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The Swedish Pharmaceutical Market: Competition and Pricing Post-Deregulation

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Abstract

This paper examines the Swedish market of over-the-counter (OTC) pharmaceuticals following the reform in 2009. The market is an oligopoly and the market concentration has increased over the recent years. Several impediments to price competition are present, including asymmetric information and significant barriers to entry. Firstly, simple regressions are performed to study whether the prices vary with the market structure overall. Secondly, the nested logit model (Berry, 1994) is applied to a subset of conventional and natural pharmaceuticals in order to estimate the demand elasticities. These are in turn used to calculate markups and Lerner indices to measure the extent of market power. While the paper presents some signs of increased prices in connection with less intense competition, these indications cannot be generalized. Market power is found to be present in market structures with a lower degree of competition, however there is insufficient evidence to infer that excessive markups are levied as a result of this.

Keywords: Market structure, Price competition, Demand estimation, Pharmaceutical retail
JEL: D22, D43, I11, I18, L13

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Contents

1 Introduction

Until 2009, the Swedish pharmaceutical market was a monopoly with state-owned Apoteket as the sole provider of pharmaceuticals. However, in 2009, the Swedish Parliament instituted a reform of the market that opened it up to competition. A central purpose of this reform was to decrease prices of over-the-counter (OTC) pharmaceuticals (The Parliament, 2008). There is an ongoing policy debate concerning the extent to which the reform has achieved this and its other purposes. Existing studies point in different directions (Swedish Agency for Public Management, 2013; Medical Products Agency 2012; Swedish Competition Authority 2017). A report by The Swedish Agency for Public Management (2013) states that a price index for OTC pharmaceuticals increased less than the consumer price index (CPI) in the initial period after the deregulation. On the contrary, a report from the Swedish Competition Authority (2017) states that prices of OTC pharmaceuticals have increased overall since the deregulation. In general, there is an ongoing debate questioning whether the market, post deregulation, is functioning the way the reform intended.

The purpose of this study is not to evaluate the success of the policy reform per se, but to shed light on the role of market power in terms of the pricing of OTC pharmaceuticals. To date, no study has connected the price developments to the developments of the market structure. There are several *a priori* reasons to believe that market power is important in this regard.

One potentially important aspect is the limited number of firms. From being a pure monopoly in 2009, the market had more than ten different actors in 2010 and 2011. Following within-market acquisitions and bankruptcies, it now has only six actors[1]. Three of these control almost 80 percent of the national market, and one of them is vertically integrated with one of two suppliers of pharmaceuticals (Medical and Dental Benefits Agency, 2016; Oriola, 2017). Moreover, from a theoretical perspective, the market is characterised by certain traits that are often associated with market power. For instance, there are substantial barriers to entry and the pharmacies face consumers with highly inelastic demand (WHO, 2012). Perhaps more importantly, by regulation, pharmacies are the sole seller of a large fraction of OTC pharmaceuticals (Medical Products Agency, 2017). In certain communities, consumers only have one pharmacy to choose from (Apoteksinfo.nu), which puts the local pharmacy in a position of monopoly. Needless to say, the implications of market power abuse could have extensive welfare implications given the nature of the goods sold.

To conduct the analysis, a unique data set is used including information on pharmaceutical sales, the location of pharmacy stores and the demographics of the population, over the period 2011 to 2016 (Swedish eHealth Agency, 2017; Apoteksinfo.nu, 2017; Statistics Sweden, 2017). All are gathered at a county level which allows for a structural approach where the different counties are considered different markets. These data are used to map the general trends in prices. With initial hedonic price regressions we control for factors relating to product characteristics such as the treatment area and the method of application, but also to traits that relate to the degree of competition, such as the size of the manufacturer, whether the producer has a monopoly within a treatment area, and

[1] When regarding individual entrepreneurs, currently owning three percent of stores, as one firm.

whether the product is also available in retail. These regressions are extended by including various market characteristics defining the development of the market. This allows for a descriptive analysis of the market developments on price levels. To our knowledge, this is the first time that an analysis of this dimension is conducted.

Whereas the hedonic regressions can be applied to illuminate certain aspects of the market, they suffer from weaknesses in that they do not capture causal relationships. In order to examine the market in more detail we therefore proceed to apply the discrete choice nested logit model developed by Berry (1994) using a subset of the data. This method makes it possible to draw inferences about aggregate consumer choices from observed market shares of the various products. An advantage of the approach is that it is not necessary to have information on all characteristics that affect consumers. Rather than mapping the own- and the cross-price elasticities between each pair of products in the market, one can group products into groups (or nests), based on the assumption that products in the same group share some common characteristic (Berry, 1994). With the estimates of the price elasticities calculated in this manner, it is possible to understand the mechanisms of consumer demand and thus to what extent firms can exert market power, with a limited amount of information. This enables our second contribution, which is to structurally determine whether prices are set at their current level due to marginal costs or due to the markups, i.e. because of price discrimination and differences in demand elasticities. These help to establish how market power is exerted in the market.

Taking both components described above into account, the overall research questions of this paper are thus: How do prices of pharmaceuticals vary with respect to various market structure characteristics? And to what extent are the current price levels determined by marginal costs and markups?

The findings suggest that certain market characteristics are indeed associated with differences in prices as predicted by economic theory. In particular, the firm concentration of stores and the number of firms present in the different regions are associated with high and low price levels respectively. However, the structural analysis proves inconclusive. No evidence of a correlation between market characteristics and the traditional measures of market power, markups and the Lerner index, can be established. This indicates that the observed price levels may mainly be caused by marginal costs, which we cannot control for. In sum, while it can not be established that market power is prevalent and a source of excessive markups, neither can it be ruled out.

The structure of the paper is as follows: in Section 2, background information about the structure of the Swedish community pharmacy market is provided, together with details on the pricing regulation. In Section 3 the current state of knowledge is discussed, while the data are explained and visualised in Section 4. Section 5 presents the model and the empirical framework whereas Section 6 contains the results. Section 7 concludes.

2 Background

2.1 The Swedish community pharmacy market and the deregulation

Community pharmacies provide and sell pharmaceuticals to the public, those who prescribe them and to the healthcare sector (Medical Products Agency, 2017). Generally, these pharmacies supply both prescription and non-prescription pharmaceuticals, and sell hygiene products and food supplements, vitamins, *et cetera*. There are two other types of pharmacies, hospital and extempore pharmacies, but their accessibility and product range is different compared to community pharmacies. Hospital pharmacies supply hospitals rather than end consumers, and extempore pharmacies are only granted temporary licenses, for instance for the purpose of storing pharmaceuticals for a limited period of time. Therefore, in line with how the market was defined by the Growth Analysis (2013), the market for community pharmacies is considered a separate one. Henceforth, the term pharmacy will therefore be used to refer to a community pharmacy, accessible to the public.

The primary reasons why the Parliament initiated a liberalization of the pharmaceutical market in July 2009 were to achieve increases in efficiency, product diversity and product quality. Expectations were that increased competition would lead to lower prices and and increased production and productivity. Additionally, the Parliament aimed to provide consumers with increased accessibility to pharmaceuticals as well as a better and wider range of services offered.

Early reports and studies of the pharmaceutical market in Sweden, which are not limited to prices, indicate that the market has been positively affected by the deregulation. For instance, accessibility has improved in that the average opening hours of pharmacies increased from about 45.5 hours per week in 2008, to 52 hours in 2012 (Swedish Agency for Public Management, 2013). Product variety has also improved, both in terms of pharmaceuticals and in the provision of additional services. Currently, pharmacies for instance offer health checks, vaccinations and close collaborations with doctors to expand their product offerings (Swedish Pharmacy Association, 2016). With regards to general availability, the number of pharmacies has increased by over 45 percent, from 946 stores in 2009 to 1,391 stores in 2017. The vast majority of new pharmacies have been established in urban areas, in particular in Stockholm, Skåne and Västra Götaland. Meanwhile Västmanland and Kronoberg have an unchanged number of pharmacies. In summary, most of the mentioned changes can be regarded as welfare-enhancing and positive effects caused by the deregulation.

While the new situation, which enables competition, is substantially different than the one of the state monopoly, a minimum requirement is that the standards concerning safety and competencies surrounding the provision of pharmaceuticals are maintained (The Parliament, 2008). For the sake of public safety, there are still strict requirements regarding how and by whom pharmaceuticals are sold. For that reason the market ought to be considered re-regulated rather than deregulated (Medical Products Agency, 2017). However, for simplicity and because the market is currently less regulated than before, the term deregulated will be used throughout.

By the end of 2010, approximately a year after the deregulation, the national market consisted of nine pharmacy firms including a few independent pharmacies. As the market has matured, bankruptcies and within-market acquisitions have reduced this number to five pharmacy firms and a few independent pharmacies. In 2013, Apotek Hjärtat acquired Vårdapoteket and Apovet. The same year, Oriola acquired MedStop. In 2014, ICA Sverige AB, owner of Cura pharmacies, acquired Apotek Hjärtat. In 2014 DocMorris changed name to LLoydsApotek (Dental and Pharmaceutical Benefits Agency, 2016). Boots Apotek and Åhlens Apotek went bankrupt in 2010 and 2011 respectively (Swedish Pharmacy Association, 2016). The result of these developments is that the pharmacy market in Sweden today consists of five larger firms; Apoteket, Apoteksgruppen, Apotek Hjärtat, Kronans Apotek and LLoydsApotek. These represent, in terms of the number of pharmacy stores, 97 percent of the national market. The remaining three percent of pharmacies are owned by individual entrepreneurs, some of which belong to the same owner (Dental and Pharmaceutical Benefits Agency, 2016; Apoteksinfo.nu, 2017). These are henceforth referred to as *Non-affiliated*.

2.2 Pricing of pharmaceuticals and compensation to pharmacies

The objective of this paper is to analyse the competition aspect of the market and how it is associated with prices of OTC pharmaceuticals. Going forward, other aspects and consequences of the deregulation which influence welfare, such as availability and prices of prescription medications, will be beyond the scope of the analysis.

Until 2009 the state-owned monopolist Apoteket had control of all 946 national stores and, as a consequence, the prices. Since the deregulation, the pricing of different types of pharmaceuticals is regulated differently depending on whether they are OTC medications or prescription medications with or without generic substitutes. Free pricing applies for OTC medications, meaning that no regulation is enforced. The key takeaway concerning the regulation of prescription medications is that the markup that pharmacies are permitted to charge is determined by the Dental and Pharmaceutical Benefits Agency. Pharmacies obtain a fixed fee and/or a percentage of the purchasing price for expediting the good to the consumer. This amount is designed to compensate the pharmacist for costs incurred for the expedition. The applicable benchmarks were re-evaluated by the regulating authority in 2016 to ensure that the amounts were still appropriate. A few adjustments were made in April 2016, but the overall conclusion of the Dental and Pharmaceutical Benefits Agency was that the markup was sufficient as compensation (Dental and Pharmaceutical Benefits Agency, 2016).

In contrast to this, the Swedish Pharmacy Association stated in their Annual Report (2016) that the markup in fact is insufficient to compensate for the costs to expedite prescription medications. According to firms in the industry, this is mentioned as a reason for pharmacies to increase the margins on OTC medications and other trade goods and services that they supply (Swedish Pharmacy Association, 2016). In the same report, it is presented that the majority of pharmacies' revenues stem from prescription medications. In 2015, prescription medications accounted for revenues of SEK 28.7 billion. In comparison, OTC medications in the same year sold for SEK 3.8 billion whereas other trade goods, such as food supplements, and services, like the health checks mentioned above, generated SEK 5.6 billion in revenues. While the Swedish Pharmacy Association's statement regarding the insufficient markups may be a biased and political one, the effects of it would have implications on the largest part of the pharmacies' revenues. This in turn, if true, would mean they need to impose relatively larger margins in the relatively smaller section of OTC medications and other services to make up for the lacking incomes from prescription pharmaceuticals. This debate further stresses the importance of a deeper analysis of the pricing aspect of this particular market.

3 Literature

3.1 Policy reports on the Swedish pharmacy market

In 2017, the Swedish Competition Authority released a study aimed to establish how prices has developed in response to increased competition. In particular, the intent of this report is to establish how the introduction of new sales channels, online and retail sales channels has influenced prices of OTC medications. The scope of the report is limited to the top twenty best selling products in terms of sales volumes. The treatment categories studied are for instance nicotine replacement therapies (NRTs), and pain and fever alleviation. In total, the categories studied accounted for approximately one fourth of all OTC revenues in 2015. The study concluded that prices of OTC pharmaceuticals are on average eleven percent lower in retail than in pharmacies. The biggest price differences are applicable in pain and fever alleviation where, on average, prices are 22 percent lower in retail compared to in pharmacies. In summary, it is inferred that pharmacies do not compete on prices, and that prices have not been substantially influenced by increased competition from retail and online sales channels (Swedish Competition Authority, 2017).

Growth Analysis conducted a study of the price development of an index of OTC pharmaceuticals in 2012. They conclude that the price index has, in the aggregate, followed the development of CPI. More in detail, from January 2008 to October 2012 the OTC price index increased with about 8.5 percent, whereas CPI increased with seven percent. Another finding of this study is that the total sales volume of pharmaceuticals was virtually unchanged in the period, while the number of pharmacies increased, which means that the average sales per pharmacy has decreased. Since the study was conducted shortly after the deregulation, it was suggested that a new one should be performed some years later to get a better understanding of the effects as the market becomes more stabilised (Growth Analysis, 2012).

3.2 Deregulation of pharmaceutical markets

Turning to academic studies of the relation between market structure and the pricing of OTC pharmaceuticals, Stargardt, Schreyögg and Busse (2007) conduct a study of the German pharmaceutical market. They apply a probit regression model to identify which variables increase the likelihood of a price modification. Their sample spans pharmacies in Berlin and the five most frequently prescribed medications which are also available without a prescription, thus OTC. They find that population density is positively and significantly associated, while the geographic concentration of pharmacies is significantly negatively associated with price changes. However, only 7.5 percent of the pharmacies that were surveyed had changed their prices after the deregulation, and just under one third of those had increased their prices. Therefore the study concludes, as in the report by the Swedish Competition Authority (2017), that German pharmacies do not compete on price.

Similar results are found in several other European countries, including the Nordic countries Norway, Denmark, Finland and Iceland, which have all deregulated or re-regulated their pharmaceutical markets in the past twenty years. In their 2014 study, Vogler et al. analyse the implications of the deregulation in nine European countries, including the aforementioned. With respect to the prices, they conclude that the desired outcome of lower prices for pharmaceuticals had not been achieved after Norway deregulated their market in 2001. Individual pharmacies compete on location rather than on price, resulting in increased costs and in some aspects, a deterioration of service. In all the countries studied there had been urban clustering, referring to the fact that the number of pharmacies had increased overall, but only in areas where the density of pharmacies was already relatively high. This is in accordance with the developments observed in the Swedish market. Vogler et al. also mention that price studies of OTC medications are rare and that evidence has been inconclusive. Most importantly, they conclude that there have not been strong indications that prices have decreased as a result of deregulated markets.

Anell (2005) studies the pharmaceutical market in Iceland, deregulated in 1996, and in Norway, deregulated in 2001. The primary focus of this study is not the prices but rather market concentration. In 2004, when both the Icelandic and the Norwegian markets had been deregulated for a few years, Anell finds that two pharmacy firms in Iceland and three pharmacy firms in Norway controlled 85 and 97 percent of the markets respectively. Despite the fact that the markets were liberalised, they were thus highly concentrated some years after the deregulation. Additional details of the price developments are not thoroughly discussed, but there is mention of the fact that an increased number of pharmacies in Iceland is associated with higher prices, likely affected by the fact that having more stores results in higher fixed costs.

3.3 Market power in the market for pharmaceuticals

3.3.1 Sources of market power

According to economic theory, the more concentrated the market is, the greater is the chance that firms charge higher markups[2]. At one extreme, with perfect competition, theory predicts that firms will charge the marginal cost for their products. At the other extreme, the monopolist as the sole supplier of the good has the possibility to maximise profits by supplying less of the good than what would equal the quantity of optimal demand (Belleflamme and Peitz, 2015). Most industries however, like the Swedish pharmacy market, are oligopolies with a limited number of firms supplying the

[2]This does not apply for Bertrand competition with homogeneous goods.

goods to the market. The market power of these firms is likely to increase due to a number of reasons, for instance due to inelastic demand, asymmetric information, barriers to entry and switching costs.

When consumers have inelastic demand, they do not decrease their demand substantially, i.e. purchase less of a good, as a result of a price increase. This allows for producers or resellers to charge higher prices than they would with perfectly competitive pricing, and thereby apply markups. Furthermore, according to WHO (2012), when a good costs only a small amount relative to a consumer's income, demand is relatively inelastic by definition. Inherent to theories of markups, which will be explained in more detail below, is the concept of product differentiation. Product differentiation applies when products in a market are imperfect substitutes to each other. Firms' capacity to differentiate products increases their market power and softens price competition. With product differentiation, demand functions are not perfectly elastic in prices. Rather, the more product differentiation is present, the higher markups the firms are able to apply (Belleflamme and Peitz, 2015). In other words, product differentiation is also an impediment to perfect competition.

Additionally, asymmetric information hinders competition. If a consumer is not fully aware of the effects of a good and available substitutes, she will not be (equally) able or prone to switch to another good. In the case of pharmaceuticals, examples of this are that an incumbent brand may have invested more in branding, and that consumers may be unaware of an available generic substitute with the same active substance. Both these situations result in that the incumbent has an ability to charge a higher markup. This also touches on the subject of switching costs, that consumers may for instance develop a *status quo bias*, causing them to prefer the brand they are used to (Kahneman, Knetsch and Thaler, 1991). Lastly, there are barriers to opening a pharmacy, related to high entry costs. Substantial investments are required in terms of getting the IT systems necessary to fulfill the reporting obligations, a pharmacist needs to be present during opening hours, and primarily, the pharmacist needs to have all pharmaceuticals which can be prescribed available in stock (Medical Products Agency, 2017).

We argue that OTC pharmaceuticals should be considered differentiated products by consumers, seeing that medications with the same active substance and concentration but with a different brand, differ in sales volumes and prices. Moreover, demand for health care has empirically been shown to be inelastic (Koc, 2004). Additionally, according to the WHO (2012), the price-demand elasticity for pharmaceuticals, especially those that consumers regard as essential, is low. Both because the product generates a relatively high level of utility, and because the the price level is low in comparison with income. What should also be mentioned is that the demand for pharmaceutical goods, like the demand for health care, is indirectly a demand for good health. Rather than the product itself, the primary utility that the consumer obtains is from the effect that it has on her health (Grossman, 1972).

To summarise, there are several factors that would enable the use of market power, or charging prices that are higher than the marginal cost, applicable in the Swedish OTC pharmaceutical market. A high market concentration and product differentiation are both present and could, together with the generally low price-sensitivity, enable firms to charge high markups.

3.3.2 Market power measures

Market power is defined as the ability a firm has to raise prices above the level which would prevail in case of perfect competition, the marginal cost. The markup is defined as the difference between the price and the marginal cost. Cowling and Waterson (1976) show that, based on the assumption that firms maximise profits, the markup that a firm charges on top of the marginal cost is inversely related to the number of firms that are active in the market. If a firm exits the market, prices are predicted to increase and conversely, if a firm enters the market, prices are predicted to decrease, *ceteris paribus*. In addition, Cowling and Waterson (1976) write that the ratio of profit over revenues relates positively to the concentration in an industry measured by the Herfindahl-Hirschman index (HHI), whereas it relates inversely with price elasticity of demand.

According to Belleflamme and Peitz (2015), within a pre-defined market, such as that of OTC pharmaceuticals, market power can be assessed. The Lerner Index (LI) utilises the definition of the markup and makes it relative to the price in order to capture the degree of competition. Formally, it is expressed as: $LI = \frac{p-mc}{mc}$ and can take a value between 0 and 1. The lower (higher) the ratio, the lower (higher) the firms' markup and the higher (lower) the degree of competition (Belleflamme and Peitz, 2015). As will be described in the following section, marginal costs are not available in the data that have been supplied to conduct this research, and for that reason it is not straightforward to estimate the LI. However, using the structural approach described in Section 5 allows us to make inferences based on the estimated market shares and demand elasticities of products. We calculate markups using the market share divided by the own-price elasticity. To derive the Lerner indices, we simply divide these markups with the prices.

The HHI is a common measure of market concentration is the (Belleflamme and Peitz, 2015). The measure is traditionally expressed in terms of store revenues, but the index that we use is a modified version of that, namely what we refer to as the *Share of Stores*, I_s. Where α is the percentage of the number of stores that a specific firm has from the total number of stores in a certain market, *Share of stores* can be written as:

$$I_s = \sum_{i=1}^{n} \alpha_i^2 \tag{3.1}$$

$0 < I_s \leq 10,000$ where 0 indicates perfect competition and 10,000 applies for a monopoly (with one firm having 100 percent of the stores). The application of this measure rests on the assumption that stores are of approximately the same size[3]. While using store revenues would have been preferable in this regard, an increase in the number of stores per pharmacy firm should generally indicate that the competition in the market has increased. In turn, the theoretical prediction presented by Cowling and Waterson (1976) above would be that an increase in I_s, like an increase in HHI, allows for greater capacity to charge a higher markup too.

[3] We consulted the available Annual reports for the pharmacy firms to find revenues for the individual stores. Our attempts were however unsuccessful.

3.4 Reduced-form price studies

With a method similar to ours, Asplund and Friberg (2002) look at the price differences between groceries in relation to market structure variables such as competition intensity and store- and region-specific factors in the Swedish market. Their intent is to establish whether price differences that do exist can be attributed to differences in costs, or to differences in market power. Examining differing market structures across regions, caused for instance by historical reasons or differences in the market size, they assume that the nature of competition is the same in all.

Rather than testing specific theories, they intend to make broad predictions. Their main approach for that reason is to perform reduced form regressions with price as the dependent variable and market structure variables as the independent variables. They mention that according to theory, as the number of firms in a market increases, competition intensifies and prices should decrease. They also state that empirical studies of varying market power across different geographical markets tend to be in line with the theoretical predictions and that there is a negative correlation between prices and the number of firms. Overall, they find that the relation between market structure and food prices is weak, but that certain market characteristics can explain part of the variation in prices. For instance, they find that a higher local concentration of stores is correlated with higher prices. However, this price difference is small. This finding is of particular interest to our study since the market concentration of pharmacies has mainly decreased in urban areas of Sweden (Apoteksinfo.nu, 2017; own calculations) following the deregulation, but is fairly high in all counties. More details will be provided in Section 4.2.

Basker and Noel (2009) analyse the short- and medium term effects that the entry of a certain grocery store chain has on competitors' prices. They combine data about the chain's and competitors' prices with a separate data set that contains the opening dates of all stores in the period studied. They begin their analysis with OLS regressions at a cross-sectional level, but as is applicable in our dataset too, these are subject to endogeneity. It cannot be assumed that the locations of new stores are randomly assigned, and thus the number of stores in a market are likely correlated with the error term in the OLS regressions. One method used to solve this is performing an instrumental variable regression, using the number of stores that do not sell the groceries studied, and thus are uncorrelated with these prices, as instrument. They find that competitors, on average, respond by lowering their prices with approximately 1 to 1.2 percent when the grocery store enters a market. Discount grocery stores, which compete more closely with this specific firm, lower their prices more than twice as much than higher-end stores. While a different topic, this paper serves as a good example of reduced-form regressions can generate important insights.

3.5 Demand estimation with aggregate-level data

While reduced form price regressions can be used to understand the underlying characteristics associated with price levels, the model that we use in our structural analysis, as described by Berry (1994), allows for estimation of demand. As Einav and Levin (2010) state, estimating demand elasticities is relevant in order to determine what degree of market power a firm has, and to what extent consumers substitute between products when prices or characteristics change. When inferences have been made about consumer demand elasticities, the welfare implications of mergers can be better understood, and antitrust work expanded.

Estimating demand from aggregate data is difficult given that, to fully map the degree of cross-substitution elasticity of n products, it would be required to calculate n^2 elasticities, unless restrictions are imposed to the cross-substitution patterns. Berry (1994) presents a framework for how to deal with this, namely by inversely estimating demand through market shares of differentiated goods. In summary it entails undertaking the following steps: Find a number of goods that have something in common and separate them into nests of goods that are substitutes to each other, but not perfect ones. Within the nest, the products are grouped depending on characteristics that they have in common. Then specify the size of the market as a whole, depending on for instance the durability of the good. Next, the market shares of the good as a part of the nest and as a part of the group are estimated. The market shares are considered aggregated demand and to reflect the level of consumer utility. These are regressed on product characteristics with hedonic regressions, creating outputs that can be used to calculate own-price and cross-price demand elasticities of the goods in the market. The theory and method to apply the model empirically on the Swedish pharmaceutical market are discussed more in detail in Section 5.2.

Goldberg and Verboven (2001) apply the nested logit model described by Berry (1994) to the European car market. In their paper, they begin by analysing the patterns of price dispersion in five European car markets to discover whether there are differences between markets that should be subjected to additional scrutiny. Next, they identify the underlying causes of these differences using an oligopoly model for product differentiation. Like ours, their dataset has three dimensions covering the products, markets and time. They use a dataset with detailed information including price, characteristics and production location of the car models. For instance, they categorise cars as foreign or domestic, assuming that consumers prefer the one or the other and are more prone to substituting within a group.

Using hedonic regressions, they capture how utility is influenced by product characteristics, or quality differences. Additionally, the application of the oligopoly model for product differentiation makes it possible to establish whether price differences are caused by different marginal cost or by price discrimination. In case price discrimination is the source, the framework also allows for an investigation of the sources of it.

They establish that there are differences in pricing across the markets[4], captured by three potential sources: price elasticities that in turn generate differences in markups, costs, and import quota constraints. The results of their subsequent analysis concerning the price elasticities indicate that prices differ because of a preference for domestic brands in one market, because cars are better equipped in another, and because dealers apply discounts differently.

Berry, Levinsohn and Pakes (1995) also analyse the demand for cars. They incorporate product

[4] They study the markets in five different countries.

characteristics such as gas mileage, horsepower and size, plus a variable for unobserved characteristics in a model which allows them to group goods, assuming that consumers are more likely to make switches to some products than to others. Their framework, which allows for more flexible substitution patterns than Berry's nested logit model (1994) and the one used in this paper, is explained and applied by Nevo (2000). Whereas the formality of this model is beyond the scope of our paper, the key takeaway is that they introduce an additional variable that captures the income of consumers. This allows for that consumers' price sensitivity is not determined by the functional form, but by their varying marginal utility from income. In other words, the coefficients estimated are specific to the consumers. The outcome of their study is that they are able to estimate demand parameters for virtually all car models that are present on the market.

To summarise, the literature reviewed regarding price and market developments following deregulations of pharmaceutical markets provide varying results. In particular, the Swedish market has not yet been extensively studied. This chapter also introduced some sources of market power and in what respect they may be present in this particular market. Having described previous research conducted using our two methods of choice, namely hedonic and reduced-form regressions and the nested logit model, we proceed to introduce our dataset below.

4 Data and descriptive statistics

4.1 Data

4.1.1 Product data

Yearly data on the sales volumes and revenues of OTC medications were supplied by the Swedish eHealth Agency (2017). The time period covered in this dataset is 2010 to 2016 and all observations are sorted on a county level and according to the ATC categorisation. This is a coding system that indicates the active ingredient in a pharmaceutical based on the treatment area and the condition it is applied for[5]. The quality of the data can be considered high since entities that sell pharmaceuticals are obliged to regularly and accurately report their statistics to the Swedish eHealth Agency (2017). The file contains information on the quantities and sales revenues (in SEK) of OTC pharmaceuticals sold. Since the authority is unable to provide more detailed information such as the item numbers due to confidentiality, we calculate a proxy for the average prices by dividing revenues with quantities per product. The measure is a proxy rather than an accurate measure since it contains temporary rebates and is no perfect measure of the unit price. For instance, a package may contain 50 or 100 tablets[6]. Confidentiality is also the reason why no information about which firm has made the sale was disclosed.

The products are identified by their ATC identification number, their producer and their brand. The data are used to create numerous dummy variables for the application method, the size of

[5] An explanation about this classification system can be found in the Appendix.
[6] A more extensive discussion of the implications of this measure is included in Section 7.

the manufacturer (small, medium, large)[7], whether the product is available in retail, and whether there is only one manufacturer that produces the good in the ATC product group. FASS.se (2017) was consulted to find the physical application method of each product, such as cream or pill. To adjust the prices to inflation, we use data on the consumer price index (CPI) from Statistics Sweden (2017a).

Due to the way in which reporting is currently done from pharmacies to the Swedish eHealth Agency, it is not possible to distinguish between online and offline sales. In the beginning of 2016, around four percent of the total revenues as well as the total volumes in the community pharmacies were estimated to come from online sales, and the figures reported include both. The fact that this distinction is not made complicates the tracking of developments of online sales (Dental and Pharmaceutical Benefits Agency, 2016). The Swedish Competition Authority (2017) mentions that it is desirable to change this procedure in the future, in order to be able to track the developments as online sales grow. The current trend is that they increase rapidly. However, as online sales account for such a small percentage of total sales currently, and since they cannot be separated in the data, we will disregard the fact that online sales can not be distinguished in our analyses.

Approximately 18 percent of OTC pharmaceuticals are sold in retail (Swedish Pharmacy Association, 2016). This is a significant amount which cannot be disregarded in the analyses. Generally, the variety of products available in retail is scarce, however, (Swedish Competition Authority, 2017) so it is likely that only a small number of products is significantly affected by the fact that they are available outside of pharmacies. Nonetheless, dummy variables for availability in retail have been introduced to capture the effect in our analyses.

Important to note is also that we contacted the five largest firms by telephone[8] to establish whether pricing is uniform across the firm. Whereas they all stated that prices can differ between online and offline channels, two out of five firms (Apoteksgruppen and Lloyds Apotek) have pricing policies that allow for price dispersion across stores, at the store manager's discretion (personal communication, 22 Feb). The remaining three firms, Apoteket, Apotek Hjärtat and Kronans Apotek claim to apply a national pricing policy[9] but that temporary deviations are possible, for instance due to sales campaigns.

4.1.2 Pharmacy location data

The dataset provided by Apoteksinfo.nu contains yearly data on the geographic coordinates of all physical Swedish community pharmacies and which municipality they are located in, classified according to which firm they belong. The period with complete information is 2011 to 2016. We used information from Statistics Sweden (2017b) to translate the municipality locations to counties. The file also includes information about where Apoteket's stores were located before the deregulation in 2009, but as the organization Apoteksinfo.nu had not yet been founded in 2010, information about

[7] The size of the manufacturer is determined by their proportion of yearly sales, and categorised accordingly.
[8] We called the general customer service line of each firm for information.
[9] We assume that all non-affiliated pharmacies apply heterogeneous pricing.

this year is lacking at a regional level. The aggregate number of stores in 2010 is however available (Swedish Pharmacy Association, 2016) and included in the analysis.

The information has been gathered during the fall every year with the exception of 2015, when it was done in May. All individual pharmacy stores have a unique ID number which allows for tracking of whether a store has closed or been bought by another firm during the time period. This enabled us to map for instance which firms were present in a county in a certain period, whether the number of stores increased or decreased, and whether the change was caused by an acquisition. Apoteksinfo.nu is an independent organization whose data has previously been used as the primary data source in a report on the geographical availability of pharmaceutical by The Swedish Agency for Economical and Regional Growth (2012). Like this authority, we consider the data to be reliable and accurate.

4.1.3 Regional data

To compile the regional data, displayed in Table 4.1, population data, the median incomes and the population density were collected (Statistics Sweden, 2017c) as well as information about the prescribed daily dosages of pharmaceuticals (DD) (The National Board of Health and Welfare, 2017). These data are merged with the number and location of pharmacies (Apoteksinfo.nu, 2017).

As can be seen in Table 4.1 on the next page, incomes vary considerably. The highest are in Stockholm, approximately 15 percent above the national median, and the lowest in Gotland, approximately seven percent below it. Stockholm is also an extreme county in terms of the prescribed dosages, approximately 18 percent below the national average, while Norrbotten is approximately 18 percent above it. To account for these differences, *Income* and *DD* are included as a control variables in the analysis.

The most scarcely populated counties of Jämtland and Norrbotten had only three inhabitants per square kilometer in 2016 whereas the, by far, most densely populated Stockholm has 348 inhabitants per square kilometer. Average population density is not fully informative when the population is concentrated to a part of the region. To capture the aspects of both population density and the proximity to a pharmacy, we introduce a variable which limits the average population density measure to relatively densely populated areas only. This variable takes into account only the area and number of inhabitants around villages and cities with a minimum of 200 inhabitants, defined as urban areas (Statistics Sweden, 2017d). We refer to this variable *Pharmacy density*, and it is defined as the number of pharmacies divided by the number of inhabitants within densely populated areas[10].

$$Pharmacy\ density = \frac{Number\ of\ pharmacies}{Average\ number\ of\ inhabitants\ within\ densely\ populated\ areas} \tag{4.1}$$

As an example, Stockholm had 290 pharmacy stores in 2016, and 22.5 inhabitants per km^2 of densely populated areas[11], which entails a *Pharmacy density* outcome of $290/22.5 = 12.89$. This variable captures the relative measure of competition for individual pharmacies better, i.e. how

[10] We thus assume that all pharmacies are located in areas with a minimum of 200 inhabitants.

[11] The calculation of this variable per county has been omitted for the sake of space.

intense the competition is for them with respect to the number of consumers close by. Simply put: the higher the ratio, the greater the number of pharmacies relative to the population density and thus the more intense competition is between pharmacies. Based on this measure, pharmacy density is the highest (and competition is most intense) in Västra Götaland, Stockholm and Skåne, while it is lowest in Gotland, Blekinge and Västmanland.

The two last columns show the number of stores and the number of firms active in each county. The developments of these variables will be explored more in detail in Section 4.2.

Table 4.1: *Descriptive statistics per county in 2016*

County	Population	Median* income	Population density	Pharmacy density	DD	Stores	Firms
01 Stockholm	2,269,060	290,476	348	12.89	1.27	290	6
03 Uppsala	361,373	263,871	44	3.12	1.49	48	6
04 Södermanland	288,097	246,841	47	2.62	1.68	33	5
05 Östergötland	452,105	247,552	43	4.34	1.66	65	4
06 Jönköping	352,735	261,057	34	4.35	1.69	51	5
07 Kronoberg	194,628	249,560	23	2.87	1.61	30	5
08 Kalmar	242,301	244,739	22	4.51	1.76	39	5
09 Gotland	58,003	233,794	19	1.28	1.67	10	4
10 Blekinge	158,453	241,632	54	2.29	1.70	20	5
12 Skåne	1,324,565	240,100	121	11.07	1.55	169	6
13 Halland	320,333	266,028	59	5.29	1.55	47	5
14 Västra Götaland	1,671,783	260,481	70	15.27	1.48	209	6
17 Värmland	279,334	238,712	16	4.24	1.73	43	5
18 Örebro	294,941	246,528	35	3.57	1.60	42	5
19 Västmanland	267,629	252,389	52	2.47	1.75	36	5
20 Dalarna	284,531	248,358	10	6.57	1.69	41	5
21 Gävleborg	284,586	242,356	16	5.10	1.70	46	4
22 Västernorrland	245,572	254,083	11	5.06	1.77	42	4
23 Jämtland	128,673	242,024	3	3.64	1.62	25	4
24 Västerbotten	265,881	253,469	5	4.18	1.69	47	5
25 Norrbotten	250,570	262,584	3	4.50	1.82	42	4
All counties	9,995,153	252,000	25	4.97	1.54	1,375	6

** Data for 2015*
Authors' rendering of data from Statistics Sweden (2017); Apoteksinfo.nu (2017); The National Board of Health and Welfare (2017). DD shows the average number of daily dosages of prescribed medication per capita. The median income is applicable for the population aged 16+.

4.1.4 Aggregated dataset

The dataset which we construct is unique and has three dimensions: a product, a market and a time dimension. The complete dataset includes 40,572 observations, with 276 distinct pharmaceuticals defined by their product name, sold in the 21 Swedish counties over the course of seven years (2010-2016).

As mentioned above, the dataset constructed is balanced, meaning that all products included are sold in each time period and each county. While the original data file consists of 98,420 observations, we omit observations of all products that were not sold in all counties and in all time periods. While this means that approximately half of the observations are dropped, we argue that the balanced dataset is preferred for a number of reasons. Firstly, we observe that the total number of products in Stockholm exceeds the equivalent number for Gotland by approximately ten percent. Since our intent is not to analyse differences in the product mix, and since such differences are likely to alter the effects that we wish to highlight, we prefer the balanced dataset. Secondly, since we aim to discuss how prices may have been affected by regional changes in market structure, it seems reasonable to assume that the products included are both present in all counties and time periods studied. This is particularly important given the relatively short time frame. Thirdly, using a balanced data set reduces the effects of the limitations in our product data caused by the fact that differences in package sizes cannot be taken into account. By making sure that all products have been sold in all periods in all counties, and thereby ensuring that they are mature products, the probability of these changing in terms of package sizes is reduced. For these reasons, all other pharmaceuticals are omitted from the analysis.

Having accounted for the current state of knowledge based on information available in reports written prior to this analysis, we continue with the analyses based on the data available to us.

4.2 Descriptive analysis

4.2.1 Market structure

The number of firms active on the market has varied since the deregulation. In 2010, there were eight firms together accounting for 99 percent of the number of stores while in 2016, five firms had a share of 97 percent. In Table 4.2 the number of pharmacies per county per year is presented to illustrate the regional differences in the number of pharmacies. Table 4.3 provides insight into how the market has developed in terms of different pharmacy firms[12].

From Table 4.2 it is apparent that there are large variations in terms of number of pharmacies per county as well as in the development in the number of pharmacies over time. The counties where the number of pharmacies have increased the most in absolute terms are also the most densely populated, Stockholm, Skåne and Västra Götaland. In relative terms however, Gotland experienced the greatest change with 43 percent. The lowest changes in relative terms apply in Kronoberg and Västmanland.

Table 4.3 describes the development of acquisitions in the market as described in Section 2.1. As can be seen, three firms now control almost 80 percent of the total number of pharmacies in the market, namely the pharmacies that claim to apply national pricing, that is, Apoteket, Apoteket Hjärtat and Kronans Apotek. The remainder of pharmacies are owned by Apoteksgruppen, Lloyds Apotek and individual entrepreneurs (Non-affiliated).

[12] 2010 has been omitted since information at a county level is not available.

Table 4.2: *Number of pharmacies per county and year*

County	2011	2012	2013	2014	2015	2016	ΔAbsolute	Δ Relative
01 Stockholm	233	237	251	261	264	290	57	24%
03 Uppsala	39	41	41	42	44	48	9	23%
04 Södermanland	32	32	34	33	33	33	1	3%
05 Östergötland	61	60	64	62	63	65	4	6%
06 Jönköping	45	48	48	49	49	51	6	13%
07 Kronoberg	30	30	30	31	31	30	0	0%
08 Kalmar	33	36	36	38	38	39	6	18%
09 Gotland	7	8	9	10	10	10	3	43%
10 Blekinge	16	17	17	17	19	20	4	25%
12 Skåne	148	151	158	160	159	169	21	14%
13 Halland	38	40	43	45	45	47	9	24%
14 Västra Götaland	192	196	203	204	204	209	17	9%
17 Värmland	42	41	41	41	41	43	1	2%
18 Örebro	38	39	38	40	41	42	4	11%
19 Västmanland	36	36	37	38	38	36	0	0%
20 Dalarna	40	40	38	40	41	41	1	2%
21 Gävleborg	42	42	42	44	44	46	4	10%
22 Västernorrland	39	39	40	43	42	42	3	8%
23 Jämtland	24	24	24	25	25	25	1	4%
24 Västerbotten	44	45	46	45	45	47	3	7%
25 Norrbotten	41	41	42	42	42	42	1	2%
All counties	1,220	1,243	1,282	1,310	1,318	1,375	155	13%

Source: Authors' rendering of data from Apoteksinfo.nu, 2017
The last two columns show the changes comparing 2011 with 2016

Table 4.3: *Percentage of total number of stores per pharmacy firm and year*

Pharmacy firm	2011	2012	2013	2014	2015	2016
Apoteket	30	30	29	28	28	28
Apoteksgruppen	13	13	13	13	13	13
Apotek Hjärtat	22	22	24	23	24	28
Kronans Apotek	17	17	18	23	23	23
Non-affiliated	1	1	1	2	2	2
LloydsApotek			6	6	6	6
Cura	3	3	4	5	5	
Medstop	5	5	5			
DocMorris	7	6				
Vårdapoteket	2	2				

Source: Authors' rendering of data from Apoteksinfo.nu, 2017

As illustrated in Table 4.4, the present Number of firms active in each county varies widely. In certain counties, only four different firms are present. The counties with only four firms are Östergötland, Gotland, Gävleborg, Västernorrland, Jämtland, Västerbotten and Norrbotten. All of these lack pharmacies from Lloyds Apotek and non-affiliated pharmacies. The counties where all six firms are present are Stockholm, Uppsala, Skåne and Västra Götaland. The remaining ten counties have five firms present of which four are Apoteket, Apoteksgruppen, Apoteket Hjärtat and Kronans Apotek. Thus, the firms which are not established in all counties are Lloyds Apotek and Non-affiliated pharmacies.

Table 4.4: *Number of pharmacies per pharmacy firm per county in 2016*

County	Apoteket	Apoteks-gruppen	Apotek Hjärtat	Kronans Apotek	Non-affiliated	Lloyds Apotek	Nr. of firms
01 Stockholm	68	38	84	54	20	26	6
03 Uppsala	7	8	17	10	2	4	6
04 Södermanland	8	5	9	8		3	5
05 Östergötland	17	13	21	14			4
06 Jönköping	16	6	11	16		2	5
07 Kronoberg	9	3	10	6		2	5
08 Kalmar	12	5	12	7		3	5
09 Gotland	2	3	1	4			4
10 Blekinge	6	2	6	5		1	5
12 Skåne	47	14	53	38	4	13	6
13 Halland	13	11	11	10		2	5
14 Västra Götaland	58	30	49	54	6	12	6
17 Värmland	15	6	10	11		1	5
18 Örebro	12	8	10	9		3	5
19 Västmanland	8	3	14	8		3	5
20 Dalarna	15	3	8	12		3	5
21 Gävleborg	12	6	16	12			4
22 Västernorrland	14	2	16	10			4
23 Jämtland	13	3	6	3			4
24 Västerbotten	13	2	13	18		1	5
25 Norrbotten	17	5	8	12			4
All counties	382	176	385	321	32	79	4:6*

Source: Authors' rendering of data from Apoteksinfo.nu, 2017
** Note that the dispersion in the number of firms was greater (up to ten) in previous years*

In order to investigate the differences market structure more closely, we apply our measure *Share of Stores*, I_s[13]. As can be seen in Figure 4.1 below, the development of this index per county proves interesting in the respect that it varies substantially and increases over time. Moreover, it appears as though the market becomes more concentrated over time. This development is also summarised in Table 4.5, where the decreasing variation in *Share of Stores*, illustrated by the decreasing standard deviation, shows that the variation in the regional concentration decreases. Meanwhile the mean level of *Share of Stores* increases, confirming that our measure for market concentration has converged to a higher overall level. From a market power point of view, this is an important finding.

[13]The reader is reminded that it is defined as $I_s = \sum_{i=1}^{n} \alpha_i^2$, where α is the market share in percent. It thus captures the concentration in the market, spans from 0 to 10,000 and is explained in detail in Section 3.3.2.

Figure 4.1: *Development of Share of stores*

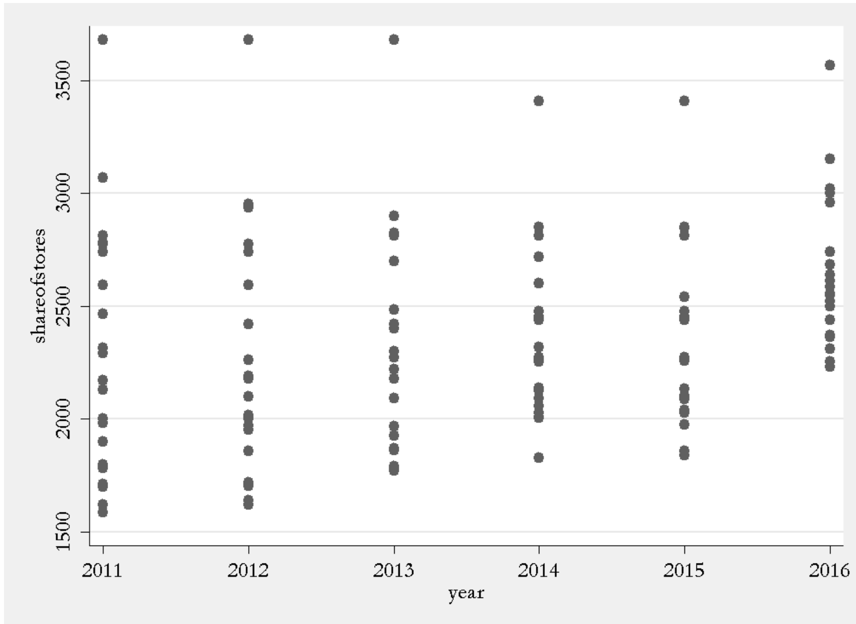


Table 4.5: *Share of Stores summary statistics*

Year	Min	Median	Max	Mean	Std. dev.
2011	1,588	2,170	3,681	2,281	540
2012	1,621	2,099	3,681	2,254	514
2013	1,770	2,273	3,681	2,311	464
2014	1,829	2,273	3,408	2,362	358
2015	1,840	2,265	3,408	2,344	379
2016	2,230	2,587	3,568	2,650	322

Source: Authors' rendering of data from Apoteksinfo.nu, 2017

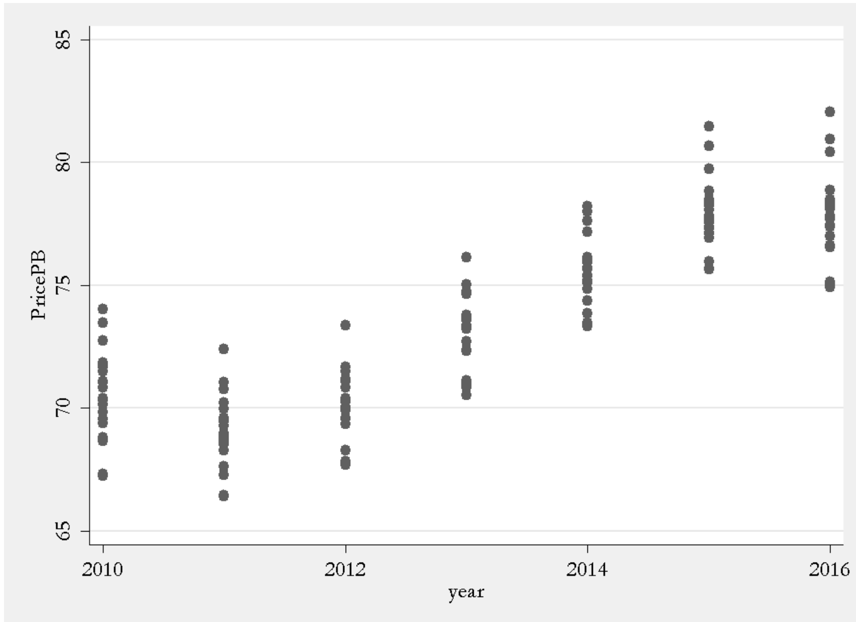
4.2.2 Prices

As a first means of evaluating how prices have developed since 2010, we calculate a weighted average price level for each county[14]: $average\, price_t = \frac{\sum_{i=1}^{N} p_{it} \times q_{it}}{\sum_{i=1}^{N} q_t}$, where p_{it} and q_{it} specify the inflation-adjusted price p_{it} and packages q_{it} sold for product $i \in N$ in county m in time period t. The product of these are summed per county and year and divided by the total number of packages sold in county c and time period t. This generates a comparable price index for each county and year based on the 276 products in the sample. The development of these can be seen in Figure 4.2.

Summary statistics of all prices are presented in Table 4.6. As can be seen, there is a slight increase in the general price over time. As hinted by Figure 4.2, the price level appears to have increased over time in all counties. This is confirmed in Table 4.6 below. Moreover, Figure 4.2 indicates variations in regional price development, which connects to the findings on the increase

[14]The subscript m indicating each market will be omitted throughout.

Figure 4.2: *Development of weighted averge price level of pharmaceuticals*



in market concentration in Section 4.2 above. In Table 4.7, summary statistics for prices in 2016 can be seen per county. It is clear that the different measures of the price level vary between the counties. The fact that the minimum price in Stockholm is much lower than in all other counties is an indication of a regional price-reduction [15]. Stockholm has the lowest overall average price of SEK 101. The highest average price is found in Dalarna, at SEK 106. Dalarna is also the county with the by far highest variation in prices, with a standard deviation of SEK 82. They account for the highest observed price, at SEK 648. Differences in the product mix can not explain this observation since the dataset is balanced.

Given the variation in prices, the median prices are also relevant to study. Stockholm has the lowest median price, SEK 82, while Gotland has the highest at SEK 85. Making the connection with the market structure based on the descriptive statistics in Table 4.1, we note that Stockholm has a relatively high level of *Pharmacy density*(12.9), indicating more intense competition between pharmacies. On the contrary, Gotland has the lowest level of *Pharmacy density* (1.28). Dalarna (6.6) on the other hand is slightly above the national average (5.0).

[15]The fact that our prices may include these will be discussed as a limitation in the Discussion, Section 7.

Table 4.6: *Summary statistics for price*

Year	Min	Median	Max	Mean
2010	67.25	70.40	74.04	70.58
2011	66.40	68.99	72.39	69.07
2012	67.69	70.04	73.38	70.11
2013	70.52	73.29	76.15	73.11
2014	73.34	75.41	78.20	75.52
2015	75.66	77.71	81.46	77.90
2016	74.94	77.83	82.04	77.87

Source: Authors' rendering of data from the Swedish eHealth Agency, 2017

Table 4.7: *Summary statistics for price per county in 2016*

County	Min	Median	Max	Mean	Std. dev.
01 Stockholm	14.1	81.8	520.4	101.3	76.0
03 Uppsala	22.8	83.6	526.5	104.6	75.2
04 Södermanland	25.0	84.1	526.5	104.5	75.9
05 Östergötland	23.6	82.9	563.4	104.5	77.0
06 Jönköping	23.6	83.9	526.5	104.3	76.1
07 Kronoberg	22.0	84.3	526.5	104.8	78.4
08 Kalmar	24.5	84.2	542.3	104.1	76.6
09 Gotland	19.9	85.2	574.4	105.4	78.4
10 Blekinge	28.2	83.9	539.1	103.5	74.1
12 Skåne	25.2	84.3	548.9	105.2	77.9
13 Halland	24.0	83.7	561.3	105.2	79.0
14 Västra Götaland	24.3	84.8	529.0	105.5	78.2
17 Värmland	21.1	84.8	526.5	104.7	76.6
18 Örebro	24.3	84.6	526.5	103.5	75.1
19 Västmanland	25.2	84.3	526.5	105.1	76.4
20 Dalarna	24.0	84.0	648.4	105.8	82.2
21 Gävleborg	24.3	84.4	537.2	105.0	78.1
22 Västernorrland	22.5	84.0	527.9	104.3	77.6
23 Jämtland	22.2	82.5	551.0	102.3	74.0
24 Västerbotten	24.4	84.7	520.9	104.9	77.4
25 Norrbotten	21.1	84.3	526.5	103.9	75.4

Source: Authors' rendering of data from the Swedish eHealth Agency, 2017

To investigate whether the indications of a connection between this competition measure and the median price can be generalised, we correlate three different market structure measures with the median and with the mean prices per county. We note that the results, both in terms of direction and magnitude, are similar. The result for *Pharmacy density* is counter intuitive, since as this measure increases, so does the competition intensity. The prediction would be that it has a negative effect on the price. On the contrary, the results for *Number of firms* and *Share of stores* are in line with the predictions, both indicating that increased competition is associated with lower price levels. In Section 6 we go more into detail concerning what might cause these relations.

Table 4.8: *Median and mean inflation-adjusted price level per county and year*

Measure	Corr. median	Corr. mean
Pharmacy density	0.101	0.0898
Number of firms	-0.404	-0.4224
Share of Stores	0.253	0.2355

5 Empirical method

This section builds on two parts, being hedonic price regressions and the (nested) logit model. The first relates to a descriptive process of fitting consumer utility with variables that influence it, such as price and product characteristics. The second is an approach where the elasticity of demand is derived to make inferences about the degree of market power. Both will be treated in turn.

5.1 Hedonic price regressions

In order to evaluate the pharmaceutical market and in particular how it affects prices, it is imperative to determine what variables affect prices in general. With this in mind, hedonic price regressions are a natural first step.

Pakes (2003) states that in order to construct a relationship between prices and characteristics of goods and consumers, a few assumptions needs to be made about the equilibrium. In this framework it is commonly assumed that firms compete on prices and that Bertrand-Nash equilibrium is achieved. Rosen (1974) elucidates that the Nash equilibrium conditions include that demand equals supply, so that there is a match between buyers and sellers and the market clears. Therefore, consumers and producers make their decisions based on that they are maximizing profits and utility. The market clearing prices are determined by consumer tastes and producer costs.

Pakes (2003) assumes that if (x_i, p_i) denote the characteristics and price of a specific good, and (x_{-i}, p_{-i}) denote the characteristics and price of all other goods in a market, then the demand for good i can be written as $D_i(\cdot) = D(x_i, p_i, x_{-i}, p_{-i}, A)$ where A denotes the distribution of consumer characteristics that influence their preferences of the product characteristics. In turn, if firms produce just a single product and marginal costs are denoted $mc(\cdot)$, then prices can be expressed as

$$p_i = mc(\cdot) + \frac{D_i(\cdot)}{|\partial D_i(\cdot)/\partial p|} \tag{5.1}$$

The second term represents the markup, which is inversely related with the elasticity of demand.

The hedonic function $h(x)$ captures an expected marginal cost plus a markup, conditional on the product characteristics of a good. This expression shows that the markup for a product depends on the characteristics of other products as well as on consumer tastes. Therefore, if the markup of the product being analysed is significant, it should be expected that the price varies as the characteristics of the product changes. Since the hedonic function is in a reduced form, with the endogenous variable expressed in terms of exogenous ones, there are no *a priori* restrictions. In other words, keeping the product characteristics constant, as would be the case for a specific product, the expected outcome can differ depending on the consumer characteristics that may differ across markets. Formally,

$$h(x) \equiv E[p_i|x_i] = E(mc(\cdot)|x_i) + E(\frac{D_i(\cdot)}{|\partial D_i(\cdot)/\partial p|}|x_i) \tag{5.2}$$

Whereas Pakes (2003) describes the form of the hedonic regression model, Rosen (1974) focuses on the underlying principles. According to this paper, goods are valued according to their characteristics, or in other words the way that their traits affect utility. By observing how specific amounts of characteristics affect the prices of differentiated products, the econometrician can derive the implicit prices of attributes. With a first-step simple robust OLS regression, where the price of a good is expressed in terms of characteristics, inferences can be made about the direction, and to a certain extent the magnitude, in which a trait affects the dependent variable price. The outcome of hedonic price regressions are however purely descriptive and do not identify neither demand nor supply (Rosen, 1974).

In our approach, we use hedonic regressions to capture the relation between price and product characteristics. We then use these as controls when further analysing how the market structure variables are associated with prices.

5.2 Structural demand

The logit model – The model, described by Berry (1994), builds on assumptions regarding consumer preferences, product characteristics and a Bertrand-Nash equilibrium in pure strategies. Additionally, it is assumed that all consumers can observe all product characteristics and decisions made by all participants in the market. The econometrician is able to observe the market outcomes in terms of price and quantities sold by each firm. She is also able to observe a part of the product characteristics. Another part of the product characteristics is however unobservable, as are the decisions of individual consumers. This can for instance be because certain aspects of product quality can not be measured. In a general empirical setting, the unobserved variables characteristics will be the cause of econometric error since the firms take them into account when setting their prices and the consumers consider them before making a purchase. For this reason, when dealing with aggregate data, it is important to use a framework which estimates the unobserved product characteristics, as the one proposed by Berry (1994) and described below.

The model assumes that there are M independent markets, with $j = 0, 1, ..., J$ goods, where $j = 0$ denotes an outside good. The utility that results when consumer i purchases product j in period t depends on the product characteristics: $U(x_{jt}, p_{jt}, \xi_{jt})$, where x_{jt} are observed product characteristics, such as method of usage, p_{jt} which captures the price, and ξ_{jt} characteristics which are unobserved by the econometrician, such as unobserved product quality (Berry, 1994). The model is a discrete choice model meaning that consumers purchase one good only, namely the good that generates the highest utility. The consumer may also choose to purchase the outside good, where the utility of purchasing the outside good, δ_0, is normalised to 0.

All consumers have unobservable individual taste parameters as defined by ϵ_{ijt}. The utility for consumer for consumer i of purchasing product j in period t can be expressed as[16]:

$$u_{ijt} = \beta x_{jt} - \alpha p_{jt} + \xi_{jt} + \epsilon_{ijt} = \delta_{jt} + \epsilon_{ijt}. \tag{5.3}$$

where ξ_{jt} can be interpreted as the mean of consumers' valuations of all the unobserved product characteristics, and ϵ_{ijt} expresses the the distribution of consumer preferences around this mean. Given the fact that these unobserved characteristics are likely to be taken into account when prices are set, it is probable that p_{jt} and ξ_{jt} are correlated. In the utility expression (5.3), α, the coefficient which captures the disutility of paying the price of the product, does not vary between consumers but is an average value applicable to all consumers. β, the coefficient on the observed product characteristics is individual and may vary between consumers but is estimated in the aggregate. δ_{jt}, the mean utility, is the same for all consumers. Consumers purchase different amounts of the products, and aggregate demand and the market shares can be derived for the mean level of utility per product. Berry (1994) suggests to assume that the distribution of the unobservable consumer characteristics is known, since that allows for market shares to depend only on the mean utility levels. Accordingly, we assume that they follow an i.i.d. type I extreme value distribution.

Besides the goods on the market, the outside good $j = 0$ should be included in order to be able to account for substitution patterns in case of a general price increase. Without an outside good, only relative price changes would influence substitution between goods. With an outside good, a general price increase can predict a decreased aggregate output[17]. The market share for the outside good is the share of the market, in this case N, which is not accounted for with the goods $j = 1, ..., J$:

$$s_{0t} = 1 - \sum_{j=1}^{J} s_{jt} \tag{5.4}$$

Empirically, β and α in (5.3) are estimated so that the observed market shares fit those predicted by the model. For each product j in period t, the difference in the natural logarithm of the market share of the inside and the outside good equals the aggregate mean utility. In other words:

$$ln(s_{jt}) - ln(s_{0t}) = \delta_{jt} \tag{5.5}$$

Combining this expression with 5.3 entails that,

$$ln(s_{jt}) - ln(s_{0t}) = \beta x_{jt} - \alpha p_{jt} + \xi_{jt} \tag{5.6}$$

Again, the vector ξ_{jt} captures the unobserved characteristics that are not accounted for by the vector of observed characteristics, x_{jt}. Some of the unobserved characteristics can be captured with dummy variables, for instance year fixed effects. The unobserved characteristics for product j in market m

[16] In our regressions we will assume that the form is $u_{ijt} = \beta x_{jt} + \alpha_{jt} + \xi_{jt} + \varepsilon_{ijt}$, but that $\alpha < 0$.
[17] An example with its implications is included in the following subsection on the nested logit model.

and period t can in other words be decomposed:

$$\xi_{jmt} = \xi_{jt} + \xi_{mt} + \eta_{jt} \tag{5.7}$$

In the empirical application, we test regressions with fixed effects. Further to that, since p_{jt} remains an endogenous variable, an instrument z_{jt} needs to be applied. The requirements for suitability are that it is correlated with the price of the product, but uncorrelated with the utility-influencing product characteristics. In other words, an instrument for which $E[\eta_{jmt}|\mathbf{x}'_{jmt}] = 0$ and $E[p_{jt}|z_{jt}] = 0$. The unobserved characteristics are assumed to be independent across markets, and within each market mean independent of z. A suggested instrument is the average price of the same product in other markets (Berry, 1994; Hausman, 1997; Toro-Gonzalez, 2012), and this is what we apply in our analysis.

There are A consumers in a market. In this analysis, the measure will be the number of inhabitants per county. Here we will assume that the market size $N = 1.5 \times A$, with the underlying reason being that consumers purchase at least one package of cold-alleviating medication per year, but since colds are more frequent than once a year they will potentially purchase more. This is equivalent to assuming that consumers get a cold on average 1.5 times per year. If P_{ij} denotes the probability that a consumer purchases a good, then the market share for good j can be expressed as

$$s_{jt} \equiv \frac{N \times P_{ijt}}{N} = \frac{e^{\delta_{jt}}}{\sum_{k=0}^{J} e^{\delta_{kt}}} = \widetilde{s}_{jt}(\alpha, \beta, \xi_1, ..., \xi_J) \tag{5.8}$$

$\widetilde{s}(\cdot)$ denotes the predicted market share, conditional on the values of $(\alpha, \beta, \xi_{1,...,J})$ which are estimated empirically. Again, we assume that the error term follows an i.i.d. type I extreme value distribution.

When the mean utility δ_{jt} and the market shares $\widetilde{s}_{jt}$ have been estimated and fitted empirically, the expressions hold. This is conditional on the true values of δ_{jt} since the observed mean utility levels contain the unobserved product characteristics ξ_{jt}. As a consequence of this fit, the mean utility levels that have been observed can be utilised in the estimation procedure.

$$\delta_{jt}(\widetilde{s}_{jt}) = \beta x_{jt} - \alpha p_{jt} + \xi_{jt} \tag{5.9}$$

The first step when empirically applying this method is to make a connection between the level of utility and the product characteristics using simple OLS regressions. The aspects of this process were discussed more in detail in the preceding section. With this specification, an instrumental variables regression can be conducted, using $\delta(s)$ on (x_{jt}, p_{jt}) to estimate β and α with ξ_{jt} as the unobserved variable.

The nested logit model – If applying the standard logit model without imposing *a priori* restrictions to substitution patterns, cross-price elasticities (thus demand) are purely proportional to market shares. They do not take the similarity between goods into consideration. All characteristics that influence market demand for good j are distinguished only by the market share, or mean utility δ_{jt}. Nevo (2000) discusses some implications of this assumption in a study of the market for cereal. Suppose that there are three brands of cereal on the market, each with an equally large market share:

two for children and a third for adults. Without imposing restrictions on the substitution patterns, if one of the children's cereal brands exits the market, this specification predicts that the market shares of the two remaining brands expand by a proportional amount. In practice it would be more likely that consumers substitute to the children's brand than to the adult's. Similarly, using this approach in the pharmaceutical market would entail that any two medication with the same market shares have the same cross-price elasticity compared to any other, third product. What the treatment area is or how closely it is related to conditions treated by the third product would be irrelevant.

The independence of irrelevant alternatives (IIA)(Arrow, 1950) is a very strong assumption. Applying the nested logit entails capturing the similarities between products using an additional variable in the regressions, thus effectively relaxing the IIA assumption and allowing for that shocks to utility between goods are correlated within the nest or product group (Berry, 1994). With the discrete choice nested logit model, consumers are assumed to first select a nest depending on their preference and then select a product within a distinct group within that nest. The demand functions that are derived from this setup allow there to be a different, higher degree of substitution within groups than across them. The cross-price elasticities are lower between groups than within them, but positive among both. This means that when the price of one good increases, the likelihood that another good will be purchased increases (Belleflame and Peitz, 2015).

When the nested logit structure is applied, the utility function can be expressed slightly differently.

$$u_{ijt} = \beta x_{jt} - \alpha p_{jt} + \xi_{gjt} + (1-\sigma)\epsilon_{ijt} \tag{5.10}$$

With this model, ξ_{gjt} is a variable that all products in the nested group g have in common. Its distribution function depends on σ. As has been shown by Cardell (1991), if ϵ_{ijt} is i.i.d. and an extreme value random variable, which it is assumed to be in this specification, then so is $\xi_{gjt} + (1-\sigma)\epsilon_{ijt}$. What is relevant for the further empirical analysis is the resulting expression for the mean utility levels[18]. Using the principles underlying equation (5.6) and the natural logarithms of market shares for good j and good 0 in period t,

$$ln(s_{jt}) - ln(s_{0t}) = \beta x_{jt} - \alpha p_{jt} + \sigma ln(s_{jt|g}) + \xi_{jt} \tag{5.11}$$

β, α and σ can thus be estimated with a linear instrumental variables regression, using the natural logarithms of market shares of the inside and the outside good, together with the product characteristics, the price and the logarithm of the share of good j in period t, within group g.

In essence, what is estimated with the nested logit model is how strong preferences are within the nests, and how strong substitutability between goods are. The newly introduced term $(1-\sigma)\epsilon_{ijt}$ applies to all products in group g and has a distribution function that depends on σ, where $0 \leq \sigma < 1$. When $\sigma \to 0$, the correlation of utility within the group tends to zero. Such a situation can be estimated with a standard logit model since the nesting structure becomes unimportant. Substitution is no different within a group compared to products outside it. If, on the other hand $\sigma \to 1$, the

[18] For a more detailed step-by-step derivation of the model, the reader is referred to the article by Berry (1994), where the equations on p. 253 explain each step of the way.

within-group correlation is strong. Consumers become indifferent to products within the group as correlation becomes stronger.

Using the analytical expression of the market shares, the own-price and the cross-price elasticities can be derived[19]:

$$\frac{\partial s_j}{\partial p_j} \times \frac{p_j}{s_j} = \quad \alpha s_j \left(\frac{1}{1-\sigma} - \frac{\sigma}{1-\sigma} s_{j|g} - s_j\right)$$

$$\frac{\partial s_j}{\partial p_k} \times \frac{p_k}{s_j} = \begin{cases} \alpha s_k \left(\frac{\sigma}{1-\sigma} s_{j|g} + s_j\right) & if\ j\ and\ k\ same\ group \\ \alpha s_j s_k & otherwise \end{cases}$$

The own-price elasticity for a good is proportional to the own price and for that reason, a lower price in absolute terms entails a lower demand elasticity (Nevo, 2000). This allows for a higher markup for products with lower prices than that of a relatively more expensive product.

5.2.1 Empirical implementation

A prerequisite for being able to apply the nested logit model is that assumptions concerning the structure of the nests are made *a priori*. For many industries this would not be straightforward, but it is possible for pharmaceuticals given their distinct categories. In order to apply this model, we focus on a subset of pharmaceuticals that are used to alleviate symptoms experienced during a cold or a flu. This subset of goods serves as an appropriate sample as it allows us to construct a nest consisting of two groups, denoted *Natural* and *Conventional* pharmaceuticals. The underlying assumption is that consumers are prone to prefer one of the two, but could potentially be willing to switch to the other if, for instance, prices or product characteristics of the competing good were sufficiently appealing. Another reason to why this is an appropriate sample is that it represents one of the six largest categories in terms revenues, as categorised by the Swedish Competition Authority (2017). The pharmaceuticals belonging to the two groups in the nest are listed in the Appendix 9.1 below.

The outside option $j = 0$ is regarded as the possibility for consumers to purchase their goods, or other similar provisions, in retail. The total market for the goods is, as mentioned above, $N = 1.5 \times A$ within each county. The market share that the products j and the group g have in period t are, respectively: $s_{jt} = \frac{q_{jt}}{N_t}$ and $s_{gt} = \frac{q_{gjt}}{\sum q_{gt}}$. We now proceed to our results.

6 Results

6.1 Hedonic regressions

As a first step to investigate the association between price and market characteristics, we perform our hedonic regressions. This is complemented by adding market characteristics into a reduced-form setting. We begin with using the weighted average price level defined above as our dependent variable in order to detect general trends in price developments. Secondly, we perform the equivalent regressions for all product-level prices in our sample, to see whether any findings can be confirmed

[19] See eq. 25 in Berry (1994) for details.

at a more detailed level. Pooled OLS is used to estimate:

$$ln(p_{ijt}) = \beta W_{ijt} + e_{ijt} \tag{6.1}$$

Where p_{ijt} denotes the inflation-adjusted product-level price and W_{ijt} is the matrix of exogenous explanatory variables, including a constant term[20]. β measures the direction and magnitude with which observable product characteristics influence the price level, and robust standard errors are used to correct for heteroskedacity.

Table 6.1 presents the estimated coefficients when *Weighted average price level*, as defined in Section 5.2, is used as dependent variable. Table 6.2 shows the estimated coefficients from when the inflation-adjusted product level price is the dependent variable. In both tables, the results of the simple hedonic price regressions are excluded for space purposes and can be found in the Appendix. Robust standard errors have been applied throughout. Columns (1)-(5), in both tables include a number of variables indicating different market characteristics. Due to collinearity, many of these cannot be included in the same specification. For instance, when the proportion Kronans Apotek increases it is also likely that *Entry national pricing* increases[21], since they apply a national pricing policy. As stated above (see eq. (5.7)), it is possible to use dummy variables to capture county and year fixed effects. When applying county and year fixed effects, we found that there was not sufficient variation in the data for this approach to improve the model [22].

In the omitted column in Table 6.1, seen in Table 9.2 in the Appendix, we control only for regional specifics, being *Income*, *Population*, *Pensioners* and *DD* (daily dosages). *Income* is specified as the median income among the population older than 16. *Population* and *Pensioners* are the respective absolute numbers and *DD* is the average number of prescribed dosages per capita. These represent our variables for our hedonic price regression when using the weighted average price level as the dependent variable. We note that all coefficients are significant at the one percent level.

Similarly, the results of our regression when using the entire sample and *Price* as dependent variable, can be found in its entirety in the Appendix, Table 9.3. This regression includes several dummy variables for the application method. This specification also includes dummy variables: *Retail*, indicating whether the pharmaceutical is available in retail; *Monopoly within ATC*, indicating whether the pharmaceutical is the sole product within its ATC; *Small*, *Medium*, *Large manufacturer* indicating the size categorization of the manufacturer, and finally Natural, which indicates if the product is categorised as a natural medication.

The treatment method *Pill* and manufacturer *Large* are the omitted categories. All but one characteristic are significant at the one percent level. The sole insignificant characteristic is *Pill or oral fluid* which is not surprising seeing that the omitted category *Pill* is unlikely to be substantially differently priced. Population is negatively correlated with the price, as is *DD*. Theory predicts that an increase in population and in *DD* results in a relatively higher demand which in turn should

[20] A more detailed description of the theory underlying this model is included in Section 5.1. Interested readers are also referred to Asplund and Friberg (2001).

[21] It will do so when Kronan enters the county for the first time, not when its number of stores only increases.

[22] Similar results were found in Asplund and Friberg (2001).

increase price. The coefficient on *Pensioners* captures is in line with that reasoning and is associated with a higher price level. With regards to the size of manufacturers, both *Small* and *Medium* are associated with a lower price level than the omitted *Large*. This could be because large manufacturers are well marketed and able to charge higher prices because of it, but also because they produce goods with higher marginal costs. Both *Retail* and *Natural* are associated with higher prices. It would be expected that a higher degree of competition, as is the case for *Retail* entails a lower price level but that is not so. The higher coefficient on *Natural* could capture that consumers value these goods higher on average, but this is not possible to determine.

We now turn to the market characteristics of interest. In all further regressions using *Weighted average price level* and *Price* as dependent variables, their respective variables of characteristics are included as control variables. The market variables included in specification (1) to (5) in Table 6.1 and 6.2 are five different variables capturing different characteristics of the market. *Pharmacies established* captures the number of new stores opened in a year, while *Entry free* and *Entry national pricing* are both dummy variables used to indicate whether an entry to a market, if applicable, was made by a firm with a free or with a national pricing policy. *Proportion [Firm name]* is defined as the number of stores from a certain firm, divided by the number of total stores. *Share of stores*, I_s indicates the concentration of stores and *Number of firms* is the number of firms present. All specifications are on a county level, including the years 2011 to 2016 with the exception of regressions (5). This regression also includes year 2010 since it is based on aggregate pharmacy information only[23].

Before discussing the signs of the coefficients, we want to remind the reader of the fact that they cannot be interpreted causally, but simply represent the association between price and each characteristic. Firstly, we discuss the results of using *Weighted average price level* as the dependent variable in Table 6.1. Looking at *Number of pharmacies* in specification (1), an increase in this variable is associated with a lower price. A similar finding extends to the variable *Entry free pricing* in specification (2), a dummy variable indicating whether a pharmacy with heterogeneous pricing within its firm has been established. On the other hand, the entry of a pharmacy with nationally homogeneous pricing, *Entry national pricing* is associated with a higher price in the same specification. These coefficients are statistically significant in both estimations. An interpretation of these coefficients is that if a pharmacy store that belongs to one of the firms that applies national pricing, this is likely to be correlated with a higher price. The opposite applies for a pharmacy store that allows for independent pricing. This is theoretically viable as pharmacy firms with a national pricing policy are unlikely to enter a market and lower their prices in order to compete, but rather align with prices in other regions. The effect associated with a free pricing policy is also theoretically viable, given their capabilities to compete. However, while interesting findings, it is important to note that this might mean that the firms choose to establish new stores in locations where price competition is less or more intense respectively. In other words, the possibility of reverse causality cannot be excluded.

[23]The complete outputs of regressions in Table 6.1 and 6.2 are included in the Appendix.

Table 6.1: *Reduced-form regressions, weighted average price level*

	Dependent variable: Weighted average price level				
	(1)	(2)	(3)	(4)	(5)
Pharmacies	-0.00153***				
established	(-25.22)				
Entry		0.00274***			
national pricing		(-6.22)			
Entry		-0.00525***			
free pricing		(-12.38)			
Proportion			0.0125***		
Hjärtat			(3.80)		
Proportion			0.173***		
Apoteksgr.			(41.60)		
Proportion			0.167***		
Kronan			(40.14)		
Proportion			0.0779***		
Lloyds			(14.51)		
Proportion			-0.103***		
Non-Affil.			(-10.56)		
Share of				9.39e-06***	
Stores				(25.4)	
Number of					-0.0111***
firms					(-75.59)
Cons.	3.666***	3.655***	3.556***	3.639***	3.775***
	(1115.03)	(1038.73)	(994.74)	(1138.6)	(1014.08)
adj. R^2	0.546	0.542	0.616	0.545	0.565
N	147	147	147	147	147

*Source: Authors' own calculations. Demographic variables included in all specifications as controls. Controlling for year. t-statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*
For the simple hedonic specification and included control variables, the reader is referred to the Appendix.

Specification (3) includes variables specifying the proportion of all pharmacies belonging to each pharmacy firm, excluding the proportion of state-owned Apoteket. The coefficients are statistically significant, and state that Apotek Hjärtat, Kronans Apotek, Apoteksgruppen and Lloyds pharmacies are associated with higher prices. In contrast, non-affiliated pharmacies are associated with a lower price. In accordance with the previous results, the fact that non-affiliated pharmacies are associated with a negative price change may be explained by the fact that they, as individual entrepreneurs, must compete harder to obtain customers. Thereby, price levels are likely to be lower where non-affiliated firms are present.

Specification (4) introduces our measure of market concentration, *Share of Stores*. The coefficient is positive and highly significant, indicating that a higher market concentration is associated with a higher price level. As described in Section 3.2, this is consistent with economic theory of market power. Nevertheless, it is important to note that this measure of market concentration rests on the assumption that pharmacies share the same size across stores and that they provide the same mix of products. This is unlikely to be completely accurate, but the results are nonetheless interesting and

Table 6.2: *Reduced-form regressions, entire balanced dataset*

	Dependent variable: Inflation adjusted price				
	(1)	(2)	(3)	(4)	(5)
Pharmacies	-0.000645				
established	(-0.63)				
Entry		0.00688			
national pricing		(1.14)			
Entry		-0.0109			
free pricing		(-1.68)			
Proportion			0.0414		
Apotek Hjärtat			(0.84)		
Proportion			0.117*		
Apoteksgruppen			(2.06)		
Proportion			0.0879		
Kronans Apotek			(1.83)		
Proportion			-0.0467		
Lloyds Apotek			(-0.55)		
Proportion			-0.152		
Non-affiliated			(-0.82)		
Share of Stores				0.0000252***	
				(4.3)	
Number of					-0.00976***
Firms					(-4.27)
Const.	3.887***	3.894***	3.828***	4.007***	3.991***
	(79.41)	(77.51)	(72.19)	(88.12)	(73.74)
adj. R^2	0.232	0.232	0.232	0.231	0.233
N	34,776	34,776	34,776	34,776	34,776

Source: Authors' own calculations. Demographic and product characteristics included in all specifications as controls.
*t-statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$*
For specification (1) control variables and omitted variables, please see the Appendix.

indicate, together with the coefficients described above, that market structure may be associated with differences in general price levels in different regions.

The final specification (5) includes the number of firms active in the market. As can be seen, the coefficient is positive and statistically significant at the one percent level, indicating that an increase in the number of firms present is associated with a lower price level. Seemingly, where there is a higher number of firms available to purchase from, it is likely that this is associated with higher competition in terms of prices. Thereby, prices are lower. Again, no causal inference can be made.

When regressing the entire sample in Table 6.2, the results change. The estimates associated with *Pharmacies established* and the dummy variable for *Entry national pricing* keep their directions but become insignificant. Similarly, the entry of a free price-setting pharmacy remains associated with a lower price level but also becomes insignificant. However, in difference to *Pharmacies established* and *Entry national pricing*, this coefficient is on the verge of being statistically significant with a p-value of 0.08. Looking to the proportions of the different pharmacy firms, only *Proportion Apoteksgruppen* remains statistically significant and associated with a higher price level. *Proportion Lloyds Apotek* is insignificant but has a p-value of 0.06, and is thus also on the verge of being significant with respect to price levels. Interestingly, the results hold for specifications (4) and (5) regarding the higher price level associated with a higher *Share of Stores* and a lower price level associated with a higher *Number of firms.*

From specifications (1)-(5) in Tables 6.1 and 6.2, we can thus conclude that there are indications that most of the market characteristic variables of interest are associated with different price levels on a more aggregated price level, as in Table 6.1. However, when using individual prices, the significance of some of these decreases. It should be noted that prices are proxies, likely causing a measurement error. Therefore it may be that aggregate level data is more accurate. Nevertheless, the significance levels and signs of our competition measures *Share of stores* and *Number of firms* remain. This, in turn, indicates that market structure and competition may be of importance in terms of pricing in this market. Given the variations in market structure across the country and the importance of the market for welfare reasons, this calls for further analysis.

6.2 Demand estimation

As a means of addressing these findings, we turn to our application of the logit model and demand estimation. For the nested part of this analysis, we use our constructed basket of goods commonly purchased to alleviate symptoms from a cold or the flu. The products included in this basket are introduced in Section 5.2 above, and can be viewed in Appendix Table 9.1. For the purpose of the analysis, these goods are separated into two groups, *Conventional* and *Natural* pharmaceuticals.

The method used to obtain the results in Table 6.3 is described in Section 5.2. Specification (1) estimates the logit model with OLS, and specification (2) estimates the same model using 2SLS instrumental variables regression. Meanwhile, specification (3) introduces the nested logit version of the model using OLS and (4) presents the results of the nested logit model while using 2SLS instrumental variables (IV). In all specifications four control variables are included, where *Oral* is a characteristic defining the method of usage of the product. *Oral* is a dummy variable equal to one if the method of usage entails oral application (for instance for a pill) and zero otherwise (for instance for a salve). All specifications include dummy variables capturing the time effect, allowing us to control for structural differences across counties that may affect the probability of purchasing the good. In both regressions where IV is used, the mean price of the good in other counties serves as an instrument for price to solve the endogeneity issue. This is considered an appropriate instrument since we assume that the average level of consumer utility in one region is unaffected by the price levels of their good of choice in other regions (Hausman, 1997)[24].

The first stage regression of (4), included in Table 9.4 (Appendix), confirms that the instrument is indeed highly correlated with the price and thus appropriate to use. The efficiency of the instrument is further confirmed by the fact that the coefficient on price becomes more negative

[24]This is a common instrument applied in these settings, as described in Section 5.2.

between specifications (3) and (4), indicating that it corrects for some endogeneity present in (3) (Nevo, 2000). Therefore, we choose to use the instrumental variable specifications going forward.

Table 6.3: *Logit versus Nested logit regressions*

Dependent variable: $ln(s_{jt}) - ln(s_{0t})$				
	(1) Logit OLS	(2) Logit IV	(3) Nested Logit OLS	(4) Nested Logit IV
Infl. price	-0.0215***	-0.0217***	-0.0214***	-0.0217***
	(-41.02)	(-40.01)	(-73.98)	(-72.83)
Monopoly	-0.271***	-0.281***	-0.675***	-0.687***
within ATC	(-7.12)	(-7.34)	(-17.70)	(-17.99)
Oral	-0.567***	-0.554***	-0.217***	-0.202***
	(-18.16)	(-17.60)	(-8.53)	(-7.93)
Medium	0.216***	0.220***	-0.140***	-0.135***
manufacturer	(5.57)	(5.68)	(-6.69)	(-6.52)
Small	-1.511***	-1.504***	-1.266***	-1.257***
manufacturer	(-25.95)	(-25.78)	(-31.47)	(-31.10)
Within-			0.642***	0.642***
market share			(79.41)	(79.51)
Cons.	-2.284***	-2.274***	1.092***	1.103***
	(-47.47)	(-46.87)	(27.3)	(27.49)
N	4,410	4,410	4,410	4,410

*t-statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.*
Specifications (1) and (2) refer to equation 5.6, while specifications (3) and (4) refer to eq. 5.11.
Controlling for year.

In the choice between the logit and nested logit model, we note that specification (4) clearly shows that the separation of the two groups is relevant to the consumer. This is inferred from the positive and statistically highly significant coefficient on *Within-market share*, i.e. σ. As explained in Section 5.2, when $\sigma \to 1$ consumers are prone to substitution within the group, considering other goods within it close substitutes (Berry, 1994). In practice this entails that while consumers do not completely disregard products outside their preferred group *Natural* or *Conventional* pharmaceuticals, they do have a strong preference.

Table 6.4: *Nested Logit IV regressions*

Dependent variable: $\ln(s_{jt}) - ln(s_{0t})$					
	(1)	(2)	(3)	(4)	(5)
	Pharmacies established	Entry	Proportion	Share of stores	Number of firms
Price	-0.0218***	-0.0218***	-0.0224***	-0.0218***	-0.0218***
	(-69.41)	(-69.24)	(-68.37)	(-68.72)	(-68.43)
Within-market share	0.647***	0.647***	0.658***	0.648***	0.648***
	(77.45)	(77.54)	(75.67)	(77.29)	(77.13)
Monopoly within ATC	-0.671***	-0.671***	-0.700***	-0.671***	-0.671***
	(-16.54)	(-16.51)	(-16.48)	(-16.48)	(-16.45)
Oral	-0.209***	-0.209***	-0.173***	-0.209***	-0.208***
	(-7.64)	(-7.62)	(-6.14)	(-7.59)	(-7.57)
Medium manuf.	-0.142***	-0.142***	-0.139***	-0.142***	-0.142***
	(-6.41)	(-6.40)	(-6.02)	(-6.41)	(-6.38)
Small manuf.	-1.282***	-1.282***	-1.259***	-1.282***	-1.281***
	(-29.46)	(-29.41)	(-27.00)	(-29.34)	(-29.29)
Pharm. establ.	0.0267***				
	(10.9)				
Entry free pricing		0.232***			
		(8.58)			
Entry national pricing		0.0487			
		(1.76)			
Prop. Hjärtat			-1.296***		
			(-6.81)		
Prop. Apoteksgr.			0.17		
			(0.78)		
Prop. Kronan			-0.622***		
			(-3.30)		
Prop. Lloyds			1.805***		
			(5.5)		
Prop. Non-affiliated			5.568***		
			(8.32)		
Share of stores				-0.000197***	
				(-8.65)	
Number of firms					0.0578***
					(6.81)
N	3,780	3,780	3,780	3,780	3,780

*t-statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Variables controlling for year are included but omitted from the output. Refer to eq. 5.11 for the details of the estimation. The interested reader is referred to the Appendix.*

At this point, it is important to note a drawback with the specification above. The estimations do not account for the possible endogeneity caused by the fact that there might be a correlation between the within-market share and the market share. Ideally, this should also be instrumented for in the regressions. Unfortunately we were unable to find and apply a suitable variable to do so. A deeper analysis of this limitation will be presented in the Discussion (Section 7), but is important to acknowledge given that these coefficients are at the base of the following analysis. Referring back to our interest in market structure variables and the findings in Section 6.1, we expand specification (4) to take these into account.

The five specifications in Table 6.4 include our market variables of interest. These are introduced for consistency reasons, in order to be able to analyse how the Lerner indices and markups, derived in Section 6.3, vary with the market structure. Recall from Section 5.2 that these regressions capture the difference in market share between the inside good and the outside good, a measure for utility, as a function of product characteristics and market variables. The market variables of interest are to the most part highly statistically significant, indicating that our mean level of consumer utility is affected by their impact. For instance, we note that *Pharmacies established*, *Entry free pricing* and *Number of firms* are all associated with a higher aggregate level of consumer utility. Meanwhile the proportion of Apotek Hjärtat, Apoteksgruppen and the *Share of stores* are negatively associated with the aggregate level of consumer utility.

In order to make inferences about markups and Lerner indices, we firstly choose to focus on specification (5), *Number of firms*. The reasons for this is that it is a clear measure of market development over time, and an aspect that differs across counties. Moreover, as established in our OLS regressions in Section 6.1, it is associated with a statistically significant lower price level throughout. Finally, the measure does not rely on assumptions regarding the size of the pharmacies, as in the case with *Share of Stores*.

Using the coefficients on price and within-market share in specification (5), we can now calculate price elasticities as described in Section 5.2. The summary statistics of these are presented in Table 6.5. As can be seen, the mean price elasticity is higher for natural medications. This tells us that consumers are more price sensitive for natural medications, where the mean elasticity is -6.98 as compared to -3.90. That outcome seems reasonable based on the assumption that natural medications are deemed less effective than conventional medications by consumers.

Table 6.5: *Summary statistics price elasticity*

	Min	Median	Max	Mean	Std. dev
Conventional	-7.93	-3.82	-1.58	-3.90	1.48
Natural	-16.77	-7.06	-2.42	-6.98	2.94

6.3 Markup, Lerner index and market structure

Using the price elasticities derived above, we can now construct estimates of markups and Lerner indices as described in Section 3.3.2. Summary statistics of markups and LI can be found in Table 6.6. These results appear reasonable. In terms of the whole nest, for the Lerner index which can take on the values $[0, 1]$, the mean is 0.25 and the maximum value is 0.63. Inherently related to this is the estimate of markups for our products, averaging at SEK 16 and not exceeding SEK 20. For a mean sample product price of approximately SEK 75 this seems plausible. The level of markups are similar between the two groups at approximately SEK 16 for both, while the Lerner index is higher on average for conventional pharmaceuticals, with 0.26 and 0.14 being the respective medians. This holds as average prices of natural pharmaceuticals are higher than for conventional products[25][26].

Table 6.6: *Summary statistics Markup and Lerner Index, by group*

	Type	Min	Median	Max	Mean	Std. dev
Markup	*Conventional*	15.44	15.86	18.88	16.08	0.57
	Natural	15.45	16.37	19.99	16.93	1.21
	Total	15.44	16.04	19.99	16.31	0.87
Lerner index	*Conventional*	0.13	0.26	0.63	0.30	0.12
	Natural	0.06	0.14	0.41	0.18	0.09
	Total	0.06	0.25	0.63	0.26	0.12

Table 6.7: *Relation with market structure*

Correlation	Number of firms
Markup	0.005
Lerner index	0.033

In order to evaluate whether the estimates for Lerner indices and markups may help to explain the findings from the pooled OLS regressions in Section 6.1, we investigate how the markups vary with the number of firms present in the markets. As a first step, we look to correlations between markup and Lerner and the number of firms. If firms have and make use of their market power, the expectation is that *Number of firms* should be negatively correlated with the two measures. This follows from the assumption that number of firms is positively correlated with competition. Important to note is that, as the number of firms was part of estimating Lerner indices and markups, the following steps may suffer from a degree of endogeneity since the outcomes for markups and Lerner indices were derived using the same variable initially. Nevertheless, as a first step, this is not corrected for in order to determine whether or not there are any findings of interest at all.

Table 6.7 provides the simple correlations between our estimates for Lerner index and markup and number of firms. This analysis proves inconclusive. The correlations observed are very small in terms of magnitude and for this reason we do not analyse the direction of the correlations further. The correlations are too low to indicate any significant results.

To complement these results, we look at scatter plots and took various measures to see if we are able to detect any other interesting findings. We perform the same analysis for the variables *Pharmacies established*, *Entry national/free pricing*, *Proportion of pharmacies* and *Share of stores*. We are unable to detect any general trends linking estimates of Lerner indices or markups to any of the market structure variables. In fact, virtually all analyses prove insignificant. There is thus, given this subsample, insufficient evidence to infer that the market structure variables as defined are associated with excessive markups. A deeper analysis and discussion of these results and their implications will follow below in the discussion and concluding remarks.

[25] Recall that $LI = \frac{p-mc}{p} = \frac{markup}{p}$. Let markup be denoted $x_n = x_c$. Then $\frac{x_n}{p_n} < \frac{x_c}{p_c} \rightarrow \frac{x_n}{p_n} < \frac{x_n}{p_c} \rightarrow p_c < p_n$.

[26] See Table 9.1 in the Appendix.

7 Discussion and concluding remarks

In this paper, we compile and use a unique data set to look at the effects of market concentration on the pricing of over-the-counter pharmaceuticals in Sweden, following the 2009 deregulation. By performing reduced-form regressions, we establish that certain market characteristics, such as the concentration and number of firms present in the market, are associated with significant price effects. However, applying a structural approach by estimating demand we fail to determine that these characteristics are associated with excessive markups. One possibility is that there is no strong relationship of this form, and that prices instead are mainly determined by other factors. This would be in line with previous findings in other markets. Another possibility is that increased prices observed are caused by increased marginal costs, for instance following increased fixed costs of firms. While we cannot exclude this, there are however other, and in our view more plausible reasons related to the quality of the data primarily, that may offer explanations for our results.

The main concern with the data is the lack of exact prices. Proxies for prices have been derived by dividing revenues with packages, and these include both online sales and temporary rebates. These could both be possible explanations for some of the relationships observed. For instance, it could be that the variable for new pharmacies established is highly correlated with temporary rebates, which in turn will make its coefficient associated with a lower price level, as observed. It could also be that the usage of online sales channels, which have lower prices in general, are more frequently used in certain regions. While we believe that it is unlikely that either of these lacking details can explain the entirety of our results, being able to exclude this possibility would increase the level of certainty concerning the conclusions.

Another limitation with respect to the data is the fact that we do not have data on the level of article numbers. This means that we can not be certain that products are of the same package size in all firms and counties, which in turn also affects the accuracy of our measure for price. This has been corrected for to the extent possible by using a balanced data set. However, if package sizes vary between firms, we can not infer whether price effects are the result of firm behaviour or simply a change in cost due to a different package size. Secondly, the lack of article numbers has vastly limited the information regarding product characteristics that has been available to us. For the nested logit implementation, the availability of product characteristics is essential to determine the effect of other, unobservable, product characteristics on the probability of a consumer purchasing a product. If more information on product characteristics was available, we would likely have been able to improve the fit of the model and thereby able to generate more precise results with respect to demand elasticities. However, both exact price data and article numbers were unavailable to us due to confidentiality.

A third feature of our data that limits the amount of accuracy is the level of aggregation, both in terms of regions and in the time dimension. It would be desirable to use data at for instance the municipality level rather than at the county level. In particular, since there are local monopolies at a municipality level, it is possible that the effects on prices of various market characteristics would be more evident. Similarly, monthly data of sales, rather than yearly, would be desirable for a more detailed analysis. Three of the five largest firms generally apply a national pricing policy which entails that there is little dispersion in the prices. However, since they do have special offers and temporary rebates, if the data were more detailed the effects of these campaigns that increase price competition would be less diluted. We also see the potential in looking into more exact sales data per stores preferably, or else firms, in regions. Similar to the study by Basker and Noel (2009), dates of new store openings could bring a more local dimension to the effect of market changes on prices. As with municipality data, this is likely to offer a deeper understanding of the market developments on prices. Again, none of these data are publicly available to our knowledge.

In terms of our empirical implementation, there are issues related to endogeneity in terms of the explanatory variables being correlated with the error terms. While we use an instrument to correct for endogeneity of price in the nested logit regression, it would be desirable to instrument for the within-market shares too, since they are likely to be correlated with the error term. Similarly, when estimating the market characteristics on consumer utility, instruments should be used. For both of these, the lack of detail in the data resulted in difficulties in terms of establishing appropriate instruments. In particular, while for instance the number of articles per product could serve as an appropriate instrument for within-market share, these data were not available. In terms of an appropriate instrument for the market characteristics in the final specification, it is unlikely to have changed our final results. Related to this is the subset of data used. Preferably, we would like to estimate the same model using more data and more nests. Due to the lack of product characteristics and the detail of the data, this was not possible. For this reason too, article numbers and exact prices would have been preferred. In sum, there is thus a number of limitations which are likely to have stalled the analysis in this paper. While we would argue that our study has made the best use of the data at hand, these aspects should be taken into account in further analyses. What is more, we would like to stress the fact that our method is only one of many available to analyse this market. While the nested logit model provides an interesting approach to estimating measures of market power, we see the need for other types of studies too. For instance, studies establishing how OTC prices have developed, taking all products into account, would be interesting and highly relevant. Similarly, as mentioned, more local approaches to market structure are important too.

To conclude, there are shortcomings of the data that should be remedied before solid conclusions can be drawn regarding the developments following the 2009 reform. Nevertheless, associations between market characteristics and prices of OTC pharmaceuticals have been established. We consider this to be an important finding that deserves additional attention to ensure that the results hold even with analyses conducted on more detailed data. Since there is a lack of academic studies in this field, and given the importance of the topic at hand, we would strongly encourage further analyses with the same intent.

8 Bibliography

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9 Appendix

Human pharmaceuticals are classified by a seven-digit Anatomical Therapeutic Chemical (ATC) coding system, at five different levels. To begin with, a letter indicates the treatment area, such as the Cardiovascular system (C) or the Nervous system (N). Next, two numbers indicate the pharmacological or therapeutical subgroup – for example N01 is used for anesthetics and N02 for analgesics. The following letter classifies the treatment method, with N01A being a local anesthetic and N01B a general one. The remaining two levels, indicated by a letter and two digits respectively, classifies the pharmaceuticals by the type of substance and the active ingredient. N01BB52 is for instance the code for the Amide Lidocaine. An overview of all classifications can be found on the Community register of Pharmaceuticals, supported by the European Commission (WHOCC; EC, 2017).

Table 9.1: *Basket of pharmaceuticals for alleviating colds and flus*

Type	Name (Manufacturer)	$\overline{P}$	$\overline{Q}$	**s** (%)	**s group** (%)
Conventional					
A11GA01	C -vimin Apelsin (Meda)	102.9	289	0.03	0.05
	C-vimin (Meda)	103.8	731	0.09	0.14
	Ido-c (Abigo Medical)	98.5	1,761	0.23	0.40
R01AA05	Nasin (Omega Pharma Nordic)	30.3	37,471	5.47	9.37
	Nezeril (Omega Pharma Nordic)	41.4	47,232	6.41	11.20
R01AA07	Nasoferm (Nordic Drugs)	29.2	44,847	6.37	11.14
	Otrivin (Glaxosmithkline	30.8	36,409	4.71	7.89
	Otrivin Menthol without preservatives	51.8	33,032	4.65	8.14
	Otrivin without preservatives	42.8	38,796	5.22	9.17
R01AB06	Xyloipra (Novartis Sverige)	56.5	12,622	1.73	2.85
R02AA03	Strepsils Jordgubb (Reckitt)	62.8	93,197	1.30	2.30
	Strepsils Honung & Citron (Reckitt)	65.4	24,713	3.26	5.76
	Strepsils Mint (Reckitt)	62.8	7,710	1.04	1.80
R02AB30	Bafucin Mint (Mcneil Sweden)	63.8	15,767	2.07	3.59
	Bafucin (Mcneil Sweden)	63.6	11,628	1.63	2.82
R02ADÖÖ	Mucoangin Mint (Boehringer)	59.6	5,835	0.80	1.34
R05CA03	Teracough (Glaxosmithkline)	62.2	9,762	1.51	2.61
R05CA10	Quilla Simplex (Aco Hud Nordic)	53.1	7,934	1.16	2.02
R05CB02	Bisolvon (Boehringer)	54.2	32,793	4.76	8.32
	Bisolvon Citron (Boehringer)	47.0	2,905	0.41	0.71
	Bromhex (Mcneil Sweden)	55.5	8,486	1.22	2.08
R05DA07	Nipaxon (Mcneil Sweden)	91.6	24,618	3.48	6.29
Natural					
vN06ÖÖÖÖ	Arctic Root (Bringwell Sweden)	164.0	4,059	0.63	17.27
	Chisan (Bringwell Sweden)	135.7	2,028	0.30	8.05
	Gericomplex (Boehringer)	174.8	474	0.06	1.50
vR01AÖÖÖ	Olemin Inhalator (Atoma)	46.3	1,931	0.28	7.66
vR05ÖÖÖÖ	Echinagard (Meda)	46.3	7,472	0.96	27.09
	Echinaforce (Svenska Bioforce)	46.3	1,597	0.19	5.01
	Kan Jang (Bringwell Sweden)	46.3	6,925	0.92	25.71
vR02AA15	Nyodex (Mundipharma)	56.0	2089	0.28	7.71

Source: Authors' rendering of data from the Swedish eHealth Agency, 2017
$\overline{P}$ *and* $\overline{Q}$ *indicate the average price (in SEK) and quantity (rounded to integers) respectively.*
s denotes the market share among all products, and s_g *the share within the group, both in percentages.*
The timeperiod includes all years.

Table 9.2: *Reduced-form regressions, weighted average price level and complete specification*

	Hedonic	(1)	(2)	(3)	(4)	(5)
Income	0.00247***	0.00271***	0.00275***	0.00287***	0.00272***	0.00250***
	(226.8)	(199.77)	(184.52)	(213.76)	(200.42)	(179.07)
Population	-1.22e-07***	-1.43e-07***	-1.70e-07***	-1.74e-07***	-1.67e-07***	-1.4-07***
	(-48.38)	(-47.73)	(-62.32)	(-65.67)	(-61.60)	(-52.93)
Pensioners	7.9e-07***	9.53e-07***	1.11e-06***	1.11e-06***	1.10e-06***	-9.98e-07***
	(43.18)	(45.38)	(55.91)	(58.77)	(57.01)	(55.25)
DD	-1.21e-08***	-1.19e-08***	-1.51e-08***	-1.15e-08***	-1.43e-08***	-1.31e-08***
	(-21.24)	(-20.10)	(-28.05)	(-23.11)	(-27.62)	(-31.03)
Pharmacies		-0.00153***				
established		(-25.22)				
Entry			0.00274***			
national pricing			(-6.22)			
Entry			-0.00525***			
free pricing			(-12.38)			
Proportion				0.0125***		
Hjärtat				(3.80)		
Proportion				0.173***		
Apoteksgr.				(41.60)		
Proportion				0.167***		
Kronan				(40.14)		
Proportion				0.0779***		
Lloyds				(14.51)		
Proportion				-0.103***		
Non-affil.				(-10.56)		
Share of					9.39e-06***	
Stores					(25.4)	
Number of						-0.0111***
firms						(-75.59)
Cons.	3.723***	3.666***	3.655***	3.556***	3.639***	3.775***
	(1442.25)	(1115.03)	(1038.73)	(994.74)	(1138.6)	(1014.08)
adj. R^2	0.54	0.546	0.542	0.616	0.545	0.565
N	147	147	147	147	147	147

*t-statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Controlling for year.*

Table 9.3: *Reduced-form regressions, entire balanced dataset and complete specification*

	Hedonic	(1)	(2)	(3)	(4)	(5)
Income	0.00265***	0.00273***	0.00269***	0.00278***	0.00200***	0.00252***
	(15.86)	(13.32)	(12.55)	(13.56)	(11.23)	(12.16)
Patch	0.257***	0.249***	0.249***	0.249***	0.249***	0.249***
	(10.21)	(9.24)	(9.24)	(9.24)	(9.24)	(9.24)
Nail polish	1.428***	1.390***	1.390***	1.390***	1.390***	1.390***
	(112.22)	(110.57)	(110.44)	(110.2)	(114.19)	(109.27)
Oral spray	1.176***	1.146***	1.146***	1.146***	1.146***	1.146***

	(95.51)	(90.36)	(90.57)	(90.19)	(95.29)	(90.06)
Oral fluid/	-0.206***	-0.222***	-0.222***	-0.222***	-0.222***	-0.222***
chewable tablet	(-14.63)	(-14.52)	(-14.52)	(-14.52)	(-14.52)	(-14.52)
Pill or	-0.500***	-0.500***	-0.500***	-0.500***	-0.500***	-0.500***
suppository	(-21.36)	(-19.67)	(-19.67)	(-19.66)	(-19.68)	(-19.69)
Pill or oral fluid	-0.000108	0.000417	0.000417	0.000417	0.000417	0.000417
	(-0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Cream or	0.609***	0.618***	0.618***	0.618***	0.618***	0.618***
oral fluid	(58.69)	(55.06)	(55.2)	(55.19)	(53.84)	(55.49)
(Effervescent)	-0.957***	-0.956***	-0.956***	-0.956***	-0.956***	-0.956***
pill	(-112.20)	(-103.46)	(-103.26)	(-103.62)	(-101.38)	(-103.25)
Rectal	-0.284***	-0.289***	-0.289***	-0.289***	-0.289***	-0.289***
	(-19.89)	(-18.66)	(-18.66)	(-18.66)	(-18.61)	(-18.67)
Vaginal	0.413***	0.402***	0.402***	0.402***	0.402***	0.402***
	(24.68)	(22.56)	(22.56)	(22.55)	(22.56)	(22.56)
Pill or	0.109***	0.109***	0.109***	0.109***	0.109***	0.109***
oral drops	(4.03)	(3.73)	(3.73)	(3.73)	(3.73)	(3.73)
Eye drops	-0.0869***	-0.0947***	-0.0947***	-0.0947***	-0.0947***	-0.0947***
or cream	(-7.72)	(-7.82)	(-7.82)	(-7.82)	(-7.81)	(-7.82)
Nasal	-0.139***	-0.150***	-0.150***	-0.150***	-0.150***	-0.150***
	(-10.21)	(-10.26)	(-10.26)	(-10.26)	(-10.26)	(-10.26)
Oral powder	0.351***	0.345***	0.345***	0.345***	0.345***	0.345***
	(24.43)	(22.05)	(22.05)	(22.06)	(21.98)	(22.06)
External fluid	-0.118***	-0.122***	-0.122***	-0.122***	-0.122***	-0.122***
	(-6.61)	(-6.34)	(-6.34)	(-6.34)	(-6.34)	(-6.34)
Cream	-0.108***	-0.112***	-0.112***	-0.112***	-0.112***	-0.112***
	(-13.23)	(-12.69)	(-12.70)	(-12.70)	(-12.67)	(-12.70)
Eye gel	-0.247***	-0.245***	-0.245***	-0.245***	-0.245***	-0.245***
	(-17.67)	(-15.93)	(-15.95)	(-15.96)	(-15.77)	(-15.98)
Chewing gum	0.640***	0.658***	0.658***	0.658***	0.658***	0.658***
	(42.77)	(40.41)	(40.41)	(40.42)	(40.36)	(40.44)
Shampoo	-0.102***	-0.0996***	-0.0996***	-0.0996***	-0.0996***	-0.0996***
	(-11.01)	(-9.74)	(-9.73)	(-9.75)	(-9.66)	(-9.75)
Oral drops	-0.414***	-0.421***	-0.421***	-0.421***	-0.421***	-0.421***
	(-35.51)	(-33.04)	(-33.07)	(-33.07)	(-32.85)	(-33.12)
Effervescent	-0.0975***	-0.0995***	-0.0995***	-0.0995***	-0.0995***	-0.0995***
tablet	(-8.33)	(-7.88)	(-7.88)	(-7.89)	(-7.87)	(-7.89)
Oral	-0.0427***	-0.0472***	-0.0472***	-0.0472***	-0.0472***	-0.0472***
suspension	(-4.59)	(-4.70)	(-4.70)	(-4.70)	(-4.69)	(-4.70)

Lozenge pill	-0.147***	-0.156***	-0.156***	-0.156***	-0.156***	-0.156***
	(-15.88)	(-15.75)	(-15.75)	(-15.75)	(-15.74)	(-15.76)
Chewable pill	0.0399**	0.0340*	0.0340*	0.0340*	0.0340*	0.0340*
	(2.65)	(2.12)	(2.12)	(2.12)	(2.11)	(2.12)
Mouth wash	-0.335***	-0.335***	-0.335***	-0.335***	-0.335***	-0.335***
	(-39.07)	(-36.55)	(-36.57)	(-36.57)	(-36.33)	(-36.60)
Uncategorised	0.0652***	0.0568***	0.0568***	0.0568***	0.0568***	0.0568***
	(5.38)	(4.34)	(4.34)	(4.34)	(4.33)	(4.34)
Retail	0.0590***	0.0559***	0.0559***	0.0559***	0.0559***	0.0559***
	(7.92)	(6.96)	(6.96)	(6.96)	(6.95)	(6.96)
Monopoly	0.0557***	0.0607***	0.0607***	0.0607***	0.0607***	0.0607***
within ATC	(6.12)	(6.21)	(6.21)	(6.21)	(6.2)	(6.21)
Medium manuf.	-0.318***	-0.315***	-0.315***	-0.315***	-0.315***	-0.315***
	(-43.65)	(-39.93)	(-39.93)	(-39.93)	(-39.90)	(-39.93)
Small manuf.	-0.203***	-0.199***	-0.199***	-0.199***	-0.199***	-0.199***
	(-30.39)	(-27.66)	(-27.66)	(-27.66)	(-27.63)	(-27.67)
Natural	0.0566***	0.0562***	0.0562***	0.0562***	0.0562***	0.0562***
	(4.85)	(4.47)	(4.47)	(4.47)	(4.46)	(4.47)
Population	-3.e-07***	-3.13e-07***	-3.15e-07***	-3.17e-07***		-2.96e-07***
	(-8.14)	(-6.79)	(-7.51)	(-7.13)		(-7.07)
Pensioners	1.95e-06***	2.04e-06***	2.07e-06***	2.07e-06***		2.00e-06***
	(7.48)	(6.56)	(7.02)	(6.72)		(6.89)
DD	-9.45e-09	-1.03e-08	-1.23e-08	-9.12e-09		-1.01e-08
	(-1.40)	(-1.46)	(-1.78)	(-1.31)		(-1.47)
Pharmacies		-0.000645				
established		(-0.63)				
Entry			0.00688			
national pricing			(1.14)			
Entry			-0.0109			
free pricing			(-1.68)			
Proportion				0.0414		
Apotek Hjärtat				(0.84)		
Proportion				0.117*		
Apoteksgruppen				(2.06)		
Proportion				0.0879		
Kronans Apotek				(1.83)		
Proportion				-0.0467		
Lloyds Apotek				(-0.55)		
Proportion				-0.152		

Non-affiliated				(-0.82)		
Share of Stores					0.0000252***	
					(4.3)	
Number of						-0.00976***
Firms						(-4.27)
Const.	3.902***	3.887***	3.894***	3.828***	4.007***	3.991***
	(99.3)	(79.41)	(77.51)	(72.19)	(88.12)	(73.74)
adj. R^2	0.232	0.232	0.232	0.232	0.231	0.233
N	40,572	34,776	34,776	34,776	34,776	34,776

*t-statistics in parentheses. * p < 0.05, ** p < 0.01, *** p < 0.001*

Table 9.4: *First stage regression*

				Number no obs	=		4,410
				F(12,4397)	=		45451.04
				Prob > F	=		0.0000
				R-squared	=		0.9912
				Adj R-squared	=		0.9912
				Root MSE	=		3.6181

Infl. price	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
ln_mshare_s	-.0122137	.0443571	-0.28	0.783	-.0991758	.0747485
Monopoly in ATC	-.0181073	.1506203	-0.12	0.904	-.313399	.2771843
Oral	.0263591	.1668225	0.16	0.874	-.3006971	.3534154
Medium manuf.	.0162895	.0794208	0.21	0.838	-.1394152	.1719942
Small manuf.	.0146504	.149373	0.10	0.922	-.2781959	.3074967
Year						
2011	-.0008866	.1571094	-0.01	0.995	-.3089002	.3071269
2012	-.000476	.1654518	-0.00	0.998	-.3248448	.3238929
2013	.000401	.2359446	0.00	0.999	-.4621693	.4629713
2014	.0011279	.1971355	0.01	0.995	-.3853569	.3876127
2015	-.0002256	.2028426	-0.00	0.999	-.3978993	.3974481
2016	-.0001397	.1925857	-0.00	0.999	-.3777046	.3774252
Infl. price mean	.9993077	.004585	217.95	0.000	.9903187	1.008297
Cons.	-.0143157	.3727044	-0.04	0.969	-.745004	.7163726