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Comparing Pharmaceutical Prices in Europe

A Comparison of Prescription Drug Prices in Norway with Nine Western European Countries

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Comparison of Pharmaceutical Prices in Europe

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Foreword

The Institute for Research in Economics and Business Administration (SNF) has conducted the project ”Comparison of pharmaceutical prices in Europe” on behalf of the Norwegian Pharmacy Association (Apotekforeningen). The purpose of the project has been two-fold. First, the project should find a sound method of comparing prices of pharmaceuticals across countries. Second, the project should analyse whether the price level of prescription drugs in Norway is higher (or lower) than in comparable European countries. The project has been carried out by using data from IMS Health on prices and sales volumes of all prescription bound sales within the 300 most selling substances for first six months of 2010 in ten European countries.

The current report is a follow-up of three previous projects. The first report (SNF report 05/08) was conducted for the Ministry of Health, while the two following reports (SNF report 06/09 and 08/10) were conducted for the Norwegian Pharmacy Association who is also funding this report. The continuation of this project has enabled us to further develop our analysis and understanding of pharmaceutical pricing across countries. This report differs from the previous reports along three dimensions. First, we describe the prices and sales volumes, as well as the computation of the price indices for the products under reference pricing (trinnpris) in Norway in much greater detail. Second, we have computed additional price indices where we restrict the comparisons to substances that face the same competitive environment (generic competition or not) in Norway and the reference countries. Third, we have constructed separate price indices for the brand-name and generic products. These additions to the previous analysis imply a sacrifice of the analysis of the development of prices and the price indices over time.

The project has been undertaken by Professor Kurt R. Brekke (project leader) at the Norwegian School of Economics (Norges Handelshøyskole), Senior Researcher Tor Helge Holmås at the Uni Rokkan Centre (Uni Rokkansenteret), and Associate Professor Odd Rune Straume at the University of Minho in Portugal. The authors are affiliated to the Institute of Research of Economics and Business Administration (SNF) and the Centre for Health Economics in Bergen (HEB).

We wish to express our gratitude to Director Oddbjørn Tysnes and Senior Advisor Jon Andersen at the Norwegian Pharmacy Association for useful suggestions and comments, although this does not in any way make them responsible for the report’s content and conclusions.

Bergen, October 2011

Kurt R. Brekke

Summary

In this report we compare prices of pharmaceuticals between Norway and the following nine Western European countries: Austria, Belgium, Denmark, Finland, Germany, Ireland, the Netherlands, Sweden and United Kingdom. The purpose is to analyse whether pharmaceuticals are more (or less) expensive in Norway than in the reference countries, and thus identify any potential cost savings related to importing foreign price levels.

We use product-level sales data from IMS Health. The data contain information about monthly prices and sales volumes at wholesale and pharmacy level for all prescription bound sales of about 300 (top selling) substances in each country for the six first months of 2010. The data also contain information about manufacturer, substance name, product name, product type (brand-name or generic), pack size, strength, presentation form, etc.

We compare prices at pack level and substance (dose) level. Comparing pack prices yields a high degree of precision in the comparisons, but results in non-representative samples of products, generating biased and potentially incorrect results. Thus, we emphasis the results based on comparisons of volume-weighted average (dose) substance prices. Using the Norwegian consumption of pharmaceuticals as the benchmark (weights), we compute a large set of price indices.

Our results show that only UK has lower prices than Norway on the overall price indices comprising all prescription drugs sales within the top 300 substances. We get the same result when restricting the comparison to prices of pharmaceuticals that are patent protected and do not face generic competition. These results are likely to be explained by the strict price cap regulation in place in Norway.

If we look at off-patent market segment, where brand-name products face competition from generic products, then UK and Sweden tend to have lower prices than Norway. Restricting the price comparisons to the products subject to reference price (trinnpris) regulation in Norway, the results vary according to how we construct the price indices. If we compare all substances under reference pricing, Norway has the lowest prices. However, if we restrict the comparison to substances with generic competition, then UK, Sweden and Denmark tend to have lower prices than Norway. Finally, we compute separate price indices for brand-names and generics, showing that Norway has the lowest brand-name prices, but has fairly high generic prices.

Thus, the potential for cost-savings on pharmaceuticals in Norway is limited to the import of generic drug prices from countries like UK, Sweden and Denmark. The challenge is however how to extract the potential for cost-savings. This is would crucially depend on the chosen regulatory scheme and the market dynamics.

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1. Introduction

1.1. Objective

In this study we compare prices of pharmaceuticals in Norway and nine Western European countries, i.e., Austria, Belgium, Denmark, Finland, Germany, Ireland, the Netherlands, Sweden and United Kingdom. These countries constitute the basket of countries that form the basis for setting maximum prices for prescription drugs in Norway, and can therefore be considered to be relatively comparable countries. The objective of the study is to see whether prescription drugs are less or more expensive in Norway than in other Western European countries.

1.2. Data and analyses

To compare prices across the ten European countries, we have obtained sales data from IMS Health for the 300 top-selling (prescription bound) active substances in Norway. The data contain monthly information about prices and sales volumes for all prescription bound products (within the 300 substances) in the ten European countries for the first half of 2010. The data set also contains detailed product-level information on substance name, manufacturer, product name, product type (original/generic), pack size, presentation form, strength, etc. We have prices per pack and per (standard) dose for each product sold. Prices are at both wholesale (AIP) and retail (AUP) level.

When comparing prices across countries, we construct price indices in which the various products are assigned weights to reflect a representative pattern of consumption in the benchmark country. In this study, we use Norwegian consumption weights, where products or active substances with high sales levels (measured in volume terms) in Norway are assigned a higher weight than products or active substances with low sales levels. In this way, it can be ascertained what the Norwegian consumption pattern ("shopping basket") would cost in the various reference countries, which gives us a measure of potential cost savings.

The calculation of price indices entails a trade-off between precision and representativity. For pharmaceuticals this appraisal is particularly important because many types of pharmaceuticals are involved (for various conditions), and the same pharmaceuticals come in many variants (original/generic, pack size, strength, presentation, etc.). Precision is maximised by comparing the prices of the same packs between countries. However, the problem is that a representative sample is rarely obtained. The most selling packs in Norway are not necessarily the most selling packs in the reference countries. Comparisons based on matching packs reduce the sample of products severely due to large differences across countries in pack sizes, strengths, doses, presentation forms, etc. Thus, price differences based on matching packs are likely to be biased due to sample selection problems and lack of representativity.

Another approach is to base the price comparisons on (volume-weighted) average dose prices at substance level. For each pack we have information on the number of doses and the price per dose. Using this information, we compute the volume-weighted average dose price at substance level for each country. This approach uses all price information and constructs the "representative" price at substance level for each country. We then compare the average substance prices across countries and compute various price indices using Norwegian consumption weights.

Many price indices are calculated in this report. First, we calculate bilateral price indices, in which we match products or substances that are common to Norway and a given reference country (say Sweden). We then calculate global price indices in which we only compare prices of products or substances available in all countries in the sample. The price indices are calculated for all active substances, but we also report several sub-indices for the on-patent market segment, the off-patent market segment, the market segment covered by reference pricing (trinnpris) regulation in Norway, as well as separate price indices for brand-name and generic products.

Finally, we compare prices using a fixed-effect regression analysis approach. This approach allows us to measure cross-country price differences controlling for differences in pack size, proportion of tablet, generic competition, etc. The price differences are not weighted by the Norwegian consumption, but measures simply the average price difference across countries.

1.3. Results

The main result is that Norway is among the cheapest countries in Western Europe. If we look at the price indices computed for all products in our sample, only UK is cheaper than Norway. This result is consistent across price indices based on matching packs or average substance prices. In the other end of the scale we usually find Ireland, Germany and Belgium.

If we look at the on-patent market segment, the picture is fairly similar. Price indices of products with no generic competition show that UK is cheaper than Norway, whereas the rest of the countries are more expensive. This result is perhaps not very surprising due to the strict price cap regulation that is in place in Norway.

In the off-patent market segment, where brand-names face competition from generic products, UK and Sweden tend to have lower prices than Norway, whereas Denmark has about the same price level. There is some variation across price indices based on pack prices and on substance (dose) prices.

Looking at the products subject to reference pricing (trinnpris) in Norway, the results vary depending on the sample of products that are used to compute the price indices. If we use all substances, we find that Norway is the cheapest country closely followed by UK and Finland. If we assume that products have generic competition in Norway and the reference country, we find that UK, Sweden and Denmark are cheaper than Norway. However, there is significant variation across countries with respect to which substances that face generic competition. Generic entry is affected by regulatory aspects (patent regulation, price controls, reimbursement policies, etc.) and market conditions (market size, income, population health, etc). Which price indices that offers the "right" picture depends on the question that is posed.

Restricting the price comparisons to generic products only, show less favourable results for Norway, which now has among the mid or highest prices. Sweden, UK, Denmark and Finland tend to have low prices on generic drugs. Thus, there seems to be some potential for cost-savings related to “importing” foreign prices of generic drugs to Norway. However, Norway has the lowest brand-name prices, which is the main reason for the overall low price level.

Finally, we use regression analyses to study price differences across the ten European countries in our sample. These analyses confirm our findings from the price index analyses, though the differences in price levels are smaller. We also use regression analysis to study differences in percentage (not absolute) pharmacy margins. These analyses show that Norway has among the lowest (percentage) pharmacy margins.

1.4. Structure of the report

The report is organised as follows. In Chapter 2 we describe the pharmaceutical market and various regulatory regimes adopted in this market. We also classify the 10 countries included in this study with reference to the various types of regulatory regimes. In Chapter 3 we provide an overview of the data and present some descriptive statistics of key variables. In Chapter 4 we describe how we calculate the price indices and report results from the price comparisons based on all products in our sample, as well as the products in the on-patent and off-patent market segment. In Chapter 5 we analyse the substances and products that are subject to reference pricing (trinnpris) in Norway, and compute separate price indices for this group of drugs depending on whether or not they have generic competition. In Chapter 6 we compute the price indices for the brand-name and generic drugs separately. In Chapter 7 we conduct regression analyses to test whether the differences in prices are statistically significant. We also test for differences in pharmacy margins across countries. Finally, Chapter 8 concludes the report with a brief summary and some concluding remarks.

Chapter 2. Regulations in the prescription drug market

The market for prescription drugs is generally characterised by low price elasticity of demand and considerable market power on the supply side.[1] From a policy perspective, this is a worrying combination, since an unregulated market is expected to yield high prices and a correspondingly high level of expenditures for drug consumption. Indeed, most countries are using several regulatory instruments in order to control prices and total consumption of prescription drugs.[2] In this chapter we will give a brief overview of some of the most important regulatory instruments used and briefly discuss how different regulatory choices are expected to affect prices and demand for pharmaceuticals. We will then categorise the ten different countries under study with respect to the regulatory instruments used.

2.1. An overview and discussion of different regulatory instruments

We can make a fundamental distinction between supply-side and demand-side regulation. Supply-side regulation attempts to control drug prices directly and can apply to different levels of the vertical supply chain: manufacturers, wholesalers and retailers (pharmacies). On the other hand, demand-side regulation attempts to control prices indirectly through the design of the reimbursement system. In other words, we can distinguish between regulation of the price that the suppliers of drugs receive (supply-side regulation) and regulation of the price that consumers actually pay (demand-side regulation). The latter type of regulation consists mainly of different forms of *reference pricing*, where regulators attempt to increase the degree of competition in the market through the design of the reimbursement system.

Reference Pricing

Reference pricing implies that drugs are classified into different reference groups based on therapeutic effect. For each reference group, the regulator chooses a reference price, which is the maximum reimbursable price for all drugs in the reference group. Any positive difference between the actual drug price and the reference price is not reimbursable.

The effect of reference pricing is to increase the price elasticity of demand for prices above the reference price, which will stimulate price competition and yield lower prices. The lower the reference price is set, the stronger is the effect on price competition.[3]

<u>Generic reference pricing</u>

Under generic reference pricing (GRP) the reference groups are constructed so that each group only contains drugs with identical active chemical ingredients. This

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[1] See Scherer (2000) for an overview of specific features of the pharmaceutical market. Brekke (2009) offers also a similar overview with a focus on the Norwegian market.

[2] Danzon (1997) offers an overview of pharmaceutical price regulations with examples from various countries.

[3] See Brekke, Königbauer and Straume (2007) for a description of various forms of reference pricing and an analysis of the potential effects of these.

implies that GRP by definition only applies for the off-patent market. Thus, GRP is a regulatory instrument that is primarily intended to stimulate generic competition, with the expected price effects occurring in the off-patent market.

Therapeutic reference pricing

Under therapeutic reference pricing (TRP) the reference groups are constructed according to therapeutic (but not necessarily chemical) equivalence. This implies that drugs currently under patent protection can be included, provided the existence of sufficiently close therapeutic substitutes. Thus, TRP implies that (part of) the on-patent market is more directly exposed to stronger competition. It is therefore reasonable to assume that TRP also will stimulate generic competition, leading to lower prices, to an even stronger degree than GRP.

Other instruments to stimulate competition

In addition to specific reference pricing schemes, the demand side can also be regulated through the more general design of the reimbursement system. An important factor here is whether the patient co-payment is set as a fixed fee or as a percentage of the drug price (or a combination of both). By designing the reimbursement scheme such that the consumer pays a share of the actual drug price, the price elasticity of demand is increased. However, the pro-competitive effect of a percentage co-payment scheme is often counteracted by the fact that many countries (including Norway) impose a cap on total drug expenditures (per year and sometimes per script) for consumers.

The absence of both reference pricing and percentage co-payment should in principle lead to a very low price elasticity of drug demand, with a correspondingly low degree of price competition. Among the countries under study, this situation applies to three countries: Austria, Ireland and UK.

Another instrument for stimulating price competition is to allow for generic substitution by pharmacies. This means that, if a brand-name drug is prescribed, the pharmacy can, if possible, dispense a cheaper copy drug instead. This could potentially be a powerful regulatory instrument if generic substitution is either compulsory or stimulated through financial incentives for the dispensing pharmacies.

Price cap regulation

Reference pricing (GRP or TRP) does not solve the problem of cost control for the group of on-patent drugs where no close therapeutic substitutes exist. Therefore, reference pricing is usually combined with supply-side regulation. The most common way to regulate the supply side of the drug market is through price cap regulation, which defines a maximum price for each drug.

Many countries have introduced a price cap regulation scheme commonly referred to as *international reference pricing*. This regulatory scheme implies that the price cap for a new drug is determined as a weighted average of prices for the same (or an equivalent) drug in a pre-defined group of countries. This group usually consists of countries with comparable price and income levels.

The most obvious effect of international reference pricing is that is contributes to an international harmonization of drug prices. The more countries that apply this instrument the stronger the effect.

International reference pricing is now the most common type of price cap regulation for prescription drugs and is applied in a majority of the ten countries under study.[4] The exceptions are Denmark, Germany and UK.

Mark-up regulation

In addition to price-cap regulation at the level of manufacturers or wholesalers, most countries also regulate the mark-ups of pharmacies (and, in fewer cases, wholesalers) in order to control the drug prices that consumers face.

One interesting issue with respect to mark-up regulation is that different mark-up schemes could affect the final consumer prices through the pharmacies' dispensing incentives. More specifically, if pharmacy mark-ups are set as a percentage add-on to wholesale prices, pharmacies would have a financial incentive to increase their (absolute) mark-ups by dispensing more expensive drugs. This incentive could be eliminated by setting the mark-up as a flat fee. Even if the mark-up is set as a percentage, the incentive for pharmacies to dispense more expensive drugs could be counteracted by choosing a regressive mark-up scheme, where the percentage mark-up is lower for more expensive drugs. As we will see below, all these alternatives are currently in use by one or more of the ten countries under study.

2.2 A regulatory classification of the ten countries

Here we classify the ten countries according to the different instruments used in demand-side regulation (Table 2.1) and supply-side regulation (Table 2.2). Notice that this distinction is not always clear-cut. For example, although we have categorized generic substitution as demand-side regulation, this could arguably also be classified as a supply-side instrument. The information is mainly extracted from the PPRI Project ("Pharmaceutical Pricing and Reimbursement Information").[5]

When making this classification, it is important to bear in mind that many real-world regulatory schemes combine elements from the more stylized regulatory models presented above. This means that the assignment of different countries to different regulatory schemes is not always clear-cut. In Table 2.1, ambiguous classifications are marked with an asterisk and apply to Belgium, Ireland, Norway and Sweden.

[4] In some cases, international reference pricing is combined with other criterias, such as therapeutic benefit, when setting the price cap.
[5] Available at http://ppri.oebig.at

Let us briefly comment on the ambiguous classifications. First, the reference pricing system used in Belgium can be described as an unusually far-reaching form of GRP. The reason is that the scheme was extended in 2007 to include, in principle, off-patent brand-name drugs without generic competitors in the market. Regarding Ireland, the generic substitution scheme is unusually weak, in the sense that generic substitution is merely allowed, but not encouraged through direct instructions or financial incentives. We have also classified Norway as a country with generic reference pricing, although this is not the official name given to the current scheme. However, the system nevertheless has the fundamental ingredients of a reference pricing system (with an exogenously determined reference price). The same argument applies to Sweden, which does not officially use generic reference pricing. However, since it is compulsory for pharmacies to perform generic substitution, unless the patient chooses to pay the price difference between the brand-name drug and the cheapest available generic drug, the system is a *de facto* generic reference pricing scheme. Finally, it is also worth mentioning that even if Germany uses percentage co-payments, this applies only to certain price intervals.

Table 2.1 Demand-side regulation

Country	Generic reference pricing	Therapeutic reference pricing	Generic substitution	Percentage co-payment
Austria	No	No	No	No
Belgium	Yes*	No	No	Yes
Denmark	Yes	No	Yes	Yes
Finland	Yes	No	Yes	Yes
Germany	No	Yes	Yes	Yes
Ireland	No	No	Yes*	No
Netherlands	No	Yes	Yes	No
Norway	Yes*	No	Yes	Yes
Sweden	Yes*	No	Yes	Yes
UK	No	No	No	No

Regarding recently implemented reforms in these countries, it is worth noticing that Finland introduced generic reference pricing from 1 April 2009. It is reasonable to expect that this should lead to lower prices, particularly in the off-patent segment.

As previously mentioned, Austria, Ireland and UK are the “outliers” in this group in the sense that hardly any regulatory instruments are used to stimulate generic competition. These countries do not have generic reference pricing, percentage co-payments or regulatory schemes that provide incentives for generic substitution. On the other hand, Germany and the Netherlands are the only countries that apply therapeutic reference pricing, which stimulates competition not only in the off-patent market, but also among on-patent drugs.

Table 2.2 Supply side regulation

Country	International Reference pricing	Mark-up regulation	
		Wholesalers	Pharmacies
Austria	Yes	Regressive (%)	Regressive (%)
Belgium	Yes	Linear (%)	Linear (%)
Denmark	No	No direct regulation	Linear (% + flat fee)
Finland	Yes	No direct regulation	Regressive (% + flat fee)
Germany	No	Regressive (% + fixed fee)	Linear (% + flat fee)
Ireland	Yes	Linear (%)	Linear (%)
Netherlands	Yes	No direct regulation	Fixed fee mark-up
Norway	Yes	No direct regulation	Linear (% + flat fee)
Sweden	No	No direct regulation	Regressive (% + flat fee)
UK	No	No direct regulation	No direct regulation

Regarding the use of supply side regulation, we see that the combined choice of instruments varies quite a lot among the different countries under consideration. The most consistent pattern is that in all but one country, mark-up regulation at pharmacy level is applied (the only exception is UK, where pharmacy remuneration is based on fee-for-services). Several countries also use regressive mark-up schemes (or just a flat fee in the case of the Netherlands) in order to counteract pharmacy incentives to dispense more expensive drugs.

Chapter 3. Data and sample

Data for the price comparisons have been provided by Intercontinental Medical Systems (IMS).[6] We have obtained data for Norway and the following nine reference countries: Austria, Belgium, Denmark, Finland, Germany, Ireland, the Netherlands, Sweden and the United Kingdom. These countries are included in Norway's basket for setting maximum prices for prescription pharmaceuticals. In this part of the report we provide an overview of the data and the sample of active substances, with particular emphasis on how the prices are calculated.

3.1. Sample

The data contain monthly information about prices and volumes for all prescription bound products sold in the 300 top-selling[7] (measured in terms of sale value) active substances in Norway over the period 1 January to 30 June 2010.[8] The sample comprises exclusively pharmaceuticals sold via pharmacies. Pharmaceuticals purchased and sold in hospitals are not included. The data also contain detailed information on a number of other aspects such as active substance name, therapeutic classification, product name, producer, original or generics, patent status, pack formulation (capsule, tablet, strength, etc.), and pack size.

Information on patent status was missing for 21 active substances. These are mainly older pharmaceuticals (vaccines and a few combination pharmaceuticals). Since we do not know whether these products are patent protected or not, we exclude these from our sample, which leaves us with 282 active substances for Norway.

Table 3.1 Number of active substances in Norway and the reference countries, 2010

	All substances	Substances without patent status	Substances on reference pricing (trinnpris)	Substances in the sample
Norway	303	21	52	282
Sweden	293	18	51	275
Denmark	290	18	52	272
Finland	284	20	52	264
UK	274	13	51	261
Germany	283	20	49	263
Netherlands	286	18	49	268
Belgium	265	14	51	251
Austria	280	19	52	261
Ireland	275	15	51	260
Global active substances	210	-	47	210

[6] IMS Health is a company that is specialised in collecting data on pharmaceutical sales throughout the world. They also provide market reviews and consulting services.
[7] Three substances on reference pricing (trinnpris) are not among the 300 top-selling drugs in Norway. The total number of active substances included in our sample are therefore 303.
[8] These were the 300 top-selling products over the period September 2009 to September 2010. The turnover figures are based on prescription pharmaceuticals sold via pharmacies.

Table 3.1 shows how many of the top-selling Norwegian active substances are sold in the other countries. As expected, not all of the 282 active substances on the Norwegian market are sold in the comparison countries. In Sweden very few of the substances (10 substances) are missing. The lowest number of matching substances we find in Belgium, where we find 265 substances of the 303 substances on the Norwegian market. Notably, the number of global substances, i.e., substances that are present in all of the ten countries, is 210, which is a fairly high number.

If we limit the sample to active substances with patent status, the number of active substances varies from 282 in Norway to 251 in Belgium. The number of global substances remains unchanged. Finally, we see from table 3.1 that the number of substances that are subject to reference pricing (trinnpris) in Norway is 52. For this subsample of products, we find most of the substances present in our reference countries.

Table 3.2 below shows the number of packs that are in our sample for the ten countries. We see that the number of packs sold on national markets vary a lot. Germany has by far the largest number of packs (4493), whereas Ireland has the lowest number (1419). Norway is in the lower end with 1730 packs. The same picture applies whether we look at the on-patent market segment (without generic competition) or the off-patent market segment (with generic competition).

The table also reports the number of brand-name and generic packs on the market. In Norway we see that the total number of brand-name packs is 1130 whereas the number of generic packs is 600. In all countries there is an overweight of brand-name packs. However, if we limit the sample to substances with generic competition, then we see that the number of generic packs on the market exceeds the number of brand-name packs, which is what we would expect.

The large variation in the number of packs suggests that a price comparison based prices of identical packs raises a concern in terms of representativity. How many of the 1730 packs on the Norwegian market are also present in the reference countries? Since Norway has relatively few packs on the market, price comparisons based on identical packs would imply that we exclude a large number of packs in the reference countries. The also generates a concern of how representative the matching packs are for the price level in the reference countries. We will return to these issues in the next chapters.

Table 3.2: Number of packs, brand-names and generics, 2010.

	Norway	Sweden	Denmark	Finland	UK	Germany	Netherlands	Belgium	Austria	Ireland
Number of packs , all substances										
Brand names	1130	1443	1152	1013	1261	1746	1235	896	1026	905
Generics	600	1020	921	839	806	2747	1147	815	915	514
Total	1730	2463	2073	1852	2067	4493	2382	1711	1941	1419
Number of packs, substances with generic competition										
Brand names	461	652	473	463	711	802	607	386	448	386
Generics	600	1020	921	839	806	2747	1147	815	915	514
Total	1061	1672	1394	1303	1517	3549	1754	1201	1363	900
Number of packs, substances without generic competition										
Brand names	669	791	679	549	550	944	628	510	578	519
Number of packs, substances subject to reference pricing										
Brand names	233	230	170	197	280	231	186	137	153	160
Generics	244	445	400	378	168	1015	405	425	393	198
Total	477	675	570	575	448	1246	591	562	546	358

3.2. Price data

In the pharmaceutical market, prices arise at three different levels: producer (ex-manufacturer) level, wholesale level, and pharmacy (retail) level. We follow the established terminology and refer to producer prices as the wholesale purchase price (GIP), wholesale prices as the pharmacy purchase price (AIP) and pharmacy prices as the pharmacy sale price (AUP).[9] In the study we primarily focus on AUP since this is the price that the public authorities (insurers) and patients face. However, we also compute price indices at wholesale level (AIP). The difference between AUP and AIP is the gross margin obtained by the pharmacies. We also take a closer look at this in the Chapter 7 in our report.

Table 3.3. IMS price data: Observed price, source, calculation of AUP and AIP.

Country	Observed price	Source	Calculation of AUP and AIP
Austria	GIP	Official list prices from producers	AIP and AUP are calculated by applying regulated mark-ups for wholesalers and pharmacies.
Belgium	AUP	Association Pharmaceutique Belge	6 % VAT is deducted from AUP. AIP is calculated by using reimbursement prices and regulated pharmacy mark-ups.
Denmark	AIP	Wholesaler invoices	AUP is calculated by applying regulated pharmacy mark-ups.
Finland	AIP	Finnish pharmaceutical association	AUP is calculated by applying regulated pharmacy mark-ups and specific charges.
Germany	GIP	German Health Institute (Lauer-taxe database)	AIP and AUP are deducted by applying regulated mark-ups. Repayments (claw back) to the sickness insurance funds are then deducted.
Ireland	AIP	Official list prices from wholesalers	AUP is calculated by applying regulated pharmacy mark-ups and information on reimbursement prices.
The Netherlands	AIP	Pharmacy invoices	AUP is calculated by deducting estimated AIP discounts and then applying regulated pharmacy mark-ups.
Norway	AIP for all substances and AUP for trinnpris	Wholesale invoices and Farmapro for trinnpris products.	AUP is calculated using regulated mark-ups for all substances, except for substances under trinnpris where data are from the Norwegian Pharmacy Association database (Farmapro).
Sweden	AIP	Apoteket	AUP is calculated by applying regulated pharmacy mark-ups.
United Kingdom	AIP	National Health Service	AUP is calculated by deducting estimated AIP discounts and then applying regulated pharmacy mark-ups (dispensing fees).

[9] The abbriviations refer to the Norwegian terminology for the different price levels, where GIP stands for “Grossistenes innkjøpspris”, AIP stands for “Apotekenes innkjøpspris” and AUP stands for “Apotekenes utsalgspris”.

IMS collects price data in different ways in the individual countries. In principle, it collects information on actual pricing at a point in the distribution chain. It then uses detailed information from each country on discounts, profit regulations and reimbursement prices to calculate the other prices. It also calculates wholesale and pharmacy margins where necessary. Table 3.3 above provides an overview of how the price data from IMS have arisen for each country.

In this report the prices for products subject to reference pricing (trinnpris) in Norway has been obtained from the Norwegian Pharmacy Associations database Farmapro. The reason for this was that the Norwegian Ministry of Health was concerned whether the IMS had computed the prices for this group of drugs properly. IMS observes the transacted wholesale price (AIP) of products in Norway from invoices, but estimates the pharmacy price (AUP) by applying an estimated pharmacy margin on each product. To ensure the validity of the pharmacy prices of the trinnpris products in Norway, the Norwegian Pharmacy Association delivered the transacted prices at pharmacy level to IMS. After comparing the prices, IMS concluded that the prices were systematically biased in the sense that their estimated pharmacy margins of especially the generic drugs were too low. For the current report IMS has therefore supplied us with the transacted pharmacy prices (AUP) for all the products subject to trinnpris regulation in Norway.

The prices in our data are free of value added tax (VAT). Price differences therefore do not reflect differences in VAT between countries. Most countries in the sample have lower value added tax than Norway, apart from Denmark, which also has a VAT rate of 25%. Sweden, for example, has no VAT on prescription drugs, followed by Belgium and the Netherlands with only 6% VAT. From economic theory, we know that high taxes can contribute to producers cutting their prices to avoid losing sales. However, as long as demand for pharmaceuticals is relatively price inelastic, it is likely that payers and potentially patients bear much of the burden associated with high levels of VAT.[10]

The prices are in the individual country's currency. We have converted all prices to the Norwegian currency, so all prices are expressed in Norske kroner (NOK). For each month, we use the average exchange rate for the previous six months: For January 2010, we thus use the average exchange rate for the period from August up to and including December 2009; for February 2010, we use the average exchange rate for the period from September 2009 up to and including January 2010, etc.[11]

The price data come in two variants: *price per pack* and *price per dose*. The price per pack will be used when we compare identical packs across countries. The advantage of this approach is that precision is ensured in the sense that exactly the same product is compared across countries. However, the disadvantages are many, and essentially relate to a lack of representativity. Firstly, picking only the best-selling pack for each substance implies that we throw away information about all other packs for this substance. For Norway this means that we reduce our sample from 1687 to 282 packs.

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[10] In Norway the payer (insurer) is the government, which is also the tax collecter, so the effect of the high VAT on the pharmaceutical expenditures net of the tax income is not necessarily negative.

[11] This is the same procedure that Legemiddelverket, which is the regulatory body for the pharmaceutical sector, uses when computing the maximum prices (price caps) for prescription drugs on the Norwegian market.

Secondly, the top-selling pack in Norway may not be among the top-selling ones in the reference countries. In the worst case, this pack is not sold at all in these countries. Thus, the number of matching packs will be much lower than 282 packs, reducing the representativity of the sample not just in Norway, but even more in the reference country, so that the resulting price differences would be biased and likely incorrect. Finally, selecting the top selling pack in Norway as a measure of comparing prices will imply that generics often drop out. For substances that have come off patent, there are often a number of generic products on the market, which at least individually have a smaller market share than the original product. A selection based on top-selling packs within an active substance could then lead to low representativity of generic products in the segment for non-patent-protected products, and not give a true picture of the price because the original preparation is typically higher priced than generics.

As shown in Table 3.4 below, the average pack size varies significantly across countries. Austria has the smallest packages, with an average of 29.0 doses per pack. Sweden, on the other hand, has the largest packages, with an average of 58.8 doses per pack, which is more than double the size of Austria. The pack size in Norway is fairly average of the countries in the sample. This variation in pack size suggests that basing price comparisons on matching of identical packs is likely to generate incorrect measures of price differences across countries.

Table 3.4 Average number of doses per pack.

	All active substances	Substances with patent status
Austria	29,0	30,3
Ireland	41,0	44,8
UK	38,5	45,7
Belgium	52,4	59,5
Norway	38,5	46,5
Germany	48,1	55,7
Finland	44,4	47,4
Denmark	52,5	73,3
Netherlands	49,1	62,2
Sweden	58,8	75,9

In the current report we improve the price comparison based on matching of identical packs. Instead of selecting the top-selling pack for each substance, we use the whole sample of packs on the market in Norway. For each reference country, we then match the identical packs that are common for Norway and the reference country. This enables us to generate a much larger and thus more representative sample of products that we can base the price comparisons on.

However, the approach that maximises representativity is to use (volume-weighted) average substance (dose) prices. Price per dose is indicated by price per IMS standard unit[12]. A standard unit is a proxy for a dose, and is defined by IMS as a tablet, a capsule, 10 ml liquid, etc. It is difficult to find a perfect measure of a dose, but as long as a dose is relatively constant across the countries in the sample, this will be

[12] There are other dose measures used such as price per defined daily dose (DDD), price per gram of active substance, etc. These are not available to us via IMS's data set.

relatively unproblematic. The advantage of price per dose is that these are defined for all packs and formulations. This makes it possible to calculate an average price for each active substance. Such an approach means that we make use of all price information in our data. This also ensures a good representation of generics. As we will explain later, we weight the prices for an active substance by volume, so that we attach greater importance to the price of products that sell more than to the price of products that sell less. The weightings are calculated on the basis of each country's sales, so that we obtain the most representative price for each country. In this way, we achieve a high level of representativity.

Using volume-weighted average substance prices is in line with Danzon and Chao (2000), who also provide a discussion of why this approach is better than basing price comparisons on identical packs. See also Danzon (1999) for a broad review of studies on cross-national price comparisons for pharmaceuticals.

3.3. Volume data

The data set contains two types of volume data: *number of packs* and *number of doses*, where the number of doses is represented by IMS standard units as described above. The volume data are per product (article number) and per month for each of the countries we include in the sample for the whole period.

Volume data are used primarily to weight prices. The number of packs sold is not especially suitable for calculating weights as packs, both within active substances and not least across active substances, have differing numbers of doses (tablets, capsules, etc.). Active substances that typically have many doses in a pack will then be given too low a weight, and vice versa. We therefore use the number of doses as a basis for calculating weights.

We have two types of volume weights: (i) Weights across active substance and packs and (ii) weights within active substances. The weights within an active substance are used to calculated average prices, as will be described in section 3.4. The weights across active substances and packs are used to calculate indices, where they will reflect consumption patterns so that prices of active substances with high sales (high number of doses) are assigned a higher weighting than prices of active substances with low sales. As Norway is the starting point for the study, the price indices will be calculated with Norwegian consumption weights. This is presented in more detail when we calculate prices and indices in the next two chapters.

3.4. Volume-weighted average substance prices

For each active substance, we have a number of different pack types and we also have data for six months. This means that, for each active substance, we have a number of price observations (per dose) where some active substances have relatively few observations and others have relatively many. Furthermore, it is the case that some pack types have relatively high sales, while others are sold to a lesser extent. The aim of the volume-weighted average prices is precisely to take account of this, i.e. we want to weight the prices per dose of the top-selling pack types more than the lower-selling packs. To take care of this, we have, for each active substance and for each country, weighted the price per dose with the proportion of sales this pack accounts for out of total turnover for the active substance in this country. We then sum the volume-weighted prices within each active substance, and thereby get a price per dose per active substance. A simple example may make things clear: Assume that for active substance A (for example in Norway) we have three different packs with the following prices and turnover:

- Pack 1A: the price is NOK 10 per dose and turnover is 5 doses
- Pack 2A: the price is NOK 20 per dose and turnover is 10 doses
- Pack 3A: the price is NOK 30 per dose and turnover is 15 doses

The volume-weighted average price per dose then becomes:

$$NOK10 \times \frac{5}{30} + NOK20 \times \frac{10}{30} + NOK30 \times \frac{15}{30} = NOK23.33$$

The arithmetic (unweighted) mean in the example above is NOK 20. The volume-weighted average price in the example then becomes higher because the most expensive packs are the top-selling ones. If this has been the opposite – i.e. if turnover of the more expensive packs had been relatively low – the volume-weighted average price would conversely have been lower than the arithmetic mean.

Many studies compare prices of identical packs instead of calculating the average price within an active substance. The top-selling pack in the base country is then selected, and the price of this pack is then compared with corresponding packs in the reference countries. In our example, pack 3A is the top-selling one with a price of NOK 30. The problem with this approach is, as mentioned earlier, that this pack may not exist or may have lower sales in the reference countries. In addition, we throw away a lot of information by excluding other pack sizes in the price comparison. Volume-weighted average prices take account of both these aspects, and yield a much higher level of representativity.

3.5. Percentage margins

As we have information on pharmacies' sale price (AUP) and pharmacies' purchase price (AIP), it is possible to say something about how the margins vary between countries. To calculate the margins, we use the most common method (the Lerner index) for calculating relative margins/price supplements in a market:

$$M = \frac{AUP_i - AIP_i}{AUP_i} \times 100$$

The margin is thus measured as a percentage of the pharmacies' sale price (AUP). For each country, we use volume-weighted average AUP and AIP per active substance and calculate margins on the basis of these prices as described above.

3.6. The patent and generic market segment

The sample contains pharmaceuticals that are on patent and pharmaceuticals whose patents have expired and copy preparations (generics) have been launched, or could potentially be launched, as an alternative to the original preparation. It may be useful to break down the sample according to whether or not the pharmaceutical is protected, partly because the competitive situation is different and partly because many countries, including Norway, use different regulations of these two segments. In addition, it is the case that a certain yield (and thus a higher price) will be ensured during the patent period to promote innovation in pharmaceuticals, while the lowest possible price is a natural policy target once the patent has expired. One way of dividing the sample could be to use the patent status information in the data set. It emerges, however, that pharmaceuticals within the same active substance are registered both as being on patent (protected) and off patent (not protected). In addition, this variable is difficult to use across countries. However, the data set contains information on whether a pharmaceutical is an original preparation or generic.[13] We therefore observe whether generics are sold within an active substance. This information can be used to generate several subsamples depending on the question that one wants to address. We describe in the next chapters how we construct subsamples using the information of whether a substance has generic competition or not.

[13] This information does not exist for certain pharmaceuticals. This group is equivalent to those that do not have patent status, as discussed in the introduction. These (21) active substances are excluded from the data set, so that we are left with (282) active substances with information on whether an original preparation or generic is involved.

Chapter 4. Price indices: overall, on-patent and off-patent

In this chapter we present the results for the various price indices we have calculated for Norway and the nine reference countries. Price indices are often sensitive to how these are calculated. We have therefore conducted a number of different approximations for calculating the indices. First, we compare prices of identical packs between countries. Second, we compute volume-weighted average prices per dose per substance and use these to compare prices and construct price indices. Third, we calculate bilateral and global price indices at wholesale (AIP) and retail (AUP) level. Finally, we calculate separate indices for the on-patent and off-patent market segments. Before we present the analyses, we provide a brief theoretical presentation of price indices generally.

4.1. General aspects of price indices

A price index is a weighted average of prices for different products, generally calculated over time, such as the consumer price index. If we have two time periods, period 0 and *t*, and two products, product 1 and 2, we can express a price index as follows:

$$I_P = \frac{p_1^t w_1 + p_2^t w_2}{p_1^0 w_1 + p_2^0 w_2} \times 100,$$

where w_1 and w_2 are weights applied to the respective prices and p_1^0, p_1^t, p_2^0 and p_2^t. In calculating price indices, it is customary to use sold quantities as weights to take account of the relative importance of the various product prices. We can obtain two different indices depending on the choice of weights. If we choose sold quantities in the last period (period *t*) as weights, we obtain the so-called *Paasche price index*:

$$P_P = \frac{p_1^t q_1^t + p_2^t q_2^t}{p_1^0 q_1^t + p_2^0 q_2^t} \times 100,$$

where q_1^t and q_2^t are quantities of product 1 and 2 sold in period *t*. If we choose quantities sold over the base period (period 0) as weightings, we obtain the so-called *Laspeyres price index*:

$$L_P = \frac{p_1^t q_1^0 + p_2^t q_2^0}{p_1^0 q_1^0 + p_2^0 q_2^0} \times 100,$$

where q_1^0 and q_2^0 are quantities of product 1 and 2 sold in period 0. Both these price indices will express changes in average prices over time. If prices are less (more) than 100, this means that there has been a reduction (increase) in average prices over the period.

In this study, we calculate differences in average prices across countries (not over time) to see whether the prices of pharmaceuticals in Norway are higher or lower than in other countries. Let us assume two countries, Norway and Abroad, where products 1 and 2 are sold (but with potentially different quantities). The general price index can then be expressed as

$$I_P = \frac{p_1^U w_1 + p_2^U w_2}{p_1^N w_1 + p_2^N w_2} \times 100,$$

where p_1^U and p_2^U are the prices of product 1 and 2 abroad, and p_1^N are p_2^N the prices of products 1 and 2 in Norway, and w_1 and w_2 are the weights to be applied to these different prices. It is customary to use weights to express the relative importance of the products including when price indices are to be calculated across countries. If we use quantities sold abroad as weights, we calculate a Paasche price index. It is nevertheless natural in this context to use quantities sold in Norway as weights, giving us a Laspeyres price index, which can be expressed as follows:

$$L_P = \frac{p_1^U q_1^N + p_2^U q_2^N}{p_1^N q_1^N + p_2^N q_2^N} \times 100,$$

where q_1^N and q_2^N are quantities sold of products 1 and 2 in Norway. If the price index is more (less) than 100, this means that average prices abroad are higher (lower) than in Norway. However, it does not mean that all prices are higher abroad than in Norway. We can imagine that product 1 has a higher price abroad than in Norway ($p_1^U > p_1^N$), while it is the converse for product 2 ($p_2^U < p_2^N$). The effect on the price index will thus be determined by the weighting, which in our case is determined the Norwegian consumption weights. If product 1 has a low sales volume relative to product 2 in Norway ($q_1^N < q_2^N$), this may give rise to a price index of less than 100, i.e. on average the price level in Norway is lower than abroad.

For most price indices, we will use Norwegian quantity weightings. In this way, we measure what a Norwegian “shopping basket” costs abroad. If Norway is more expensive than the reference countries, the differences in the price index may be interpreted as the cost savings that could be achieved by importing the foreign price level. In Brekke, Holmås and Straume (2008) we also conducted sensitivity analyses where we used Swedish and Danish quantity weightings to see whether the price indices change. Such a comparison means that we import both foreign prices and foreign shopping baskets into Norway. The latter is a more unrealistic measure of possible cost savings. However, the results were fairly robust to these sensitivity checks.

4.2. Price indices based on identical packs

Let us first compare prices between countries for identical packs, i.e. packs with same size (e.g. 100 tablets), strength (e.g. 500 mg Paracetamol) and formulation (e.g. tablets). In the previous reports we selected the top-selling pack (measured in number of doses) in Norway for each substance, and compared the price of this pack with the price of an identical pack in each reference country (given that this pack was sold in the reference country).[14] This procedure gave us about 250 top-selling packs in Norway. While this is a standard procedure for price comparisons on the basis of packs, it severely reduces the size of the sample and is likely to make the sample biased and thus not representative. For instance, the most selling pack in Norway is not necessarily the most selling pack in Belgium. A cross-country price comparison should be based on a representative sample of the products sold in all countries subject to the analysis, not just the benchmark country (Norway in this case).

In this report we have therefore refined our cross-country comparison of prices of identical packs. Instead of selecting only the top-selling pack for each substance, we now compare prices of all packs that are identical in Norway and the reference country. There are usually a wide range of packs with the same substance that are sold in Norway and the reference country. By including all identical packs – not just the top-selling pack for each substance – we are able to extend the sample for comparison of pack prices substantially. Indeed, the number of packs now increases from about 250 to almost 1700 in Norway, which we try to match with the reference countries.

There is one challenge with this approach, namely that there might be several identical packs *within* a country. For instance, there might be a parallel importer offering the same pack as the brand-name producer. For products that are off patent, there are usually one or more generic producers offering identical packs as the brand-name producer. In this case, we have several prices for a given pack in each country. We handle this issue by computing the sales-weighted average price for this particular pack, which we argue is the most representable price for this pack in a given country.

By extending the sample of products that form the basis for the pack price comparison we get a more representative sample of products not just in Norway but also in the reference country. To compute the price indices for the various market segments, we use the Norwegian consumption weights based on *the number of doses* sold for each pack. Using the number of packs instead of the number of doses would have created a bias towards smaller and thus cheaper packs. Thus, using doses as the basis for generating consumption weights is more appropriate. It is also consistent the rest of the price comparisons.

We do not require the packs to be available in all countries (global) to be included in the calculation. The matching is carried out bilaterally for each country, so that the number of packs included varies depending on which country is the reference country. Having 1687 packs in Norway with a defined formulation, pack size and strength in our data, the number of matching packs varies from 1052 in Sweden to 519 in Austria. Table 4.1 below presents the results of the bilateral price indices computed for identical packs. The indices are computed using both wholesale (AIP) and retail (AUP) prices.

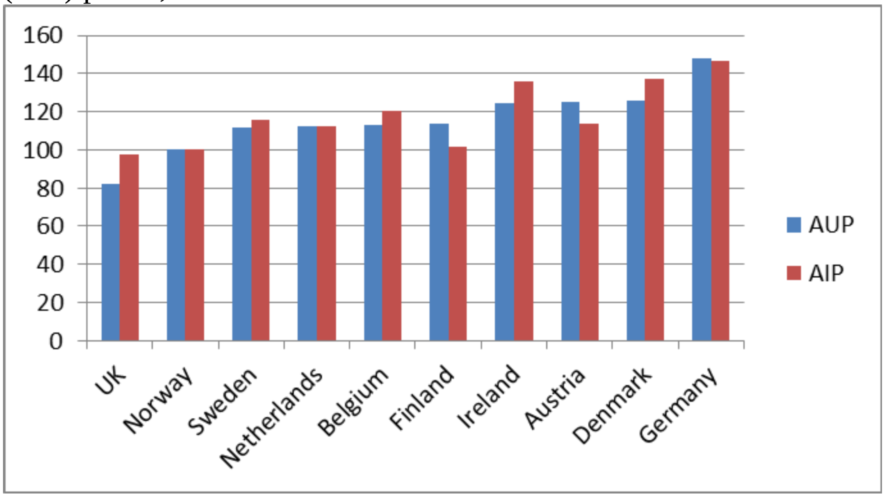
[14] This is a standard approach used in many policy-oriented price comparisons of pharmaceuticals. In Norway this has been used by e.g. LMI (2006). See Danzon (1999) and Danzon and Chao (2000) for a critique of this method.

Table 4.1: Bilateral price indices at wholesale (AIP) and pharmacy (AUP) level based on prices of identical packs (same formulation, pack size and strength).

	Norway	Sweden	Denmark	Finland	UK	Germany	Netherlands	Belgium	Austria	Ireland
All substances										
AIP per pack	100	115.5	137.2	101.6	97.9	146.5	112.4	120.7	114.0	135.7
AUP per pack	100	111.5	125.7	113.8	82.3	147.7	112.3	112.9	125.1	124.3
Number of substances	282	240	244	222	203	218	213	196	192	204
Number of packs	1687	1052	955	887	541	807	654	559	519	515
Substances on patent (without generic competition in Norway)										
AIP per pack	100	119.4	134.0	99.0	96.1	142.4	114.4	96.2	105.2	128.4
AUP per pack	100	117.3	132.5	120.3	84.5	144.4	116.6	96.5	123.2	128.0
Number of substances	165	132	135	115	110	118	117	102	104	107
Number of packs	655	425	394	342	258	338	303	231	237	232
Substances on patent in both countries (without generic competition in both countries)										
AIP per pack	100	124.1	137.9	104.3	99.7	147.8	120.4	102.6	100.5	131.1
AUP per pack	100	122.5	137.6	129.9	88.4	150.2	125.9	104.8	117.2	133.2
Number of substances		117	110	97	83	89	88	86	88	94
Number of packs		369	312	282	213	271	241	200	204	212
Substances off patent (with generic competition in Norway)										
AIP per pack	100	107.5	142.3	105.2	93.5	152.9	107.6	162.3	132.0	143.3
AUP per pack	100	101.6	117.5	106.9	76.2	151.6	104.1	133.6	128.4	121.0
Number of substances	117	108	109	107	93	100	96	94	88	97
Number of packs	1032	627	561	545	283	469	351	328	282	283
Substances off patent in both countries (with generic competition in both countries)										
AIP per pack	100	87.1	125.1	100.5	84.7	121.5	96.5	169.4	123.3	130.6
AUP per pack	100	85.7	103.9	100.4	68.9	132.1	95.2	135.9	119.7	107.6
Number of substances		98	94	98	83	91	90	82	77	83
Number of packs		576	507	516	258	427	331	288	245	245

If we first look at the bilateral price indices for all substances (or packs) and rank the countries from cheapest to most expensive based on the pharmacy prices (AUP), we get the ranking showed in figure 4.1 below.

Figure 4.1 Bilateral price indices, identical packs, pharmacy (AUP) and wholesale (AIP) prices, all substances.

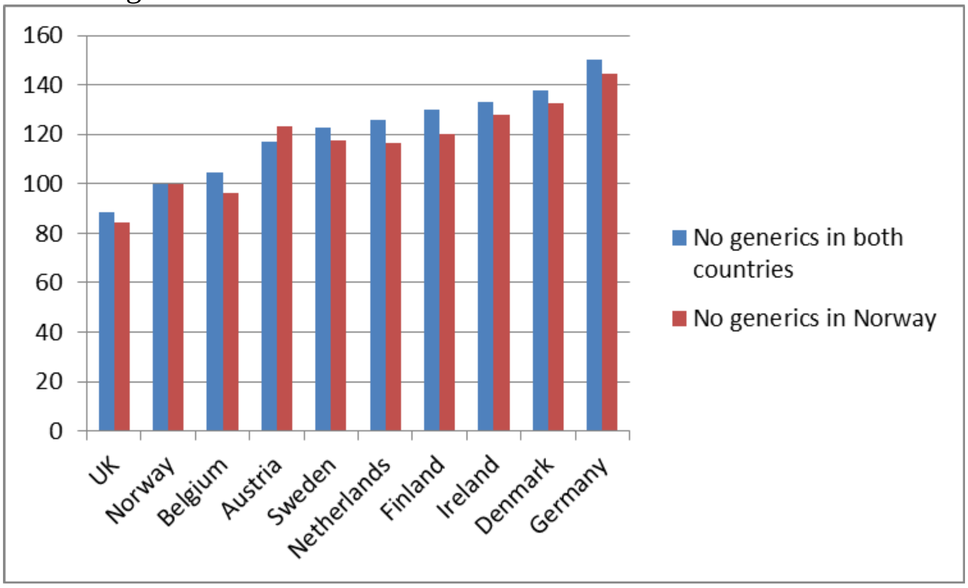


We see that UK is the cheapest country, having almost 18 per cent lower prices at pharmacy level than Norway, which is the second cheapest country. In the other end of the scale, we have Germany which is almost 48 per cent more expensive than Norway. Looking at the wholesale level, UK has just marginally lower prices than Norway, suggesting lower mark-ups at the pharmacy level in the UK. The same seems to be the case for Sweden, Belgium, Ireland and Denmark, whereas Finland, Austria and Germany seem to have slightly higher mark-ups at pharmacy level than in Norway.

In table 4.1 we report bilateral price indices for the on-patent and the off-patent market segments. Since the exact patent status is not observed in each country, as discussed in the previous chapter, we use the *de facto* presence of generic competition for a given substance as an indicator for whether we classify the pharmaceuticals as on-patent or off-patent. To separate the two market segments, we use two different definitions: (i) whether the substance has generic sales in Norway; and (ii) whether the substance has generic sales in Norway *and* the reference country. If we do not observe generic competition for a given substance, then we label this as the on-patent market segment and compare prices of all identical packs with this substance in Norway and the reference country.

Figure 4.2 reports the price index for the *on-patent segment*, where we have ranked the countries from cheapest to most expensive according to the price indices where we assume no generics in Norway *and* the reference country. The figure also reports the price index where we assume no generic sales in Norway for the substance.

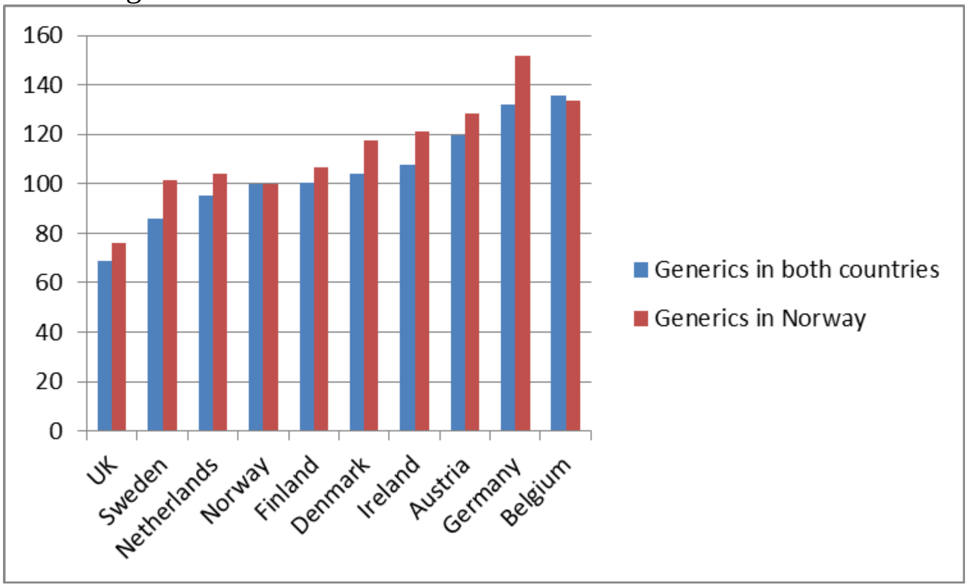
Figure 4.2: Bilateral price indices, identical packs, pharmacy prices (AUP), on-patent market segment.



As for all substances, UK is the cheapest country having almost 12 per cent lower prices on products where we do not observe generic sales in Norway and the UK. Germany is on the other end of the ranking being more than 50 per cent more expensive than Norway. Denmark has also high prices in the on-patent segment being almost 40 per cent more expensive than Norway. We see that the price index using only generic competition in Norway as the benchmark implies that the reference countries – except for Austria – become less expensive compared to Norway. This is expected as the definition opens up for a substance to face generic competition in the reference country (but not in Norway), and generic competition is likely to drive down prices.

Finally, we compute the price indices for *off-patent market segment*. Figure 4.3 offers a ranking of price indices based on comparison of pharmacy prices of identical packs of pharmaceuticals with substances with generic competition. The countries are ranked from cheapest to most expensive according to the price index where the products face generic competition in Norway and the reference country. We see from Figure 4.3 that UK, Sweden and Netherlands have lower prices at pharmacy level than Norway if we restrict the price comparison to identical packs with substances that face generic competition. Indeed, the prices in the UK are more than 30 percent lower than in Norway, whereas Sweden and the Netherlands have almost 15 and 5 percent lower prices, respectively. In the other end of the scale, we find Belgium and Germany with 36 and 32 percent higher prices, respectively.

Figure 4.3: Bilateral price indices, identical packs, pharmacy prices (AUP), off-patent market segment.



Looking at the substances that have generic competition in Norway, but not necessarily in the reference country, we see that Norway becomes cheaper relative to its reference countries. In this case, only UK is cheaper than Norway, whereas Sweden has about the same price level. These results are expected as some substances might not yet have received generic competition in the reference country. The question of whether or not one should assume generic competition in both countries when comparing prices depends on the question one asks. There might be different market or regulatory conditions that explain why some countries experience generic entry sooner than other countries. These market and regulatory conditions might also be the very source to the lower price level. Thus, the question is whether one wants to "control" for that or not.

A main problem with using price indices based on identical packs is, as discussed in the previous chapter, that the representativity of the sample of the products becomes low.[15] In this report we have mitigated this concern to some degree by including all identical packs – not just the top-selling pack for each substance. This has increased our sample from about 250 packs to almost 1700 packs with a defined pack size, strength, and formulation in Norway. However, the number of matching packs is much lower and varies substantially across countries. As can be seen from table 4.1, Sweden has the highest number of identical packs, where we are able to match 1052 packs, which is 62 per cent of the total number of packs in Norway. In the other end, we find Austria where we find 519 identical packs, which is only 30 per cent of the total number of packs in Norway. Clearly, the price comparisons based on identical packs generates great concern in terms of representativity. The price differences might be severely affected by selection bias, and thus systematically incorrect. To compensate for this, we proceed by using another and much more robust approach where price comparisons are based volume-weighted average substance (or dose) prices – a measure that uses almost all price and sales information in all countries.

[15] See Danzon (1999) and Danzon and Chao (2000) for a full discussion and analysis of the problems associated with basing price indices on identical packs.

4.3. Price indices based on average substance prices

For each substance in each country we compute the volume-weighted average dose price using each country's sales volumes measured in standard units, as explained in more detail in the previous chapter. This gives us the most "representative" (dose) price for this substance in each country using all price and volume information available. We then compare these prices in Norway with the same prices in the reference country for each substance that are matched. As can be seen from table 4.2 the number of matching substances is high, varying from 275 in Sweden to 251 in Belgium. This ensures a high degree of representativity in both Norway and the reference country, ensuring more robust measures of price differences.

We start out by calculating *bilateral* price indices based on the average substance prices. The procedure is the same as for identical packs, apart from the fact that here we match active substances instead. Table 4.2 below presents all bilateral price indices we have calculated based on the average substance prices.

We also compute what we refer to as *global* price indices, where we restrict the price comparison to substances that are present in all countries (global substances), not just between Norway and a given reference country. The results from the comparison based on global substances are reported in table 4.3 below. The benefit of the global price index is that the price difference between, say, Sweden and Denmark now becomes meaningful since the price indices are based on the same sample of substances. Under the bilateral price index, this is not the case. However, the drawback of the global price index is that the sample becomes smaller. Indeed, the number of matching substances is now reduced to 210.

As for the price comparison based on identical packs, we compute separate price indices for the on-patent and the off-patent market segment, using exactly the same approach.

Table 4.2. Bilateral price indices at wholesale (AIP) and pharmacy (AUP) level based on volume-weighted average substance prices per dose.

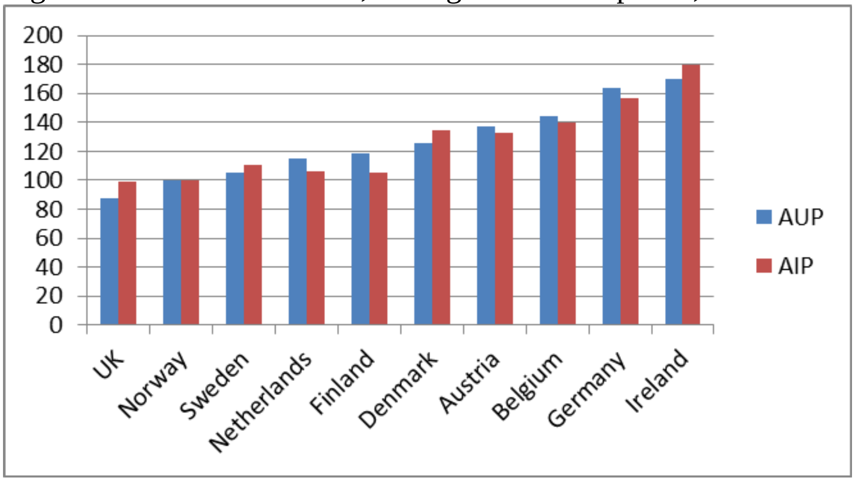
	Norway	Sweden	Denmark	Finland	UK	Germany	Netherlands	Belgium	Austria	Ireland
All substances										
AIP per dose	100	110,7	134,1	105,7	99,4	156,9	106,1	140,1	132,8	180,1
AUP per dose	100	105,3	125,4	118,6	87,9	163,4	115,2	144,1	137,1	169,9
Number of substances		275	272	264	261	263	268	251	261	260
Substances on patent (without generic competition in Norway)										
AIP per dose	100	113,1	134,1	104,7	86,0	145,3	111,0	113,3	119,7	132,1
AUP per dose	100	108,6	132,1	123,5	80,0	148,2	114,5	114,4	131,5	135,3
Number of substances		160	157	151	145	153	154	141	146	147
Substances on patent in both countries (without generic competition in both countries)										
AIP per dose	100	115.8	134.4	104.0	89.6	139.4	107.1	114.6	115.6	128.8
AUP per dose	100	111.3	133.2	123.7	82.9	138.5	108.8	115.1	128.1	133.6
Number of substances		141	129	127	109	114	116	118	62	127
Substances off patent (with generic competition in Norway)										
AIP per dose	100	106,3	134,0	107,4	117,9	177,9	97,7	185,8	155,5	260,6
AUP per dose	100	100,8	116,1	111,8	96,6	185,5	116,3	184,7	145,0	216,2
Number of substances		115	115	113	116	110	114	110	115	113
Substances off patent in both countries (with generic competition in both countries)										
AIP per dose	100	91,7	118,1	108,3	108,7	151,3	91,3	188,6	149,1	259,2
AUP per dose	100	90,2	103,6	111,5	89,2	168,3	112,5	185,5	138,2	208,1
Number of substances		103	98	101	101	100	106	94	98	95

Table 4.3. Global price indices (AIP and AUP) for substances present in all countries based on volume-weighted average substance prices per dose.

	Norway	Sweden	Denmark	Finland	UK	Germany	Netherlands	Belgium	Austria	Ireland
All substances (N = 210)										
AIP per dose	100	113.0	131.5	105.6	94.7	156.4	105.9	139.0	132.8	172.2
AUP per dose	100	108.3	124.2	121.5	84.6	161.1	115.4	142.2	139.9	164.6
Substances on patent (without generic competition in Norway) (N = 112)										
AIP per dose	100	113.9	132.8	102.3	87.2	138.1	113.0	113.2	118.7	132.3
AUP per dose	100	111.9	133.2	125.5	80.9	145.5	118.8	117.0	136.6	139.3
Substances on patent in all countries (without generic competition in any country) (N = 73)										
AIP per dose	100	103.3	118.5	101.7	83.6	130.4	96.7	105.9	105.2	124.8
AUP per dose	100	102.5	120.5	127.6	77.5	133.8	100.3	110.0	124.9	134.6
Substances off patent (with generic competition in Norway) (N = 98)										
AIP per dose	100	111.8	129.8	110.3	105.4	182.3	95.7	175.3	152.7	228.5
AUP per dose	100	104.2	114.0	117.0	88.8	178.9	111.6	170.9	143.6	193.5
Substances off patent in all countries (with generic competition in all country) (N = 68)										
AIP per dose	100	91.5	108.5	103.1	93.2	131.5	83.2	186.8	154.9	241.6
AUP per dose	100	89.2	94.2	107.9	80.0	145.7	109.0	178.6	141.6	195.0

If we start looking at the bilateral price indices for *all substances*, figure 4.4 reports the ranking of countries from cheapest to most expensive at pharmacy price (AUP) level and also at the wholesale price (AIP) level.

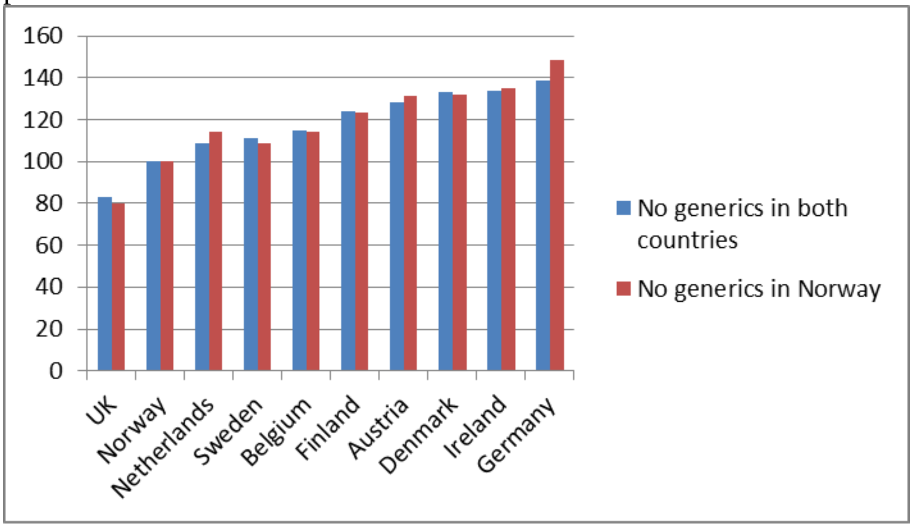
Figure 4.4: Bilateral indices, average substance prices, all substances.



We see that, as for identical packs, UK still has lowest prices being about 12 per cent cheaper than Norway at pharmacy (AUP) level. Ireland is now the most expensive country with almost 70 per cent higher prices compared to Norway. At the wholesale level, UK has only marginally lower prices than Norway, suggesting a lower mark-up at the pharmacy level in the UK. We see that the price indices at wholesale (AIP) level produce almost the same ranking with just small differences that are due to differences in mark-ups.

Looking at the different market segments, figure 4.5 below reports the results for the on-patent segment based on the two different definitions where we match substances if there is generic competition in Norway and the reference country or just in Norway.

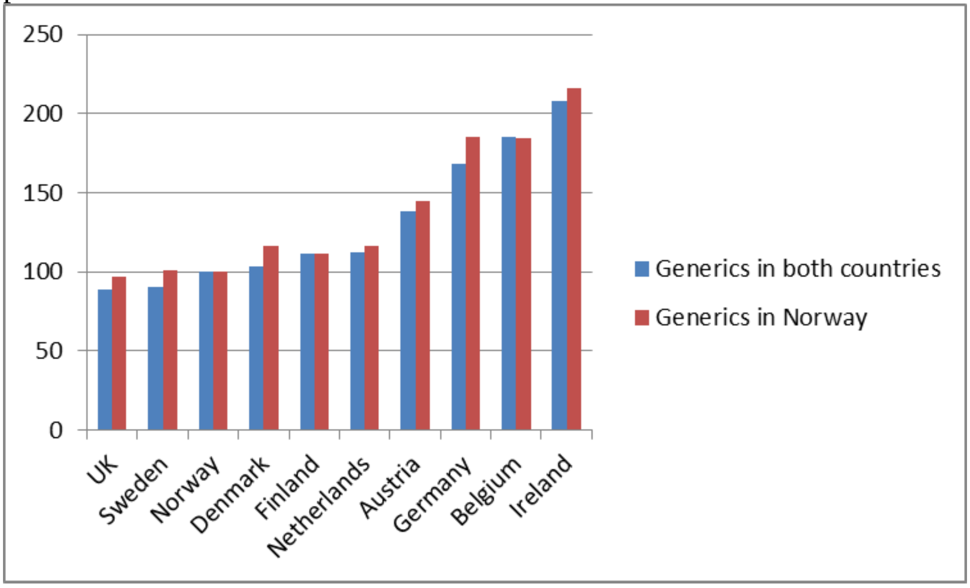
Figure 4.5: Bilateral price indices, average substance prices at pharmacy (AUP) level, on-patent substances.



The UK is still the cheapest country with around 11 per cent lower pharmacy prices than Norway when matching only substances that face no generic sales in Norway and UK. Norway is the second cheapest country followed by the Netherlands and Sweden that are around 9 and 11 per cent, respectively, more expensive than Norway. In the other end, we find Germany and Ireland that have about 38 and 33 per cent, respectively, higher prices than Norway in this segment. The results based on no generic competition in Norway, but not necessarily in the reference country, are almost the same, though there is a slight tendency that the reference countries are becoming less expensive relative to Norway as expected.

Looking at the *off-patent market segment*, figure 4.6 reports the results from the bilateral price indices computed at pharmacy (AUP) level.

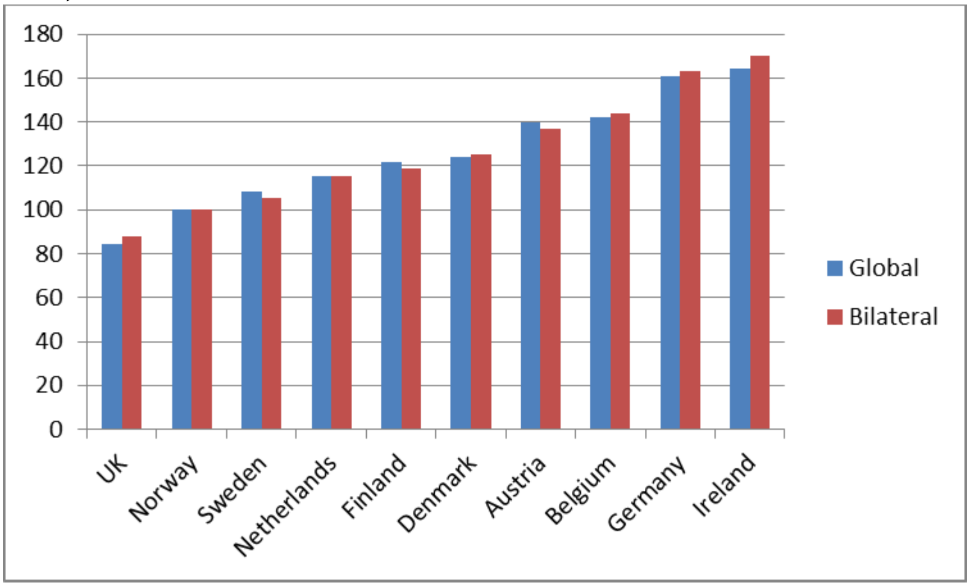
Figure 4.6: Bilateral price indices, average substance prices at pharmacy (AUP) level, off-patent substances.



From this figure we see that UK and Sweden are 11 and 10 per cent, respectively, cheaper than Norway at pharmacy level for substances that face generic competition in both Norway and the reference country. Denmark is just marginally more expensive, whereas Ireland is more than 100 per cent more expensive in the off-patent market segment. The price indices based on generic competition in Norway show a tendency of making the reference countries more expensive as expected, though the differences are not large for most countries.

Finally, we consider the *global price indices* based on average substance prices. The figure below shows the ranking of countries from cheapest to most expensive based on average substance prices at pharmacy (AUP) level for all substances. We have also added the bilateral price indices for comparison reasons.

Figure 4.7: Global and bilateral price indices, average substance prices at pharmacy (AUP) level, all substances.



The figure shows that the global price indices produce the same ranking as the bilateral price indices in qualitative terms and almost the same results in quantitative terms. The neighbouring countries UK and Ireland are still the cheapest and most expensive countries, respectively, and the figures are almost the same. The benefit of the global price indices is that it offers a more precise measure of the price difference between two reference countries since the price indices are based on exactly the same match of substances. For instance, according to the global price indices for all substances, Denmark is almost 16 per cent more expensive than Sweden, whereas the same figure is 20 per cent if we use the bilateral price indices. However, there are three substances more in Sweden than in Denmark in the bilateral price indices, which makes this comparison inaccurate.

Chapter 5. Price indices for products under reference pricing (trinnpris)

In this chapter we focus on the set of pharmaceuticals that are subject to the reference price scheme called “trinnpris” that was introduced in Norway in 2005. This scheme covers substances for which the patent has expired and generic competition has taken place.[16] At the beginning of 2010, 52 substances were subject to reference price (trinnpris) regulation in Norway. Our data set comprises information on all these substances.

The reference price (trinnpris) defines the maximum reimbursement for a set of pharmaceuticals that are therapeutically equivalent (brand-names and generics). The reference price is usually set somewhere between the high-priced drug (brand-name) and the low-price drug (generic). In Norway, the maximum reimbursement (trinnpris) is set as discount of the brand-name price, which is reduced in steps over time, thereby the name “trinnpris” (step price).[17] If patients demand product with a higher price than the maximum reimbursement, they would have to pay the full price difference out-of-pocket, as common for reference price systems. The idea is to make demand more price elastic, switching demand towards lower priced generics and trigger price competition between brand-names and generics, which would lead to lower pharmaceutical expenditures. See Chapter 2 for more details.

The main reasons we provide a separate chapter on the pharmaceuticals under reference pricing (trinnpris) in Norway are the following. First, our analysis of the drugs under trinnpris regulation in previous reports was challenged by a NRK program called “Brennpunkt” in March earlier this year. We responded in a chronicle in Bergens Tidende on March 17, where we claimed there were several misunderstandings in the NRK program.[18] Hopefully, writing a separate chapter devoting more space to our analysis on this part of the market would clarify things further.

Second, the Ministry of Health scrutinised the prices that IMS Health had delivered for the market segment covered by the trinnpris regulation at the pharmacy (AUP) level. Comparing the IMS prices with the transaction prices in the database of the Norwegian Pharmacy Association showed a systematic bias. IMS had applied the *regulated* pharmacy margins to obtain prices at retail level. However, the true pharmacy margins turned out to be higher, implying higher prices at the pharmacy level for the products under trinnpris regulation. IMS have now provided us with the transacted prices at retail level for the substances under trinnpris regulation in Norway, which are used for the analysis in this report.

Below we present the tables with the results from the different price indices calculated for the substances subject to reference pricing (trinnpris) regulation in Norway. The first table (5.1) presents the results for price indices based on comparison of pack prices of matching (identical) packs. The second table (5.2) presents the results for the price indices based on our preferred measure, namely the volume-weighted average substance prices.

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[16] However, some (five) of the substances under trinnpris regulation do not have generic competition in Norway. We will comment on that below.
[17] Details of the reference price system can be found in Chapter 2.
[18] The chronicle also appeared on http://www.forskning.no/artikler/2011/mars/283216 .

Table 5.1: Bilateral price indices (AIP and AUP) based on prices of identical packs (same formulation, size and strength). Substances under reference pricing (trinnpris).

	Norway	Sweden	Denmark	Finland	UK	Germany	Netherlands	Belgium	Austria	Ireland
All substances										
AIP per pack	100	148.8	184.4	96.5	181.8	226.8	210.3	192.2	202.5	239.8
AUP per pack	100	124.0	141.8	95.1	143.4	193.4	174.5	143.6	196.2	216.2
Number of substances	51	50	50	50	43	46	45	46	46	46
Number of packs	492	320	317	322	148	265	196	210	163	153
Substances with generic competition in Norway and reference country										
AIP per pack	100	72.2	115.0	98.6	107.7	141.2	107.7	202.0	298.8	218.3
AUP per pack	100	71.7	87.0	92.7	82.4	134.0	92.7	146.4	244.3	172.0
Number of packs		266	261	295	116	219	158	180	126	122
Substances with same competitive environment in Norway and reference country										
AIP per pack	100	127.3	162.4	98.8	112.9	192.6	205.8	201.2	260.8	210.7
AUP per pack	100	108.4	123.7	93.0	87.4	169.5	169.5	146.3	228.9	173.1
Number of packs		275	272	303	128	233	171	185	139	129

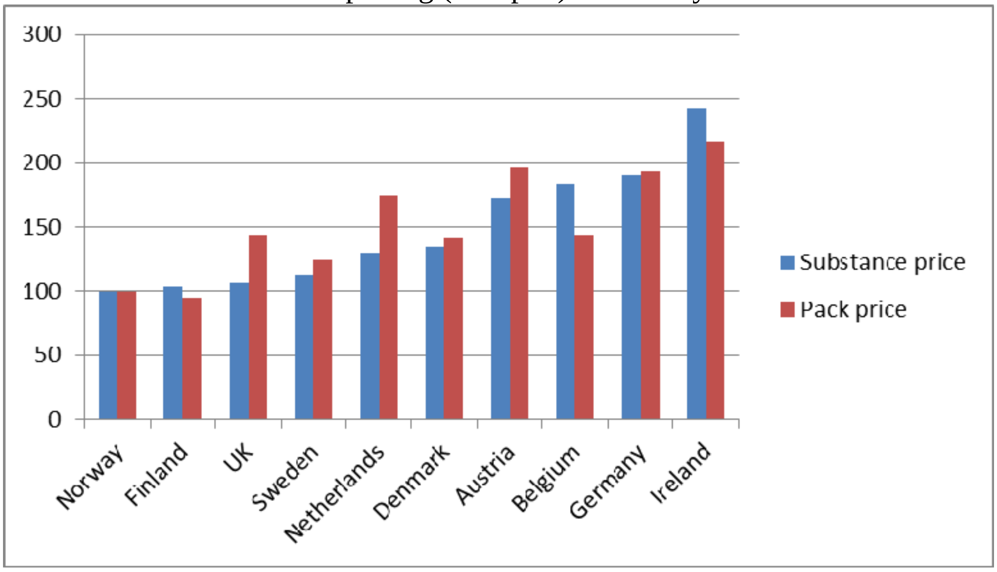
Table 5.2. Bilateral price indices (AIP and AUP) based on volume-weighted average substance prices per dose. Substances under reference pricing (trinnpris).

	Norway	Sweden	Denmark	Finland	UK	Germany	Netherlands	Belgium	Austria	Ireland
All substances										
AIP per dose	100	130.6	161.8	102.0	133.6	212.6	115.6	215.1	193.3	300.3
AUP per dose	100	112.8	134.8	103.4	106.5	190.1	130.0	183.5	172.5	242.5
Number of substances	52	51	52	52	51	49	49	51	52	51
Substances with generic competition in Norway and reference country										
AIP per dose	100	81.5	106.8	104.7	99.8	164.1	83.5	186.7	180.1	305.9
AUP per dose	100	77.8	90.8	103.3	81.8	155.2	111.4	165.8	154.5	233.4
Number of substances		40	41	45	39	39	40	39	40	38
Substances with same competitive environment in Norway and reference country										
AIP per dose	100	108.2	129.2	105.1	110.5	174.1	102.3	206.3	185.4	302.0
AUP per dose	100	96.0	107.6	104.0	90.1	162.9	122.3	175.0	164.1	239.4
Number of substances		42	43	47	41	41	42	42	43	41

5.1. All substances under reference pricing (trinnpris)

Let us first look at *all substances* that are subject to reference pricing (trinnpris) in Norway. Figure 5.1 below shows the ranking of countries from cheapest to most expensive according to the bilateral price indices based on the volume-weighted average substance prices per dose at pharmacy (AUP) level. The figure also reports the same price indices for the identical packs.

Figure 5.1. Bilateral price indices, substance and pack prices, pharmacy (AUP) level, all substances under reference pricing (trinnpris) in Norway.

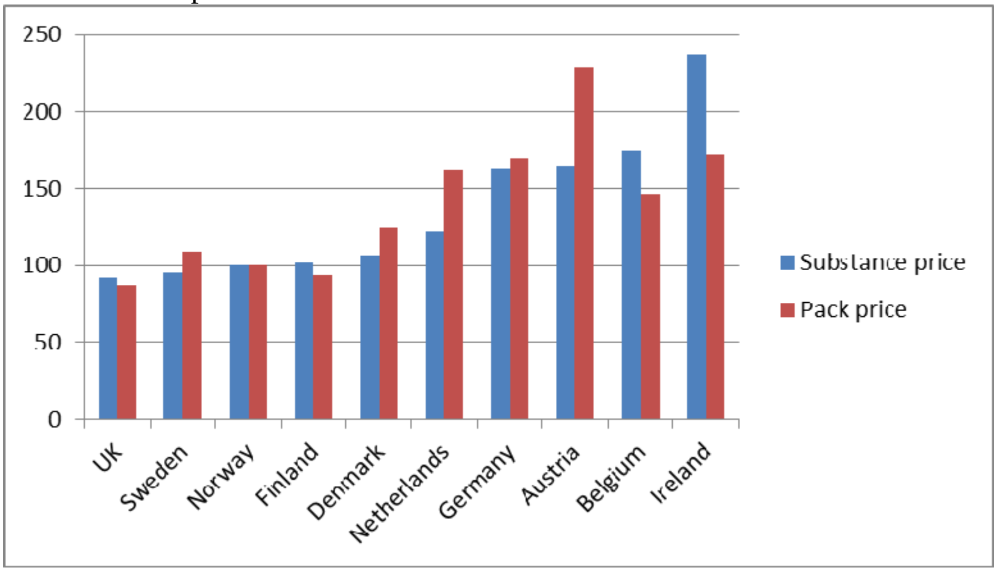


We see that Norway is the cheapest country using the average substance price indices, closely followed by Finland and UK that are 3.4 and 6.5 per cent more expensive, respectively. In the other end we find Ireland and Germany that have about 140 and 90 per cent higher prices than Norway, respectively. If we look at the price comparison based on identical packs, the pattern is fairly similar. However, there are some exceptions like UK, Netherlands and Austria that become much more expensive compared to Norway. Some countries, like Finland, Belgium and Ireland, also become cheaper when using identical packs as the basis for the price comparison. This variation is due to the change in the sample of products. The use of identical packs results in a loss of observations due to lack of matching across countries. Thus, the average substance prices are more reliable as measure of cross-country price differences.

5.2. Substances with similar competitive environment

Observing that generic competition takes place at different times in the countries in our sample, we might want to restrict the comparison to substances that face a similar competitive environment. As mentioned before, variation in generic entry across countries might be due country-specific regulations and market conditions. We therefore construct sub-indices for the set of pharmaceuticals under reference pricing (trinnpris) in Norway. First we compare prices if the substances have the same *de facto* patent status or competitive environment in Norway and the reference country. This implies that we exclude drugs that have generic competition in Norway, but not in the reference country. Vice versa, we also exclude drugs that have generic competition in the reference country, but not in Norway. Figure 5.2 below reports the results from the bilateral price indices based on substances with same competitive environment.

Figure 5.2. Bilateral price indices, substance and pack prices, pharmacy (AUP) level, substances with same competitive environment.



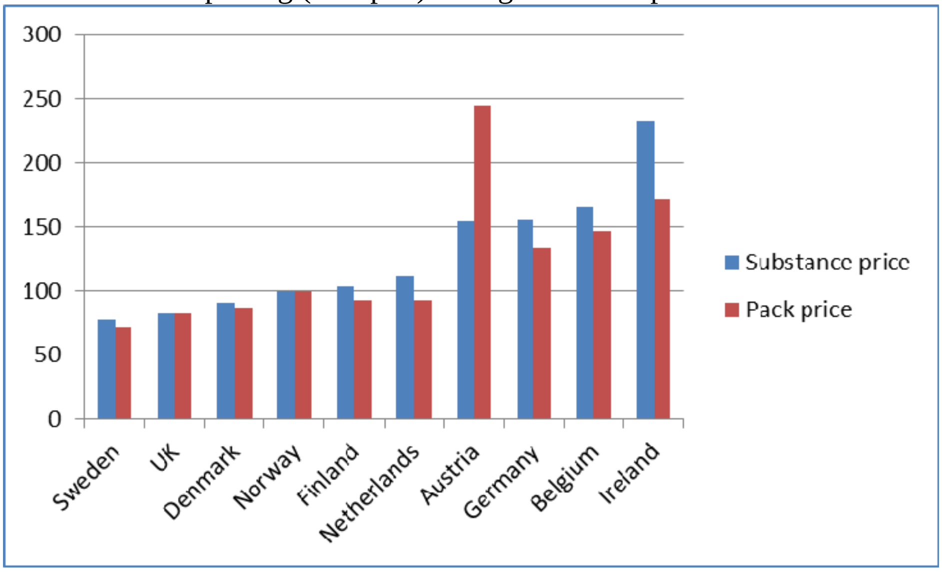
Restricting the price comparison to the substances with the *same competitive environment*, we see that UK and Sweden are 8.3 and 4.6 per cent cheaper than Norway when using the volume-weighted average substance price per dose. In the other end of the scale, we find Ireland and Belgium. We see there is a tendency to most countries becoming cheaper relative to Norway when restricting the comparison to substances that face similar competitive environment. The reason is of course the change in the sample of products that form the basis for the price comparison. There are some substances that have lower prices in Norway, most likely due to generic competition not present in the reference country, that are included in the reference price (trinnpris) system. We will look more carefully at that below.

Looking at bilateral price indices using identical packs, we see that the pattern is fairly similar as for the substance prices. However, there are some exceptions like Austria and the Netherlands that become much more expensive when using matching packs, whereas Ireland and Belgium become much cheaper when using this approach.

5.3. Substances with generic competition

We have also computed a sub-index restricting attention to substances under reference pricing (trinnpris) that have *generic competition* in Norway and the reference country. This price index excludes all substances that are under reference pricing (trinnpris) regulation, but do not face generic competition in Norway or any other country. Table 5.1 and 5.2 provide the number of packs and substances this applies to. In Figure 5.3 below we present the ranking of countries according to this price index using prices at the pharmacy level (AUP).

Figure 5.3. Bilateral price indices, substance and pack price, pharmacy (AUP) level, substances under reference pricing (trinnpris) with generic competition in both countries.



We see from the figure that Sweden, UK and Denmark have the lowest average substance prices when restriction the comparison to substances under trinnpris with generic competition in both Norway and the reference country. Sweden is now 22 per cent cheaper than Norway, whereas UK and Denmark has 18 and 9 per cent lower prices, respectively. In the other end of the scale, we find Ireland and Belgium that are, respectively, 133 and 65 per cent more expensive than Norway.

Looking at the same price indices for identical packs, we see there are some dramatic changes in the ranking for some countries. In particular, Austria becomes much more expensive using matching packs as the basis, whereas Ireland becomes much cheaper. The reason is due to the change in the sample of products. In Austria and Ireland we find only 126 and 132 matching packs, respectively, for this sample of substances. With so few observations, the price indices might be highly sensitive to the exclusion or inclusion of particular products.

Restricting the price comparison to substances with generic competition makes some countries cheaper compared to Norway, whereas others become more expensive. Compared with the "all substances" price indices, we see that particularly Sweden, Denmark and UK become much cheaper. However, the opposite is true for Finland, Belgium and Ireland, so the picture is not clear-cut.

5.4. Price comparison between the Scandinavian countries

Let us take a closer look at Sweden and Denmark to investigate in more detail what is driving the difference in the results in terms of the price indices for the substances under trinnpris regulation. In table A.2 in the Appendix we have listed all the 52 substances subject to the trinnpris scheme. This table also provides information on the consumption weight the substance is given in our calculations. These weights reflect the Norwegian consumption pattern and are computed as the number of doses sold of a given substance divided by the total number of doses sold for this sample of substances, as explained in the previous chapter. The table also provides the average brand-name and generic price per dose for each substance, as well as the volume-weighted substance prices, which the prices we use to compute the price indices. The prices are reported for the Scandinavian countries at pharmacy (AUP) level. Finally, the table provides information about the sales volumes measured in doses for the brand-names, generics and in total at the substance level.

The first set of price indices reported above *used all substances* under the trinnpris regulation. This was constructed by matching trinnpris substances with the same substances in the reference country. We see from table 5.2 that all of the 52 trinnpris substances were also sold in Denmark, whereas only one substance (Tamsulosin) was not sold in Sweden. This forms a good basis for price comparison as the sample is highly representative not just for Norway but also for Denmark and Sweden.

However, we do observe that some substances do not face generic competition, so that the competitive environment is different. Indeed, when looking at the absence of generic competition, we can construct the following table (see also table A.2 in the Appendix).[19]

Table 5.3. Trinnpris substances without generic sales (marked with X), Scandinavia.

Substance name	Norway	Sweden	Denmark
Atorvastatin	X	X	X
Cabergoline	X	-	-
Donepezil	-	X	X
Mianserin	X	-	-
Mirtazapine	X	-	-
Olanzapine	-	X	X
Pivmecillinam	-	X	-
Prampipexole	-	X	X
Quetiapine	-	X	X
Ranitidine	-	-	X
Rivastigmine	X	X	X
Sibutramine	-	X	X

The table clearly shows significant variation across the Scandinavian countries with respect to whether the substances have generic competition or not. In Norway five of the 52 substances under trinnpris regulation do not have any generic sales (only brand-name sales, despite the fact that they have been included in the reference price (trinnpris) regulation. In Denmark and Sweden 8 of the 52 trinnpris substances do not have generic sales. Notice that these are not the same 8 substances.

[19] Note that some substances also do not have brand-name sales, but only 100 percent generic sales in the Scandinavian countries (see table A.2 in the Appendix). We have, however, included these in the comparisons, since the main distinction is between whether a substance has generic sales or not.

Interestingly, there is far from perfect overlap between the countries when looking at the absence of generic competition. The substances Atorvastatin and Rivastigmine do not have generic competition in any of the three countries. However, the substances Cabergoline, Mianserin and Mirtazapine have generic sales in Denmark and Sweden, but not in Norway. The substance Pivmecillinam has generic competition in Norway and Denmark, but not in Sweden, whereas the substance Ranitidine has generic competition in Norway and Sweden, but not in Denmark. The rest of the substances listed in table 5.3 have generic competition in Norway, but not in Denmark and Sweden.

In the sub-index called price indices with *same competitive environment* we match substances that *have or do not have* generic competition in both Norway and the relevant reference country. This means that for the comparison of the price level between Norway and Denmark all the drugs listed in table 5.3 except for Atorvastatin, Ranitidine and Rivastigmine would drop out of the price comparison between Norway and Denmark, resulting in a price comparison based on 43 substances. The same procedure applies to Sweden and the rest of the reference countries.

The final sub-index we computed restricts price comparisons only to the trinnpris substances where we observe *generic competition* in Norway and the reference country. This implies that we lose all five substances without generic competition in Norway (Atorvastatin, Cabergoline, Mianserin, Mirtazapine and Rivastigmine). In addition, we also lose all substances without generic competition in the reference country. For price comparison with Denmark this implies that all of the substances listed in table 5.3, except for Ranitidine, are not included, yielding in total a reduction of 11 substances.

The question is which of the price indices offers the “right” picture of the price levels between Norway, Denmark, Sweden or any of the other reference countries. Our view on this is that it depends on the question that one asks. If the question simply is what would the consumption of drugs under trinnpris regulation cost if we imported the prices in Sweden or Denmark. The answer is, looking at table 5.2, that it would cost us 12.8 per cent more if we import the Swedish prices or 34.8 per cent more if we import the Danish prices.

However, some would argue that we are now comparing “apples with oranges” since some of the products in Sweden and Denmark are not having generic sales. Looking closer at this argument tells us also that some of the trinnpris substances do not have generic sales in Norway either. In fact, we observe quite a large variation across countries in terms of whether the substances do have generic competition. Some have generic competition in Sweden, but not in Denmark. The same pattern applies to the rest of the reference countries.

One interesting question is why we observe such variation in generic competition across European countries for the same substances. First, patent regulation is to a large extent harmonized across Europe, implying that cross-country variation in generic competition must be due to national differences in implementation and/or enforcement of the patent legislation if this is the reason. Second, price controls and reimbursement policies (like price caps and reference pricing) vary substantially across countries, stimulating generic competition in different degrees. Third, market conditions (market size, income, morbidity, etc.) are likely to influence the profitability of generic competition.

If we restrict our sample to comparisons only of prices of substances with generic competition, we rule out the price effects of national variations in regulation and reimbursement policies, which many people would argue is the very source of difference of prices across Europe. Whether this is reasonable or not depend on the question that is asked. If the question is what the Norwegian consumption of the products under trinnpris regulation cost if we import the foreign price levels, then the overall price indices for this group of products would provide the answer. The low price level in Norway could then be explained by the trinnpris scheme, the market incentives for generic entry, the patent regulation, the price regulation, the reimbursement level, etc. The price indices provide a descriptive measure of price levels, and do not say anything about the source of the low price level. If we restrict the price comparison to substances which face generic competition in Norway and the reference country, then we control for the fact that different countries have different competitive environments irrespective if this is due patent regulation, reimbursement policies, price regulations, etc. The question is thus what we would like to analyse.

Chapter 6. Price indices for brand-name and generic drugs in the off-patent market

In this chapter we compute separate price indices for brand-name and generic drugs in the off-patent market segment where the brand-name producers face competition from generic producers.[20] When computing the brand-name (generic) price indices, we exclude all generic (brand-name) sales, and use the Norwegian consumption of brand-names (generics) as weights. We compute bilateral price indices for brand-name and generic products that are common to Norway and each reference country. The comparisons are based on pack prices or (volume-weighted) average substance (dose) prices, as in the previous chapters. We compute overall price indices for the brand-names and generics, but also the sub-indices for the products subject to reference pricing (trinnpris) in Norway. We first report the results for the brand-name price indices, and then for the generic price indices.

6.1. Price comparisons of brand-name drugs in the off-patent market

The bilateral price indices for brand-name products based on prices of matching packs and on volume-weighted average dose prices of matching substances are reported below in table 6.1 and 6.2, respectively. We see from the tables that Norway consistently has the lowest brand-name prices irrespectively of whether we base the comparisons at pack or substance level.

Comparing prices of identical brand-name packs, we see that Norway has the lowest prices at both wholesale (AIP) and pharmacy (AUP) level. At pharmacy level, UK and Belgium has the second and third lowest price levels, being 7.8 and 20.6 per cent more expensive than Norway, respectively. In the other end of the scale, we find Denmark and Germany with almost 80 per cent higher brand-name prices.

The same picture appears for the subsample of brand-name products (with generic competition) that are under reference price (trinnpris) regulation, with the exception of UK that is about 6 per cent cheaper than Norway at pharmacy (AUP) level. For this subgroup of brand-name drugs, Denmark and Germany have about 130 to 140 per cent higher brand-name prices than Norway.

As mentioned before, a major problem with comparing pack prices is that the sample of products is not representative for Norway or the reference countries. The reason is due to the large variation across countries in pack sizes, formulations and strengths, which reduce the sample of products in both countries. For instance, we see from table 6.1 that the number of matching brand-name packs between Norway and Sweden is 246. Comparing this with the total number of brand-name packs (with generic competition) in the sample, we see from table 3.2 that the number is 461 in Norway and 652 in Sweden. Thus, we lose about half of the packs sold in Norway and almost 2/3 of the packs sold in Sweden. We therefore focus on the volume-weighted average substance prices in the following.

[20] Note that the price indices for brand-name products in the on-patent segment (without generic competition) are reported in Chapter 4, Table 4.1-4-3.

Table 6.1: Bilateral price indices for brand-name products with generic competition based on prices of identical packs at wholesale (AIP) and pharmacy (AUP) level.

	Norway	Sweden	Denmark	Finland	UK	Germany	Netherlands	Belgium	Austria	Ireland
Indices brand names										
AIP per pack	100	153.0	192.9	106.1	132.0	169.4	135.2	116.2	121.4	181.8
AUP per pack	100	158.9	179.7	125.9	107.8	179.4	128.8	120.6	128.8	168.2
Number of substances		68	56	59	48	51	44	46	40	46
Number of packs		246	202	236	131	139	126	106	107	117
Indices brand names subject to reference pricing (trinnpris)										
AIP per pack	100	182.3	270.3	107.7	114.9	226.2	172.6	114.9	100.9	154.9
AUP per pack	100	171.1	242.8	128.0	94.3	230.5	151.7	117.0	101.5	138.9
Number of substances		33	27	32	26	26	19	26	23	24
Number of packs		134	104	144	73	78	64	71	60	64

Table 6.2: Bilateral price indices for brand-name products with generic competition based on volume-weighted substance (dose) prices at wholesale (AIP) and pharmacy (AUP) level

	Norway	Sweden	Denmark	Finland	UK	Germany	Netherlands	Belgium	Austria	Ireland
Indices brand names										
AIP	100	141.1	208.4	119.4	136.8	200.4	127.8	169.1	108.4	138.7
AUP	100	137.5	194.2	139.8	118.6	214.8	134.8	176.8	116.5	131.8
Number of substances		89	71	83	84	84	87	79	78	77
Indices brand names subject to reference pricing (trinnpris)										
AIP	100	172.5	286.2	110.8	165.9	204.3	140.2	155.4	115.2	137.7
AUP	100	164.9	261.5	131.0	143.2	209.8	150.2	161.9	124.9	131.2
Number of substances		38	34	41	39	38	38	39	37	37

From table 6.2 we see that the bilateral price indices based on average substance dose prices produce a qualitatively similar picture as the indices based on prices of identical packs. Indeed, Norway has the lowest prices on brand-name (facing generic competition) across the ten European countries. However, the indices are not identical in quantitative terms. At pharmacy (AUP) level, Austria and UK have 16.5 and 18.6 per cent, respectively, higher brand-name prices than Norway. In the other end of the scale, we find Denmark and Germany with 94.2 and 114.8 per cent higher brand-name prices, respectively, than Norway.

Considering the subsample of brand-names that are subject to reference pricing (trinnpris), the same picture appears. Norway is still the cheapest country, followed by Austria and Finland that have 25 and 31 per cent higher prices, respectively. In this category of products, Denmark has by far the highest brand-name price level being 161 per cent more expensive than Norway.

The use of average substance prices generates a more representative sample. First, the number of matching substances increases using this approach. This can be readily verified by comparing table 6.1 and 6.2. For instance, the number of matching substances between Norway and Sweden is 89 when using average substance prices, whereas the same figure is 68 when basing the comparison on identical packs. Second, the average substance price is computed using all sales information. Thus, the number of packs that forms the basis for price comparisons is much higher, and thus more representative.

6.2. Price comparisons of generic drugs

We now proceed by considering the bilateral price indices for generic drugs, excluding all brand-name sales from the computations. First, we compare prices of identical packs. For generic products this raises a special concern, since there are several generic producers often offering the same pack. Thus, we need to generate a “representative” pack price when we have multiple generic producers offering the same pack. We do so by computing the volume-weighted average generic pack price using country-specific sales volumes, which we claim is the most representative pack price in each country when the same pack is offered by several generic producers. Second, we compare the volume-weighted average substance price of generic products across countries, where the procedure is as in the previous analysis.

If we look at the bilateral indices based on prices of matching packs in table 6.3, we see that most countries are cheaper than Norway. Indeed, in UK generic drug prices are about 45 per cent lower than in Norway at pharmacy level. Thus, if Norway “imported” the UK pharmacy price level, a cost-saving of 45 per cent on the generic drug sales could be realized. The only countries that have higher generic drug prices than Norway are Germany and Belgium when we base our comparisons on identical packs.

Table 6.3: Bilateral price indices for generic drugs based on identical packs at wholesale (AIP) and retail (AUP) level.

	Norway	Sweden	Denmark	Finland	UK	Germany	Netherlands	Belgium	Austria	Ireland
Indices for generic substances										
AIP per pack	100	65.1	102.1	96.2	65.9	117.3	72.5	213.0	90.5	128.4
AUP per pack	100	70.5	78.5	85.8	54.4	127.3	80.2	141.8	76.9	97.0
Number of substances		88	87	87	62	75	71	68	64	63
Number of packs		356	326	328	136	269	191	186	147	138
Indices for generic substances subject to reference pricing (trinnpris)										
AIP per pack	100	53.5	84.2	97.3	102.1	142.8	103.6	241.7	178.0	381.4
AUP per pack	100	56.9	59.8	81.2	67.0	126.0	86.5	149.7	125.7	247.3
Number of substances		39	40	42	25	37	33	35	34	32
Number of packs		174	176	197	63	149	103	128	81	78

Table 6.4: Bilateral price indices for generic drugs based on volume-weighted average substance dose prices at wholesale (AIP) and retail (AUP) level.

	Norway	Sweden	Denmark	Finland	UK	Germany	Netherlands	Belgium	Austria	Ireland
Indices for generic substances										
AIP per dose	100	86.5	126.2	104.3	123.0	160.8	95.1	196.8	190.2	371.6
AUP per dose	100	84.1	100.0	96.9	93.2	175.1	114.9	173.7	156.0	258.9
Number of substances		103	98	101	101	100	106	94	98	95
Indices for generic substances subject to reference pricing (trinnpris)										
AIP per dose	100	64.9	104.2	111.8	106.5	196.5	73.8	222.0	238.0	500.7
AUP per dose	100	63.9	78.1	93.6	78.5	159.1	109.1	156.1	171.5	315.3
Number of substances		40	41	45	39	39	40	39	40	38

If we look at the sub-indices based on the generic products that are subject to reference pricing (trinnpris) in Norway, we see that the cheapest country is Sweden with about 43 per cent lower prices on generic drugs than Norway. For this subsample of generic products, Austria, Belgium, Germany, and Ireland have higher prices than Norway. Notice, however, how sensitive the results are to the sample of products. If we look at Ireland, we see that they have about the same price level of generic drugs as Norway if we compare all matching packs of generic drugs. However, if we restrict the sample to generic products subject to reference pricing (trinnpris) in Norway, Ireland is suddenly 147 per cent more expensive than Norway. This illustrates our main point about generating a representative sample.

Comparing prices of identical packs ensures a high degree of precision, but is likely to generate a non-representative sample of products in Norway and the reference countries due to the severe reduction in the number of packs that forms the basis for the price comparisons, as illustrated by the case of Ireland. Comparing the number of matching generic packs in table 6.3 with the total number of generic packs on the market in Norway and the reference countries given by table 3.3, we see a significant difference. For instance, the number of generic packs is 600 in Norway and 1020 in Sweden, whereas the number of matching generic packs is 356. Thus, we lose about half of the packs in Norway and 2/3 of the packs in Sweden, when computing price indices based on identical packs. The resulting figures are likely to be biased and non-representative for the difference in price levels between Norway and the reference countries.

To ensure a higher degree of representativity, we compute bilateral price indices based on the sales-weighted average substance prices. As described above, this approach exploits price and sales information of all products that are sold in each country. The sample of generic products that forms the basis for the computation of the price indices is much larger and more likely to generate representative prices for each country.

The results are reported in table 6.3. If we look at *all* generic products, Sweden comes out as the cheapest country with about 16 per cent lower prices than Norway. UK and Finland also have lower prices of generic drugs, whereas Denmark has about the same price level as Norway. In the other end of the scale, we find Ireland with more than 150 per cent higher generic drug prices than Norway. Also Germany and Belgium have fairly high prices of generic drugs.

If we look at the sub-indices for the generic products that are subject to reference pricing (trinnpris) in Norway, we see that Sweden is still the cheapest country. The price difference is now larger with Sweden having about 36 per cent lower prices on this sample of generic drugs. Also Denmark, Finland and UK have lower prices on the generic drugs that are under reference pricing (trinnpris) in Norway. In the other end of the scale, we find Ireland, Austria, Germany and Belgium, which all have significantly higher prices than Norway for this sample of generic drugs.

Looking only at the generic sales, we see that the price level in Norway is no longer at the low-price end. Our results point at potential cost savings for Norway in the generic market segment, especially by importing prices from Sweden, which has the lowest prices on the generic products in our sample. However, this conclusion does not account for the prices and sales of brand-names that face generic competition. Indeed, we found that Norway had consistently the lowest brand-name prices in the off-patent market segment. Thus, the net effect of importing foreign price levels is much more moderate when accounting for the brand-name price level. In fact, as shown in the previous chapters, there is not much to gain in terms for cost-savings if we import the prices for both brand-names and generics.

Whether cost-savings can be realized by importing generic prices from, say, Sweden would depend on the regulatory mechanism that the government would impose and on the market dynamics. For instance, it would be important to know how the brand-name and generic producers respond in terms of pricing and sales effort to various regulatory schemes. As pointed out in, for instance, Brekke, Grasdal and Straume (2009) and Brekke, Holmås and Straume (2011) the response from pharmaceuticals producers can be very different depending on whether one uses price caps or reference prices to reduce pharmaceutical expenditures.

7. Regression analyses

In this part of the report we analyse differences in pharmacy prices and margins using regression analyses. An advantage of this kind of analysis compared with calculating indices is that it is possible to study price differences between countries corrected for the fact that other aspects may also vary. We have for example seen that pack size varies considerably. Correcting for pack size in the regressions means (in somewhat simplified terms) that we compare prices between countries for identical pack sizes. In the analyses we would also like to correct for the proportion of each active substance sold as tablets. When we analyse price differences for all active substances, we also include a variable controlling for whether or not there is generic competition. We have also tried to use the strength of the pharmaceutical as an explanatory variable, but as this had no significant effect we have chosen to omit this variable from the analyses. In analyses of this kind, we can also correct for the fact that not all countries are represented with the same active substances in the data set. We do this by including a dummy variable for each active substance[21], which implies that we are comparing the prices of the identical active substances. In these analyses, we will therefore expect the results (the differences between the countries) to be less sensitive to which active substances we include in the analyses.

7.1. Pharmacy prices (AUP)

In the regression analyses, we have chosen to focus on volume-weighted average prices (see Chapter 4 for an explanation of how these have been calculated). In these analyses, we use dummy variables to identify price differences between countries. In other words, we have, for each country, constructed a variable with value 1 for all price observations for that country, while the variable has the value 0 for price observations for all other countries. As we have 10 countries, we obtain 10 such dummy variables. To be able to identify the effect of these variables, i.e. how much of the price differences they explain, we must omit a variable. We have chosen to omit the variable for Norway, which means that we compare prices in the other countries with prices in Norway. For example, we can see from the results in Table 7.1 below that the estimated effect of the variable "Finland" is 0.094, which means that prices in Finland are 9.4 per cent higher than in Norway (this interpretation is due to the fact that prices are in logarithmic form). A negative value could accordingly be interpreted as how many per cent lower the average price was, compared with the price level in Norway. However, it is important to note whether or not the estimated effect of the variable is statistically significant. If we consider the coefficient for "Denmark", this has a value equal to 0.057. As this is not statistically significant (coefficients that are statistically significant are asterisked), we conclude that average prices in Denmark do not differ from those in Norway.

In Table 7.1 we present the results from regression analyses where we use all active substances (columns 2-4) and only global active substances (columns 5-7). We further distinguish the active substances according to whether they are on or off patent. In the same way as when we compared price levels using indices, we also find here that Norway proves to have relatively low pharmaceutical prices. As expected, the results are relatively similar if we analyse the entire sample of pharmaceuticals or only consider the sample of global pharmaceuticals. When

[21] We estimate fixed effect models.

discussing the results, we therefore only focus on the total sample. We can also see from the table that the price differences are not as great as when we compared the price indices in the previous chapter. Part of the reason for this may be that, in this part of the analysis, we do not weight the prices with Norwegian consumption weights.

If we focus on all substances for the entire sample (column 2), we find that Germany and Ireland have clearly the highest prices, approximately 35 and 22 per cent higher respectively than in Norway. Austria, Belgium, Finland and Netherlands also have higher prices (from 8.3 to 16.3 per cent higher) than in Norway, while Denmark and Sweden have price levels that do not differ significantly from the Norwegian price level. United Kingdom is the only country with a price level significantly lower than Norway (31 per cent).

Table 7.1 Differences in pharmacy prices (AUP), volume-weighted substance prices.

	Total sample			Global substances		
	All substances	Substances without generic competition	Substances with generic competition	All substances	Substances without generic competition	Substances with generic competition
Sweden	-0.017	0.056*	-0.130*	-0.033	0.060	-0.155**
	(0.037)	(0.035)	(0.074)	(0.043)	(0.040)	(0.079)
Denmark	0.057	0.202***	-0.155**	0.024	0.199***	-0.193***
	(0.038)	(0.036)	(0.075)	(0.044)	(0.041)	(0.080)
Finland	0.094**	0.168***	-0.025	0.103**	0.206***	-0.033
	(0.038)	(0.036)	(0.074)	(0.043)	(0.041)	(0.079)
Netherlands	0.083**	0.058*	0.071	0.057	0.063	0.005
	(0.038)	(0.035)	(0.074)	(0.043)	(0.041)	(0.079)
Austria	0.163***	0.157***	0.154**	0.173***	0.170***	0.166**
	(0.038)	(0.037)	(0.074)	(0.043)	(0.041)	(0.080)
United Kingdom	-0.305***	-0.302***	-0.350***	-0.324***	-0.284***	-0.403***
	(0.038)	(0.037)	(0.074)	(0.043)	(0.041)	(0.079)
Belgium	0.102**	0.062	0.138*	0.121**	0.082*	0.173**
	(0.044)	(0.040)	(0.082)	(0.050)	(0.046)	(0.088)
Germany	0.345***	0.288***	0.383***	0.335***	0.295***	0.340***
	(0.038)	(0.035)	(0.075)	(0.043)	(0.041)	(0.079)
Ireland	0.218***	0.195***	0.238***	0.204***	0.205***	0.207***
	(0.0038)	(0.036)	(0.074)	(0.043)	(0.041)	(0.079)
Pack size	-0.0024***	-0.0028***	-0.0023***	-0.0022***	-0.0022***	-0.0021***
	(0.0003)	(0.0004)	(0.0004)	(0.0003)	(0.0005)	(0.0004)
Proportion tablets	-0.113***	-0.051	-0.179**	-0.175***	-0.024	-0.061
	(0.046)	(0.040)	(0.092)	(0.044)	(0.044)	(0.097)
Generic competition	-0.157***	-	-	-0.175***	-	-
	(0.038)			(0.044)		
Constant	2.401***	3.029***	1.423***	2.173***	2.728***	1.344***
	(0.040)	(0.036)	(0.077)	(0.047)	(0.043)	(0.084)
Dummy for molecule	yes	yes	Yes	yes	Yes	Yes
Number of molecules	282	164	118	210	112	98
Number of observations	2657	1518	1139	2100	1120	980
R^2	0.173	0.226	0.175	0.172	0.232	0.174

***: significant at 1 per cent level. **: significant at 5 per cent level. *: significant at 10 per cent level.

In the same way as previously, we also distinguish active substances according to whether or not they have generic competition in Norway. If we focus on the total sample of active substances for which we do not observe generic competition (column 3 in the Table), we see that Norway has significantly lower pharmaceutical prices than all other countries with the exception of the United Kingdom and Belgium. Average pharmaceutical prices for active substances without generic competition are approximately 30 per cent lower in the United Kingdom than in Norway, while the price level in Belgium is not significantly different from that in Norway. For the other countries, the ranking is as follows (with the relative price difference from Norway in brackets): Germany (29%), Denmark (20%), Ireland (20%), Finland (17%), Austria (16%), the Netherlands (6%) and Sweden (6%).

If we consider price differences for pharmaceuticals with generic competition, we find that United Kingdom (35%), Denmark (16%) and Sweden (13%) have significantly lower prices than Norway (see column 4). For Finland and the Netherlands we do not find significantly different prices compared to Norway, while the price levels in Germany (38%), Ireland (24%), Austria (15%) and Belgium (14%) are higher all than in Norway.

7.2. Pharmacy margins

In Table 7.2 below, we present the results from regression analyses in which we analyse how pharmacy margins vary between countries. We carry out the same classification of active substances as above (all active substances in the sample, active substances available in all countries (global), active substances without generic competition in Norway and active substances with generic competition in Norway) and use the same explanatory variables. The dependent variable (pharmacy percentage margin) is given by

$$M = \frac{AUP - AIP}{AUP},$$

Where AUP and AIP are calculated as volume-weighted average prices. In the same way as previously, we use dummy variables to identify differences between countries. We use Norway as a comparison country; if we look at Table 7.2, column 2, we find for example that Denmark has a value equal to -0.020. This means that the (percentage) margin is on average 2 percentage points lower in Denmark than in Norway. If we start by looking at all active substances, we see, as above, that the results vary little whether we use the total sample or only the global active substances. Focusing on the former, we find that Finland has clearly the highest percentage margins, 10.5 percentage points higher than in Norway. The average margin in Norway is 17.9 per cent (given by the constant in the model), i.e. the average margin in Finland is 28.4 per cent (17.9 + 10.5). The Netherlands, Germany, Austria and Belgium also have significantly higher percentage margins than Norway, while United Kingdom, Ireland and Denmark have lower margins. Pharmacy margins in Sweden are not significantly different from those in Norway.

Table 7.2 Differences in pharmacy percentage margins.

	Total sample			Global substances		
	All substances	Substances without generic competition	Substances with generic competition	All substances	Substances without generic competition	Substances with generic competition
Sweden	0.005	-0.005	0.023	0.004	-0.001	0.013
	(0.008)	(0.008)	(0.014)	(0.009)	(0.009)	(0.015)
Denmark	-0.020**	0.002	-0.050***	-0.021**	0.007	-0.051***
	(0.008)	(0.008)	(0.015)	(0.010)	(0.009)	(0.015)
Finland	0.105***	0.150***	0.043***	0.107***	0.163***	0.044***
	(0.008)	(0.008)	(0.014)	(0.009)	(0.009)	(0.015)
Netherlands	0.086***	0.058***	0.127***	0.090***	0.059***	0.130***
	(0.008)	(0.008)	(0.014)	(0.009)	(0.008)	(0.015)
Austria	0.033***	0.092***	-0.048***	0.032***	0.108***	-0.057***
	(0.009)	(0.008)	(0.015)	(0.010)	(0.009)	(0.015)
United Kingdom	-0.078***	-0.067***	-0.093***	-0.076	-0.063***	-0.090***
	(0.009)	(0.008)	(0.014)	(0.010)	(0.009)	(0.015)
Belgium	0.025**	0.037***	0.007	0.016	0.039***	-0.005
	(0.010)	(0.009)	(0.017)	(0.011)	(0.010)	(0.019)
Germany	0.059***	0.050***	0.076***	0.062***	0.057***	0.068***
	(0.008)	(0.008)	(0.015)	(0.009)	(0.009)	(0.015)
Ireland	-0.051***	0.018**	-0.146***	-0.052***	0.030***	-0.145***
	(0.0008)	(0.008)	(0.014)	(0.009)	(0.009)	(0.015)
Pack size	-0.0001	-0.0003***	-0.0003	-0.0003	-0.0005	-0.0001
	(0.0006)	(0.0001)	(0.0007)	(0.0008)	(0.0010)	(0.0001)
Proportion tablets	0.035***	0.0122	0.060***	0.027***	0.013	0.048***
	(0.010)	(0.0093)	(0.018)	(0.011)	(0.010)	(0.019)
Generic competition	0.026***	-	-	0.016***	-	-
	(0.008)			(0.010)		
Constant	0.179***	0.144***	0.271***	0.192***	0.127***	0.285***
	(0.009)	(0.008)	(0.015)	(0.010)	(0.010)	(0.016)
Dummy for molecule	yes	Yes	Yes	Yes	Yes	Yes
Number of molecules	282	164	118	210	112	98
Number of observations	2657	1518	1139	2100	1120	980
R^2	0.269	0.402	0.370	0.281	0.469	0.376

***: significant at 1 per cent level. **: significant at 5 per cent level. *: significant at 10 per cent level.

If we distinguish the active substances according to whether or not we observe generic competition (column 3 and 4), the results change somewhat. Focusing on substances without generic competition, we find that only United Kingdom has significantly lower pharmacy margins than Norway. Pharmacy margins in Sweden and Denmark seem to be equal to those in Norway, while all other countries have significantly higher margins. For substances with generic competition, Ireland, United Kingdom, Denmark and Austria have significantly lower pharmacy margins than Norway. Sweden and Belgium have margins at the Norwegian level, while the Netherlands, Germany and Finland have significantly higher pharmacy margins.

8. Concluding remarks

In this study we have compared prices of pharmaceuticals in Norway with the following nine Western European countries: Austria, Belgium, Denmark, Finland, Germany, Ireland, the Netherlands, UK and Sweden. These reference countries comprise the basket for the Norwegian price cap regulation and are considered to be fairly similar and comparable countries. The purpose of this study has been to develop a sound method for cross-country price comparisons of pharmaceuticals and to analyse what the Norwegian consumption of pharmaceuticals would cost if we imported the prices from our reference countries.

To analyse these questions, we have made use of data from IMS Health containing detailed sales information of a large set of pharmaceuticals in the ten European countries for the first six months of 2010. The data cover all prescription bound sales in Norway and the reference countries for the 300 most selling substances in Norway. The data contain monthly information of prices and volumes (number of packs and doses) at wholesale and retail level per pack and per dose, as well as other details such as manufacturer, product type (brand-name or generic), pack size, strength, presentation form, etc.

Since pharmaceuticals are heterogeneous products, there is a trade-off between precision and representativity when doing the price comparisons. We have made use of two different approaches that fulfil these criteria in opposite degrees. First, we compared prices of identical packs. This approach maximizes precision, but has the disadvantage that the sample is likely to become non-representative due to a large reduction in the number of packs that constitute the basis for price comparisons. Thus, the resulting price differences would be biased and potentially incorrect, since they are not representative for the price level in Norway and/or the reference countries. Second, we compared volume-weighted average substance (dose) prices. This measure makes use of all price and sales information in each country, and thus maximizes the degree of representativity in the price comparisons. We have argued that using average substance (dose) prices is a more reliable approach to measure price differences across countries, since it is generally based on a larger and more representative sample of products.

We have computed a large set of price indices based on pack prices or substance prices using the Norwegian consumption pattern as the benchmark. First, we have computed price indices for the whole sample of products. These indices showed that Norway only UK had lower prices at retail level. This finding was robust to whether we compared prices of identical packs or average substance prices. In the other end of the scale we found Germany and Ireland. Second, we restricted the price comparisons to on-patent products (i.e., brand-names without generic competition). The price indices for this sample of products were very similar to the overall price indices, with only UK having a lower price level than Norway. These findings suggest limited scope for cost-savings by importing prices of pharmaceuticals from our reference countries.

Third, we restricted attention to products under reference price (trinnpris) regulation in Norway. Since this group of products got special attention in the media lately, we described in greater detail our data, method for comparison, and results. In particular, we produced a separate table of prices and sales in the Scandinavian countries, and computed different price indices depending on whether or not we observed generic competition in Norway and/or the reference countries. If compared prices of all products under trinnpris regulation, we found that Norway had the lowest price level. However, when we restricted the sample to products that faced the same competitive situation (i.e., generic competition or not) in Norway and the reference countries, then UK and Sweden became cheaper, whereas the rest of the countries were still more expensive than Norway. Finally, we compared the prices of products that faced generic competition in Norway and the reference countries. In this case, also Denmark had a lower price level. Thus, there seems to be some potential for cost savings on the products that face generic competition, but not for the overall set of products, including the brand-name sales, under trinnpris regulation.

Fourth, we computed separate price indices for brand-name and generic products in the off-patent market segment. The bilateral price indices for these two groups of products showed very different rankings. For the brand-name products (with generic competition), Norway had the lowest prices, whereas for the generic products the price level in Norway were more at the average or higher end of the scale. The same picture appeared for the brand-name and generic products subject to reference pricing (trinnpris). Thus, our results suggest a potential for cost-savings on generic drugs if we could import prices from low-price countries such as Sweden or UK.

By way of conclusion, we would like to make two remarks. First, the cost savings suggested by the price indices implicitly assumes that there would be no demand and price responses to the "import" of foreign price levels. This is of course a strong and fairly unreasonable assumption. It is plausible to assume that lower prices on some products would increase demand for these products. Moreover, lower prices on some products are also likely to generate price responses on competing products. Thus, the actual cost savings would depend on the demand and price responses generated by the lower price level enforced on a specific group of drugs.

Second, the results based on the price indices do not say anything about the mechanisms that could be used to import the foreign price levels and their effects. One way of importing prices from abroad is through price cap regulation such as the system in place in Norway. This mechanism directly enforces lower prices on brand-names, but the demand and price responses on generics are less clear. Another way to implement lower prices is to reduce the reimbursement rates for the products under reference pricing (trinnpris). This is also likely to affect the pricing and demand for brand-names and generics, so that the actual cost savings might be different than the ones suggested by the price indices. Brekke et al. (2009, 2011) have studied the price and demand effects of using price cap or reference price regulation, which might give some guidance in estimating cost-savings when imposing lower price levels through regulation.

Appendix

Table A: Prices and volumes in Scandinavia for substances under trinnpris regulation.

			Norway		Sweden		Denmark	
Substance name	Weight	Brand / Generic	Price (AUP)	Volume (doses)	Price (AUP)	Volume (doses)	Price (AUP)	Volume (doses)
ALENDRONIC ACID	0.0034	TOT	12.39	1 190 130	6.12	1 793 754	5.88	1 521 836
ALENDRONIC ACID		GEN	10.95	1 071 874	5.39	1 693 752	3.15	1 472 392
ALENDRONIC ACID		ORG	25.52	118 256	18.40	100 002	87.25	49 444
AMLODIPINE	0.0507	TOT	1.17	17 587 930	0.54	42 991 696	0.44	46 140 064
AMLODIPINE		GEN	1.02	15 361 940	0.48	40 705 814	0.37	45 557 236
AMLODIPINE		ORG	2.20	2 225 990	1.54	2 285 884	5.74	582 830
AMOXICILLIN	0.0075	TOT	3.24	2 608 321	3.97	3 496 677	3.87	3 576 761
AMOXICILLIN		GEN	2.79	1 692 830	3.96	3 481 443	3.81	2 335 366
AMOXICILLIN		ORG	4.08	915 491	5.99	15 234	3.99	1 241 395
ATENOLOL	0.0193	TOT	0.61	6 712 368	0.52	40 218 748	0.34	5 849 412
ATENOLOL		GEN	0.61	4 796 368	0.50	31 212 928	0.32	4 648 112
ATENOLOL		ORG	0.62	1 916 000	0.59	9 005 820	0.41	1 201 300
ATORVASTATIN	0.0404	TOT	4.25	14 035 214	11.48	12 621 866	11.64	7 483 968
ATORVASTATIN		GEN	-	-	-	-	-	-
ATORVASTATIN		ORG	4.25	14 035 214	11.48	12 621 866	11.64	7 483 968
CABERGOLINE	0.0002	TOT	10.81	75 460	18.59	97 662	37.98	68 868
CABERGOLINE		GEN	-	-	28.47	11 472	28.35	8 208
CABERGOLINE		ORG	10.81	75 460	17.27	86 190	39.28	60 660
CARVEDILOL	0.0144	TOT	1.12	4 994 622	0.80	4 735 920	0.76	8 698 680
CARVEDILOL		GEN	1.11	4 986 446	0.70	4 113 020	0.68	8 455 768
CARVEDILOL		ORG	7.32	8 176	1.41	622 900	3.56	242 912
CETIRIZINE	0.0832	TOT	0.86	28 883 720	0.68	10 765 440	1.76	2 953 550
CETIRIZINE		GEN	0.59	24 859 780	0.58	10 280 460	1.76	2 953 550
CETIRIZINE		ORG	2.48	4 023 940	2.59	484 980	-	-
CIPROFLOXACIN	0.0046	TOT	4.20	1 605 675	3.43	3 406 988	2.22	4 728 389
CIPROFLOXACIN		GEN	4.80	1 038 550	3.33	2 947 352	2.14	4 720 465
CIPROFLOXACIN		ORG	3.09	567 125	4.09	459 636	53.67	7 924
CITALOPRAM	0.0151	TOT	1.67	5 237 710	0.60	39 526 588	1.08	27 305 414
CITALOPRAM		GEN	1.36	4 655 066	0.55	39 134 574	0.71	26 059 142
CITALOPRAM		ORG	4.15	582 644	5.87	392 014	8.77	1 246 272
CLARITHROMYCIN	0.0010	TOT	8.83	363 551	9.95	159 200	16.47	404 335
CLARITHROMYCIN		GEN	6.57	212 583	4.95	79 632	13.52	267 280
CLARITHROMYCIN		ORG	12.01	150 968	14.95	79 568	22.22	137 055
DICLOFENAC	0.0578	TOT	1.13	20 054 996	1.18	38 221 592	2.10	9 354 585
DICLOFENAC		GEN	1.18	7 078 850	1.10	32 612 220	1.92	8 342 775
DICLOFENAC		ORG	1.11	12 976 145	1.68	5 609 370	3.61	1 011 810

DONEPEZIL	0.0036	TOT	11.85	1 238 498	25.68	2 574 914	31.25	1 375 878
DONEPEZIL		GEN	10.62	1 116 512	-	-	-	-
DONEPEZIL		ORG	23.06	121 986	25.68	2 574 914	31.25	1 375 878
ENALAPRIL	0.0206	TOT	0.97	7 148 986	0.53	79 083 200	0.38	36 154 352
ENALAPRIL		GEN	0.93	5 359 310	0.51	77 403 182	0.37	11 956 020
ENALAPRIL		ORG	1.08	1 789 676	1.27	1 680 014	0.39	24 198 330
FELODIPINE	0.0075	TOT	1.68	2 589 774	0.78	43 586 808	0.86	5 885 102
FELODIPINE		GEN	1.50	2 003 440	0.71	38 702 220	0.74	5 652 502
FELODIPINE		ORG	2.29	586 334	1.29	4 884 586	3.80	232 600
FENTANYL	0.0013	TOT	36.00	453 385	46.89	1 232 258	63.63	1 010 927
FENTANYL		GEN	32.28	400 795	45.78	1 028 631	80.89	342 666
FENTANYL		ORG	64.37	52 590	52.52	203 627	54.77	668 261
FINASTERIDE	0.0054	TOT	3.34	1 864 702	1.71	7 581 312	1.81	1 878 268
FINASTERIDE		GEN	3.26	1 110 158	1.03	6 828 868	0.74	1 717 184
FINASTERIDE		ORG	3.47	754 544	7.85	752 444	13.24	161 084
FLUCONAZOLE	0.0006	TOT	25.65	196 662	15.20	757 582	6.87	1 044 403
FLUCONAZOLE		GEN	23.86	168 938	12.10	709 951	6.11	1 022 120
FLUCONAZOLE		ORG	36.57	27 724	61.46	47 631	41.61	22 283
FLUOXETINE	0.0043	TOT	3.27	1 505 970	1.03	7 948 212	2.14	2 894 210
FLUOXETINE		GEN	3.01	1 303 370	0.92	7 858 360	1.86	2 758 890
FLUOXETINE		ORG	4.92	202 600	10.08	89 852	7.85	135 320
FLUTICASONE	0.0522	TOT	1.39	18 122 536	2.00	10 161 090	2.12	11 042 552
FLUTICASONE		GEN	0.52	661 200	0.86	3 659 760	1.28	2 062 560
FLUTICASONE		ORG	1.42	17 461 336	2.64	6 501 330	2.32	8 979 992
GLIMEPIRIDE	0.0218	TOT	0.85	7 566 960	0.98	1 930 230	0.84	8 235 930
GLIMEPIRIDE		GEN	0.79	3 752 520	0.93	1 251 090	0.74	7 814 520
GLIMEPIRIDE		ORG	0.92	3 814 440	1.07	679 140	2.70	421 410
LANSOPRAZOLE	0.0160	TOT	2.28	5 552 756	5.85	4 224 798	1.55	15 071 194
LANSOPRAZOLE		GEN	2.11	5 436 206	3.32	782 702	1.55	15 071 194
LANSOPRAZOLE		ORG	10.17	116 550	6.43	3 442 096	-	-
LISINOPRIL	0.0123	TOT	1.36	4 268 830	0.83	2 485 856	0.62	3 128 910
LISINOPRIL		GEN	1.32	3 506 730	0.72	2 108 400	0.62	3 128 910
LISINOPRIL		ORG	1.55	762 100	1.43	377 456	-	-
LORATADINE	0.0251	TOT	1.06	8 708 780	0.82	7 511 030	2.17	2 722 200
LORATADINE		GEN	1.06	8 708 780	0.82	7 511 030	2.17	2 722 200
LORATADINE		ORG	-	-	-	-	-	-
LOSARTAN	0.0198	TOT	3.01	6 856 836	2.68	18 378 918	2.60	10 369 864
LOSARTAN		GEN	2.42	5 033 528	0.79	10 850 370	0.62	7 058 658
LOSARTAN		ORG	4.62	1 823 308	5.39	7 528 548	6.82	3 311 206

MELOXICAM	0.0044	TOT	1.87	1 539 700	2.62	448 890	1.06	114 460
MELOXICAM		GEN	1.68	1 245 470	2.62	448 890	1.06	114 460
MELOXICAM		ORG	2.65	294 230	-	-	-	-
METOPROLOL	0.1238	TOT	1.08	42 975 096	1.17	91 346 448	1.27	45 619 696
METOPROLOL		GEN	0.91	28 712 910	1.00	68 366 630	1.04	36 914 390
METOPROLOL		ORG	1.42	14 262 186	1.67	22 979 820	2.26	8 705 308
MIANSERIN	0.0136	TOT	0.97	4 712 270	1.63	2 905 030	1.38	3 474 450
MIANSERIN		GEN	-	-	1.63	2 844 060	1.36	3 322 680
MIANSERIN		ORG	0.97	4 712 270	1.71	60 970	1.64	151 770
MIRTAZAPINE	0.0102	TOT	3.48	3 543 095	1.52	15 761 326	1.21	9 172 966
MIRTAZAPINE		GEN	-	-	1.45	15 603 364	1.06	8 987 166
MIRTAZAPINE		ORG	3.48	3 543 095	8.55	157 962	8.16	185 800
MOXONIDINE	0.0030	TOT	2.03	1 050 350	2.74	465 214	1.18	1 452 232
MOXONIDINE		GEN	1.79	867 244	2.50	333 936	1.18	1 452 232
MOXONIDINE		ORG	3.19	183 106	3.36	131 278	-	-
OLANZAPINE	0.0077	TOT	8.58	2 688 636	28.87	4 903 944	36.98	3 881 859
OLANZAPINE		GEN	5.27	1 937 936	-	-	-	-
OLANZAPINE		ORG	17.10	750 700	28.87	4 903 944	36.98	3 881 859
OMEPRAZOLE	0.0158	TOT	3.45	5 479 560	0.97	66 132 080	1.03	11 964 708
OMEPRAZOLE		GEN	3.07	3 890 512	0.92	65 674 044	0.85	11 823 836
OMEPRAZOLE		ORG	4.35	1 589 048	7.63	458 038	16.46	140 872
ONDANSETRON	0.0011	TOT	31.38	392 045	22.12	680 193	24.21	601 709
ONDANSETRON		GEN	25.35	315 375	14.64	572 780	15.61	539 085
ONDANSETRON		ORG	56.17	76 670	62.02	107 413	98.17	62 624
OXYCODONE	0.0151	TOT	6.00	5 250 208	4.86	14 982 291	5.96	16 069 715
OXYCODONE		GEN	7.89	1 806 780	3.67	388 514	3.61	7 564 445
OXYCODONE		ORG	5.02	3 443 428	4.89	14 593 777	8.05	8 505 270
PANTOPRAZOLE	0.0259	TOT	2.14	8 985 116	2.82	3 122 375	1.57	10 922 910
PANTOPRAZOLE		GEN	2.17	171 240	0.73	2 630 402	1.45	10 752 612
PANTOPRAZOLE		ORG	2.14	8 813 876	14.02	491 973	9.45	170 298
PAROXETINE	0.0082	TOT	2.13	2 842 512	1.10	5 990 262	1.19	3 217 134
PAROXETINE		GEN	1.89	2 185 020	0.96	5 492 680	0.78	3 049 322
PAROXETINE		ORG	2.94	657 492	2.71	497 582	8.48	167 812
PIVMECILLINAM	0.0123	TOT	3.16	4 281 480	6.47	2 963 726	5.22	5 433 330
PIVMECILLINAM		GEN	2.66	2 677 670	-	-	5.01	1 869 450
PIVMECILLINAM		ORG	4.01	1 603 810	6.47	2 963 726	5.33	3 563 880
PRAMIPEXOLE	0.0050	TOT	4.50	1 719 800	6.29	7 556 510	11.89	3 312 800
PRAMIPEXOLE		GEN	3.36	1 255 310	-	-	-	-
PRAMIPEXOLE		ORG	7.57	464 490	6.29	7 556 510	11.89	3 312 800

PRAVASTATIN	0.0086	TOT	2.96	3 016 222	1.09	3 100 090	2.52	1 281 290
PRAVASTATIN		GEN	2.18	2 523 870	0.96	3 046 680	2.52	1 281 290
PRAVASTATIN		ORG	7.01	492 352	8.13	53 410	-	-
QUETIAPINE	0.0110	TOT	4.25	3 850 830	13.44	5 111 640	14.54	9 269 750
QUETIAPINE		GEN	3.26	3 359 300	-	-	-	-
QUETIAPINE		ORG	11.02	491 530	13.44	5 111 640	14.54	9 269 750
RAMIPRIL	0.0309	TOT	0.97	10 720 744	0.69	26 845 610	0.74	20 663 672
RAMIPRIL		GEN	0.93	6 452 376	0.62	25 100 506	0.68	20 284 398
RAMIPRIL		ORG	1.04	4 268 368	1.66	1 745 104	3.77	379 274
RANITIDINE	0.0142	TOT	1.30	4 919 645	1.25	3 827 335	14.23	15 140
RANITIDINE		GEN	1.07	2 268 990	0.90	2 763 600	-	-
RANITIDINE		ORG	1.50	2 650 655	2.15	1 063 735	14.23	15 140
RISPERIDONE	0.0047	TOT	12.53	1 631 891	7.12	6 831 896	20.85	3 419 095
RISPERIDONE		GEN	2.79	1 430 000	0.92	5 370 390	1.54	3 228 026
RISPERIDONE		ORG	81.54	201 891	42.76	997 350	347.20	191 069
RIVASTIGMINE	0.0022	TOT	15.14	754 658	16.67	1 545 378	24.46	826 132
RIVASTIGMINE		GEN	-	-	-	-	-	-
RIVASTIGMINE		ORG	15.14	754 658	16.67	1 545 378	24.46	826 132
ROPINIROLE	0.0024	TOT	8.70	832 080	10.29	981 310	17.05	1 013 381
ROPINIROLE		GEN	3.29	196 224	4.17	15 666	4.65	282 282
ROPINIROLE		ORG	10.36	635 856	10.38	965 644	21.83	731 099
SERTRALINE	0.0124	TOT	2.24	4 300 505	0.99	23 816 480	1.06	6 500 262
SERTRALINE		GEN	2.09	1 200 540	0.76	21 434 162	0.70	6 268 548
SERTRALINE		ORG	2.30	3 099 965	3.12	2 382 318	10.85	231 714
SIBUTRAMINE	0.0005	TOT	5.95	182 382	10.04	526 624	11.73	56 364
SIBUTRAMINE		GEN	4.84	150 630	-	-	-	-
SIBUTRAMINE		ORG	11.19	31 752	10.04	526 624	11.73	56 364
SIMVASTATIN	0.1456	TOT	1.70	50 556 856	0.53	109 361 528	0.41	69 641 800
SIMVASTATIN		GEN	1.60	47 770 424	0.52	108 849 870	0.39	69 531 158
SIMVASTATIN		ORG	3.41	2 786 434	3.46	511 658	10.09	110 642
SUMATRIPTAN	0.0023	TOT	37.77	795 784	23.55	1 619 668	22.79	882 274
SUMATRIPTAN		GEN	13.46	431 850	6.23	1 246 468	7.05	751 126
SUMATRIPTAN		ORG	66.61	363 934	81.40	373 200	112.90	131 148
TAMSULOSIN	0.0125	TOT	2.76	4 324 650	-	-	1.21	4 282 020
TAMSULOSIN		GEN	2.54	2 418 000	-	-	0.92	4 107 450
TAMSULOSIN		ORG	3.03	1 906 650	-	-	7.81	174 570
TERBINAFINE	0.0034	TOT	5.64	1 187 050	2.62	1 150 656	2.65	1 899 394
TERBINAFINE		GEN	5.62	1 027 674	1.65	942 480	2.62	1 897 532
TERBINAFINE		ORG	5.77	159 376	7.03	208 176	29.41	1 862

VENLAFAXINE	0.0149	TOT	2.55	5 164 709	1.48	11 964 980	1.63	6 548 433
VENLAFAXINE		GEN	2.20	4 631 165	1.33	11 782 663	1.26	6 334 587
VENLAFAXINE		ORG	5.64	533 544	11.28	182 317	12.45	213 846

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