manufacturer rebate by 10 percentage points. Using a data set with prescription drugs with competition from parallel imports, I estimate the effect of the change in the manufacturer rebate on competition by parallel imports. Estimation results suggest that an increase in the manufacturer rebate has increased the market share of parallel imports.

JEL Classification: F12, I11, I18

Keywords: parallel imports, manufacturer rebate, pharmaceuticals, regulation

1 Introduction

Parallel trade refers to the cross-border resale of goods without authorization of the manufacturer (Maskus, 2000). Wholesalers or parallel traders may resell goods that were placed on the market in one country in another country (Maskus, 2000). In the European Economic Area, parallel trade is legal. Parallel trade occurs if price differences between countries are sufficiently to cover the cost of parallel trading, e.g. distribution cost, licence cost, repacking cost etc. For pharmaceuticals, price differences in the European Union may reach up to 100%-300% (Kanavos

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& Costa-Font, 2005). Main reasons for price differences are manufacturers' price discrimination, vertical control structures and/or differences in pharmaceutical regulation make parallel trade profitable. Pharmaceutical manufacturers regularly price discriminate between countries based on differences in income, insurance coverage etc. (Danzon & Chao, 2000, Danzon & Furukawa, 2003). Pharmaceutical markets are characterized by numerous government interventions. In the European Union, health policy and including pharmaceutical regulation are national competence of EU member states (Art. 168 TFEU) and accordingly, regulatory instruments and the strictness of regulation differ across countries (see e.g. Espin & Rovira (2007) or Carone, Schwierz & Xavier (2012) for an overview). Typically, pharmaceutical manufacturers do not sell directly but through independent wholesalers (Taylor, Mrazek & Mossialos, 2004). Consequently, parallel trade in pharmaceuticals is a common phenomenon in the European Union[1].

The extent of competition by parallel imports in the destination countries is driven by pharmaceutical regulation through three channels. First, regulatory differences between countries drive drug price differences. This is, regulatory differences determine the volume and direction of parallel imports. Second, pharmaceutical regulation in destination countries may change copayments and accordingly the choice between locally sourced versions and parallel imports. The design of the cost-sharing system, i.e. rules of copayment and reimbursement, seems to be an important factor in determining the competition by parallel imports (Kanavos et al., 2004; Enemark et al., 2006, Birg, 2018). Third, regulation in destination countries may also affect competition between locally sourced version and parallel imports. For instance, Brekke et al. (2015) show that stricter price caps may reduce competition from parallel imports. Also regulation in pharmaceutical supply chains or the regulation of wholesale prices may drive competition, as it affects the difference between retail and wholesale prices and thus the profitability of parallel trade. Almost all European countries regulate wholesale margins or pharmacy margins (Carone, Schwierz & Xavier, 2012). In addition, Germany applies a mandatory manufacturer rebate on wholesale prices. This is, pharmaceutical manufacturers and wholesalers must provide a mandatory rebate for prescription drugs to the third party payer, the statutory health insurance. In 2010, a policy reform increased the mandatory manufacturer rebate by 10 percentage points from 6% to 16%. This change in the manufacturer rebate is expected to affect

[1] Source countries of parallel imports are countries with rather low drug prices, such as Greece, Italy, Portugal, and Spain, destination countries are characterized by rather high drug prices, e.g. Denmark, Germany, the Netherlands, and Sweden (Kanavos & Costa-Font, 2005). In 2015, pharmaceutical parallel trade had a volume of € 5.3 bn (EFPIA, 2017). In the destination countries, the market share of parallel imports ranged between 8.2 % in the Netherlands, 9 % in Germany, 12 % in Sweden, and 24.9 % in Denmark (EFPIA, 2017).

the retail-wholesale margin and thus affect competition between locally sourced versions and parallel imports. By studying the effect of this reform, this paper analyzes one potential drivers of competition by parallel imports.

The literature on pharmaceutical regulation and parallel trade has mainly focused on the effect of parallel trade on regulatory choices at the retail level, suggesting that parallel trade may distort regulatory decisions (e.g. Pecorino, 2002, Grossman & Lai, 2008, Bennato & Valletti, 2014). Brekke et al. (2015) study the effect of pharmaceutical regulation on competition by parallel imports, suggesting that stricter regulation, i.e. lower price caps reduce competition from parallel imports. Similarly, Birg (2019) suggests that lower reimbursement for drugs, this is, lower reference prices may reduce competition from parallel imports. The effect of wholesale level regulation, however, has received rather little attention in the literature. Costa-Font (2016) shows that parallel imports are not only driven by price differences but also by cross-country differences in distribution margins. He concludes that parallel trade can be regarded as "regulatory arbitrage". Birg (2017) studies externalities of different wholesale level regulation instruments which also affect the manufacturer's possibilities to limit competition from parallel trade. Brekke et al. (2013) show how product margins determine pharmacies' incentives to promote generic substitution, suggesting that generic and brand-name margins determine competition between brand-names and generics.

Against this background, I study the effect of a change in the manufacturer rebate on competition by parallel imports. First, I analyze the effect of a manufacturer rebate on competition by parallel imports in a two-country model with a vertical control structure following Ganslandt & Maskus (2007) and Birg (2017). A pharmaceutical manufacturer sells a drug in two countries through independent intermediaries. Parallel trade occurs as the intermediary in the foreign country may resell the drug in the manufacturer's home country. An increase in the manufacturer rebate increases the market share of parallel imports. Second, I exploit a policy reform in Germany in 2010 that increased the mandatory manufacturer rebate by 10 percentage points. Using a data set with prescription drugs with competition from parallel imports, I estimate the effect of the change in the manufacturer rebate on competition by parallel imports. Estimation results suggest that an increase in the manufacturer rebate has increased the market share of parallel imports.

The rest of the paper is organized as follows. In the next section, the model is presented. Section 3 describes the institutional background. Section 4 presents the data set and section

5 studies the effect of a change in manufacturer rebates on competition by parallel imports. Section 6 concludes.

2 Model

Consider the pharmaceutical market for an on-patent drug b. The drug is sold by a pharmaceutical manufacturer M in two countries j, $j = D, S$. In both countries, the manufacturer does not sell directly, but through independent intermediaries ${I_j}^2$. The manufacturer charges each intermediary a wholesale price w_j per unit.

The intermediary I_D sells the authorized version b in country D; the intermediary I_S sells the authorized version b in country S and, in addition, may resell the drug b in D as a parallel import (hereafter denoted by β). This is, S is the source country, D is the destination country of the parallel import.

The locally sourced version of the drug b and the parallel import β are de facto identical but differ in sourcing. Assume that patients consider both versions to be identical, i.e. patients do not observe sourcing or they do not care [3].

Patients in both countries differ in their valuation of the drug θ, which is uniformly distributed on the interval $[0, 1]$. The consumer heterogeneity can be interpreted as differences in income, severity of the condition, prescription practices or insurance coverage (see e.g. Brekke et al., 2011). The total mass of consumers is 1 in both countries.

In both countries, consumers pay a fraction γ_j, with $\gamma_j \in (0, 1)$ of the drug price (coinsurance). This is, the drug copayment is $c_{ij} = \gamma_j p_{i,j}$ and third-party payer reimbursement is $r_{ij} = \left(1 - \gamma_j\right) p_{i,j}$. Assume for simplicity that the coinsurance rate is the same in both countries $\gamma_D = \gamma_S = \gamma$, i.e. countries do not differ in copayments [4].

Each consumer demands either one or zero units of the most preferred drug. Let

$$U\left(\theta, \gamma, p_j\right) = \theta - \gamma p_j \tag{1}$$

be the utility of a consumer who buys one unit of drug, with p_j as the drug price in country j.

In country D, the marginal consumer who is indifferent between buying either the locally

[2] The model set-up follows Ganslandt & Maskus (2007) and Birg (2017).

[3] Assuming that patients attribute a lower quality to the parallel import due to differences in appearance and packaging yields qualitatively similar results.

[4] This implies that parallel trade is not driven by differences in coinsurance rates. Assuming different coinsurance rates between countries yields qualitatively similar results.

sourced version b or the parallel import β has a gross valuation $\widehat{\theta}_D = \gamma p_D$. Demand for the authorized product b and for the parallel import β is given by $q_D = 1 - \gamma p_D$, with $q_D = q_{D,b} + q_{D,\beta}$. In country S, the marginal consumer who is indifferent between buying the locally sourced version b and not buying (0) has a gross valuation $\widehat{\theta}_S = \gamma p_S$. Demand for the drug b is given by $q_S = 1 - \gamma p_S$.

Production technologies exhibit constant marginal costs, which are normalized to zero for simplicity. Profits are

$$\pi_M = w_D q_{D,b} + w_S q_{D,\beta} + w_S q_S, \tag{2}$$

$$\pi_{I_D} = (p_D - w_D)\, q_{D,b}, \tag{3}$$

$$\pi_{I_S} = (p_D - w_S)\, q_{D,b} + (p_S - w_S)\, q_S. \tag{4}$$

Consider a two-stage game: In the first stage, the manufacturer M charges each intermediary a wholesale price w_j per unit. In the second stage, intermediaries I_D and I_S set quantities.

2.1 Coinsurance

Consider a system with coinsurance as a benchmark.

In the second stage, intermediaries compete in quantities. In country D, intermediaries I_D and I_S maximize (3) and (4) with respect to $q_{D,b}$ and $q_{D,\beta}$. The profit maximizing quantities are

$$\begin{aligned} q_{D,b} &= \frac{1 - 2\gamma w_D + \gamma w_S}{3}, \\ q_{D,\beta} &= \frac{1 - 2\gamma w_S + \gamma w_D}{3}. \end{aligned} \tag{5}$$

In country S, the intermediary I_S maximizes (4) with respect to q_S. The profit maximizing quantity is

$$q_{b,S} = \frac{1 - \gamma w_S}{2}. \tag{6}$$

In the first stage, the manufacturer maximizes (2) with respect to w_D and w_S. Equilibrium wholesale prices are

$$w_D = w_S = \frac{1}{2\gamma}. \tag{7}$$

First stage equilibrium quantities are

$$\begin{aligned} q_{D,b} &= q_{D,\beta} = \frac{1}{6}, \\ q_{b,S} &= \frac{1}{4}. \end{aligned} \tag{8}$$

Drug prices are

$$p_D = \frac{2}{3\gamma},\ p_S = \frac{3}{4\gamma}. \tag{9}$$

The market share of the parallel import is

$$\chi = \frac{q_{D,\beta}}{q_{D,\beta} + q_{D,b}} = \frac{1}{2}. \tag{10}$$

2.2 Manufacturer Rebates

Consider now that the government in country D applies a manufacturer rebate ξ, with $\xi \in (0,1)$. Both intermediaries are subject to the rebate with their sales in country D. To prevent strategic price increases, the manufacturer rebate is combined with a wholesale price freeze in country D.

Profits are

$$\pi_M^{\xi} = w_D^{\xi} q_{D,b}^{\xi} + w_S^{\xi} q_{D,\beta}^{\xi} + w_S^{\xi} q_S^{\xi}, \tag{11}$$

$$\pi_{I_D}^{\xi} = \left(p_D^{\xi} - w_D^{\xi}(1+\xi)\right) q_{D,b}^{\xi}, \tag{12}$$

$$\pi_{I_{S,b}}^{\xi} = \left(p_D^{\xi} - w_S^{\xi}(1+\xi)\right) q_{D,\beta}^{\xi} + \left(p_S^{\xi} - w_S^{\xi}\right) q_S^{\xi}. \tag{13}$$

In the second stage, intermediaries compete in quantities. In country D, intermediaries I_D and I_S maximize (12) and (13) with respect to $q_{D,b}^{\xi}$ and $q_{D,\beta}^{\xi}$. The profit maximizing quantities are

$$\begin{aligned} q_{D,b}^{\xi} &= \frac{1 - 2\gamma w_D(1+\xi) + \gamma w_S(1+\xi)}{3}, \\ q_{D,\beta}^{\xi} &= \frac{1 - 2\gamma w_S(1+\xi) + \gamma w_D(1+\xi)}{3}. \end{aligned} \tag{14}$$

In country S, the intermediary I_S maximizes (13) with respect to q_S^{ξ}. The profit maximizing quantity is

$$q_S^{\xi} = \frac{1 - \gamma w_S^{\xi}}{2}. \tag{15}$$

In the first stage, the manufacturer maximizes (11) with respect to w_S^ξ. The wholesale price w_D is fixed by regulation. Equilibrium wholesale prices are

$$\begin{aligned} w_D^\xi &= w_D = \frac{1}{2\gamma}, \\ w_S^\xi &= \frac{2\xi + 7}{2\gamma\left(4\xi + 7\right)}. \end{aligned} \tag{16}$$

First stage equilibrium quantities are

$$\begin{aligned} q_{D,b} &= \frac{7 - 5\xi - 6\xi^2}{6\left(4\xi + 7\right)}, \\ q_{D,\beta} &= \frac{\xi + 7}{24\xi + 42}, \end{aligned} \tag{17}$$

$$q_{b,S} = \frac{6\xi + 7}{4\left(4\xi + 7\right)}. \tag{18}$$

Drug prices are

$$\begin{aligned} p_D &= \frac{14\xi + 3\xi^2 + 14}{3\gamma\left(4\xi + 7\right)}, \\ p_S &= \frac{10\xi + 21}{4\gamma\left(4\xi + 7\right)}. \end{aligned} \tag{19}$$

The market share of the parallel import is

$$\chi^\xi = \frac{\xi + 7}{2\left(7 - 2\xi - 3\xi^2\right)}, \tag{20}$$

Proposition 1 summarizes the effect of a change in the manufacturer rebate ξ on competition by parallel traders:

Proposition 1 *An increase in the manufacturer rebate ξ increases the market share of the parallel import:$\frac{\partial \chi^\xi}{\partial \xi} > 0$.*

3 Institutional Background

The German pharmaceutical market had a volume of € 40 bn. in 2017 (German Pharmaceutical Industry Association, 2018). In 2018, roughly 49,000 prescription drugs were listed for reimbursement in Germany (Federal Institute for Drugs and Medical Devices, 2018). The share of parallel imports in pharmacy market sales was 8.5% in 2016 (EFPIA, 2018). According to §

129 Social Code V, pharmacists are obliged to dispense parallel imports if they are priced €15 or 15% below locally sourced brand-name.

In order to reduce expenditure borne by the statutory health insurance, pharmaceutical manufacturers, wholesalers, and pharmacists must provide a mandatory rebate for prescription drugs to the statutory health insurance.

In 2010, the Statutory Health Insurance Amendment Act (GKV-ÄndG) increased the mandatory manufacturer rebate from 6% to 16% (§ 130a (1) SGB V). At the same time, a price moratorium (price freeze) came into force. The reform only affected pharmaceuticals that are not subject to reference pricing. For all other pharmaceuticals, the mandatory rebate of 6%, which was already in force before the reform, was retained.

The reform was in force for three years since August 2010. The German Parliament passed the law in June. The legislative draft of the Federal Government is from March 2010. In the run-up, there were press reports about the plans of the federal government in early March 2010.

4 Data and Descriptive Statistics

This paper uses data of a panel data set from Insight Health that covers all prescription drugs with competition from parallel imports sold in Germany for the period from January 2008 to December 2011. For each drug, the data set contains information on the central pharmaceutical number, 3-digit Anatomical Therapeutic Chemical Classification System code (ATC code), trade name, active ingredient, administration form, package size, Defined daily dose (DDD), strength, manufacturer, launch date, dispensing requirements, and the status as import or locally sourced version.

The data set comprises monthly data on sales by pharmacies to consumers (in units and in Euro, at the pharmaceutical manufacturer price), sales by wholesalers to pharmacies (in units), returns from pharmacies to wholesalers (in units), pharmaceutical manufacturer price, pharmacy retail price, and reference price.

An observation is identified by the central pharmaceutical number, representing a product with a certain active ingredient, administration, form, strength, and package size sold by a certain firm and sold in a certain month.

The data set contains no information on source countries of parallel imports or purchase prices of wholesalers.

The analysis is based on a market definition where a market is defined by the active ingredient, package size, and dose strength. This maps substitution patterns at pharmacies, where locally sourced drugs may be substituted by parallel imports of the same active substance, package size, and dose strength.

I restrict my data set to markets that face competition from parallel imports before the reform was announced. Thereby I exclude markets that exhibit peculiar barriers to parallel imports or where those barriers have changed after the introduction of the reform.

For some markets in my data set, reference prices apply. No market switches back from having a reference price to not having one. I exclude markets for that a reference price is introduced after the reform. For the empirical identification of the reform effect on parallel imports, I only consider markets belonging to the treatment group that are never subject to reference pricing in all observed periods . All other markets are in the comparison group.

Before the reform came into effect, markets with and without a reference price to not exhibit a different trend (see Figures 1 and 2).

Table 1 shows the summary statistics.

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Reference Price	56.602	30.552	10.79	148.48	7023
Number of Importers	2.347	3.779	0	30	38736
Sales Originals	4006.617	8346.272	1	241989	27021
Sales Imports	511.854	955.202	0	13286	18272
Market Share Imports	0.201	0.275	0	1	28451
Market Share Imports weighted by Prices	0.199	0.225	0	1	27021
Number of Products in Reference Price Group	290.507	238.191	2	663	38736

I use observations of all months between January 2008 and December 2011 in 811 markets, of which 643 are affected by the reform.

5 Empirical Analysis

5.1 Empirical Strategy

The aim of this paper is to identify the effect of the reform described above on the competition by parallel imports. Therefore, I estimate the effect of the reform on the market share of parallel imports and on the number of importers. Since the reform only affects products that

are not subject to a reference price, the empirical strategy is to identify the difference in market dynamics for products that are subject to the reform and those that are not by using a difference-in-difference approach.

I estimate the following random effects model

$$y_{it} = \alpha + \beta_1 T_i + \beta_2 R_t + \beta_3 D_{it} + \rho \mathbf{X}_{it} + \delta_t + \varepsilon_{it}, \tag{21}$$

where y_{it} is the (log) market share of imported products (in packages or turnover) or the number of importers in a market i in month t. T is a dummy indicating treated markets, R is a dummy indicating post-reform periods, D is a dummy indicating the reform effect ($T \times R$), $\mathbf{X}_{it}$ contains a set of characteristics that vary over time (the market size measured in number of packages sold and the number of products in the same ATC3 group), δ_t is a month fixed effect, and ε_{it} is the robust error term.

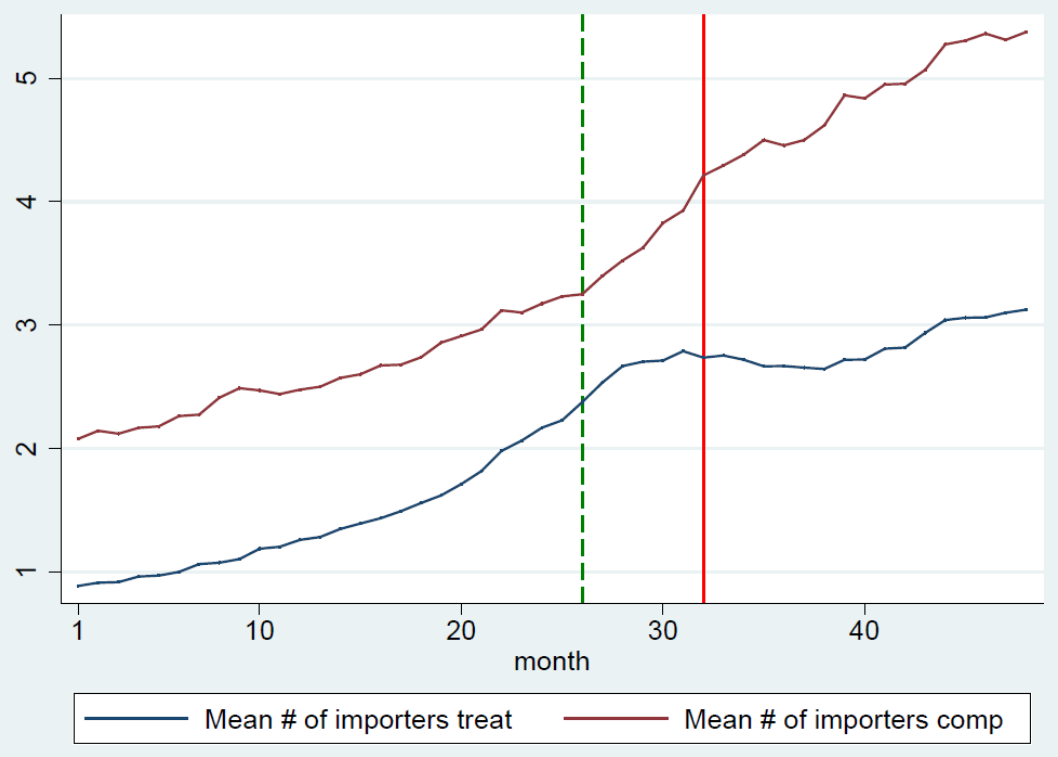
All markets in the estimations have faced competition by imports prior to the reform. Only tablets are included for the estimation. Thereby I avoid difficulties arising from potentially limited substitutability between tablet and non-tablet products. The estimation is restricted to prescription drugs, because only these drugs are possibly subject to reference prices.

The empirical strategy relies on the assumption that the evolution of treated and untreated markets does not differ systematically before the reform. To test this assumption, a pre-reform test similar to Brekke et al. (2015) is used (see Table 4 in the Appendix). The fixed effects regression contains only pre-reform observations. Interaction effects of monthly dummies with a dummy for markets affected by the reform are included. If these interactions are not statistically significant at usual levels, a similar trend of treated and untreated markets prior to the reform may be assumed. If a dummy indicating affected markets after the reform has a significant effect, this effect may be interpreted as the effect of the reform of treated markets compared to untreated markets.

It turns out that the interaction term is statistically insignificant in nearly all months (see Appendix). Six months prior to the reform, the interaction term starts to be significant at least at the five percent level. The legislative proposal of the German Federal Parliament dates to four months before the reform. Press coverage begins about one month earlier. It is not unlikely that hints about reform details were disclosed shortly before the legislative proposal and that this may have affected treated markets prior to the reform.

The development of average market shares of imported drugs for treated markets and untreated markets is shown in Figure 1. The red vertical line indicates the month where the reform came into effect. The green dashed line marks six months before the reform came into effect. This is the month with a significant interaction effect in the pre-reform test one month before press coverage. I cannot rule out the possibility that details of the reform plan have been disclosed to market participants before the general public was informed.

Average market shares for treated and untreated markets



Average number of importers in treatment and comparison group

Figure 2 shows the development of the average number of importers for treated and untreated markets.

In both figures, the trend of treated and untreated markets is not different prior to the reform.

5.2 Empirical Results

5.2.1 Market Share of Imports

The main empirical results for the market share of imports are shown in Table 2. In this specification, market share is calculated by referring to units.

Since log values for market shares are used, the coefficients measure (semi) elasticities. The estimations suggest that the reform has increased the market share of imported products by approximately 19% to 29%. So compared to the products not affected by the reform, the market share of imports in affected markets is considerably higher.

Three different sets of controls are applied. Market size is measured by the (log of the) number of packages sold per market in each month. The effect of the market size on the market share of imports is negative with an elasticity of about -0.48. The number of products within the same ATC3 group, which may be considered as therapeutic alternatives has a very small

Table 2: Market Shares

	(1) Market Share Imports	(2) Market Share Imports	(3) Market Share Imports
Treatment Group	0.173	-0.233	-0.0912
	(0.261)	(0.122)	(0.576)
Post Reform	-0.210	-0.345**	-0.345**
	(0.067)	(0.002)	(0.002)
Reform Effect	0.198	0.291**	0.291**
	(0.082)	(0.008)	(0.008)
Market Size		-0.488***	-0.487***
		(0.000)	(0.000)
Number of products in ATC3 group			0.000826**
			(0.008)
Constant	-2.208***	1.390**	1.026*
	(0.000)	(0.002)	(0.027)
N	18248	16818	16818
R^2	0.0425	0.112	0.112

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

but positive effect on the market share of imported products with an elasticity of about 0.0008. The interaction dummy capturing the reform effect is statistically significant at the one percent level in both specifications using control variables. The control variables are significant at least at the one percent level.

5.2.2 Number of Importers

The main empirical results for the number of importers in each market are shown in Table 3

The log of the number of importers in each market is the dependent variable, so the coefficients can be interpreted as (semi) elasticities. The regression indicates that the reform might have had a positive impact on the number of importers in affected markets. The reform coefficient indicates that reform may have increased the number of importers by about 7% to 9% compared to non-affected markets. However, the coefficient is not statistical significant at usual levels. An explanation for his may be that the entry decision of importers is more driven by reference prices than by this reform. In addition, the time period after the reform might be too short for significant market entries. The market size (measured by the log of packages sold) has no significant effect on the number of importers. The number of products in the same ATC3

Table 3: Number of Importers

	(1)	(2)	(3)
	Num of Importers (log)	Num of Importers (log)	Num of Importers (log)
Treatment Group	-0.326***	-0.292***	-0.144
	(0.000)	(0.000)	(0.087)
Post Reform	0.0873	0.102	0.102
	(0.150)	(0.093)	(0.092)
Reform Effect	0.0914	0.0736	0.0725
	(0.158)	(0.257)	(0.264)
Market Size		0.0271	0.0300
		(0.403)	(0.344)
Number of products in ATC3 group			0.000856***
			(0.000)
Constant	1.354***	1.179***	0.788**
	(0.000)	(0.000)	(0.002)
N	18272	16835	16835
R^2	0.281	0.310	0.310

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

group has a small positive effect on the number of importers with an elasticity of 0.020.

6 Robustness

In my main regression, market shares refer to units sold. If market shares are measured by units weighted by prices, the results do not change considerably. The magnitude of coefficients is slightly larger with a semi-elasticity of 20% to 30% and coefficients remain statistically significant. Table 5 shows regression results (see Appendix).

In the pre-reform test, the interaction term six months prior to the reform is significant . This might indicate that the anticipation of the reform already had an effect on markets. The legislative proposal was submitted to parliament four months before the reform. Press coverage begins about one month earlier. I cannot rule out the possibility that parts of the planned reform have been known to the industry since then at the latest and that actors have anticipated the reform. To account for this possibility, I use a specification where the reform is dated six months earlier. The results do not change considerably compared to the original regression (see Table 6 in the Appendix).

I test the effect of the reform in another market definition, which refers only to the active ingredient and dose strength. In this specification, 331 markets are observed, of which for 247 markets the reform applies. Table 7 (see Appendix) shows the results of the estimation. The magnitude of the reform coefficient is smaller and the coefficient is not statistically significant anymore. This may be driven by a high level of aggregation of different products in the markets. Compared to this specification, the market definition in the main part of this paper seems to be appropriate.

7 Conclusion

This paper studies the effect of a change in the manufacturer rebate on competition by parallel imports. First, it analyzes the effect of a manufacturer rebate on competition by parallel imports in a two-country model. Second, the paper exploits a policy reform in Germany in 2010, which increased the manufacturer rebate by 10 percentage points. Using a data set with prescription drugs with competition from parallel imports, I estimate the effect of the change in the manufacturer rebate on competition by parallel imports. Empirical results are in line with the theoretical prediction, an increase in the manufacturer rebate increases the market share of parallel imports. Estimation results also indicate that an increase in the manufacturer rebate tends to increase the number of importers. However, coefficients in my estimation are not statistically significant. My results concerning the market share of parallel imports suggests that stricter wholesale regulation, unlike stricter retail regulation (see Brekke et al., 2015, Birg, 2018a) could enhance competition by parallel imports.

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Appendix

Table 4: Pre-Reform Test

	(1) Market Shares Imports
Interaction 1	-0.136
	(0.436)
Interaction 2	0.0851
	(0.593)
Interaction 3	0.0844
	(0.573)
Interaction 4	0.0266
	(0.838)
Interaction 5	0.157
	(0.261)
Interaction 6	0.0383
	(0.788)
Interaction 7	0.0201
	(0.878)
Interaction 8	0.0141
	(0.910)
Interaction 9	0.0879
	(0.460)
Interaction 10	0.103
	(0.426)
Interaction 11	0.129
	(0.367)
Interaction 12	0.0235
	(0.864)
Interaction 13	-0.0615
	(0.634)
Interaction 14	0.0844
	(0.525)
Interaction 15	-0.105
	(0.393)
Interaction 16	-0.0877
	(0.491)
Interaction 17	-0.167
	(0.146)
Interaction 18	-0.144
	(0.186)
Interaction 19	-0.201
	(0.065)
Interaction 20	-0.116
	(0.317)
Interaction 21	-0.123
	(0.227)
Interaction 22	-0.00952
	(0.934)
Interaction 23	-0.0857
	(0.395)
Interaction 24	-0.0235
	(0.797)
Interaction 25	0.0301
	(0.748)
Interaction 26	0.177*
	(0.041)
Interaction 27	0.176*
	(0.029)
Interaction 28	0.141
	(0.090)
Interaction 29	0.177*
	(0.022)
Interaction 30	0.154*
	(0.035)
Interaction 31	0.0940
	(0.100)
Constant	-2.361
	(0.578)
N	10156
R^2	0.204

p-values in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Market shares weighted by prices

	(1)	(2)	(3)
	Market Share Imports	Market Share Imports	Market Share Imports
Treatment Group	0.179	-0.225	-0.0844
	(0.242)	(0.132)	(0.602)
Post Reform	-0.219	-0.355**	-0.355**
	(0.058)	(0.002)	(0.002)
Reform Effect	0.209	0.300**	0.299**
	(0.068)	(0.007)	(0.007)
Market Size		-0.472***	-0.471***
		(0.000)	(0.000)
Number of products in ATC3 group			0.000817**
			(0.008)
Constant	-2.253***	1.226**	0.866*
	(0.000)	(0.003)	(0.047)
N	18248	16818	16818
R^2	0.0426	0.108	0.108

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Market shares reform starting six months earlier

	(1)	(2)	(3)
	Market Share Imports	Market Share Imports	Market Share Imports
Treatment Group	0.0578	-0.376*	-0.229
	(0.719)	(0.015)	(0.168)
Post Reform	-0.125	-0.271**	-0.272**
	(0.234)	(0.008)	(0.008)
Reform Effect	0.282**	0.394***	0.394***
	(0.003)	(0.000)	(0.000)
Market Size		-0.496***	-0.496***
		(0.000)	(0.000)
Number of products in ATC3 group			0.000889**
			(0.005)
Constant	-2.263***	1.413**	1.028*
	(0.000)	(0.001)	(0.026)
N	18217	16787	16787
R^2	0.0451	0.118	0.118

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Market shares alternative market definition

	(1)	(2)	(3)
	Market Share Imports	Market Share Imports	Market Share Imports
Treatment Group	0.277	-0.339	-0.217
	(0.300)	(0.232)	(0.482)
Post Reform	-0.258	-0.277	-0.277
	(0.220)	(0.169)	(0.169)
Reform Effect	0.120	0.195	0.195
	(0.554)	(0.324)	(0.323)
Market Size		-0.444***	-0.446***
		(0.000)	(0.000)
Number of products in ATC3 group			0.000755
			(0.179)
Constant	-2.471***	1.387	1.094
	(0.000)	(0.096)	(0.197)
N	9032	8901	8901
R^2	0.0510	0.0999	0.100

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$