Biosimilar bidding in centralized tenders in Norway

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Abstract: Our objective is to study the competition effect of biosimilar entry in centralized tenders for an expensive category or drugs - TNF-inhibitors. We use monthly observations of prices and volumes for all brands and biosimilars in this drug category in Norway, covering the period from Jan. 2006 to Dec. 2016. Descriptive statistics and regression models are used to investigate the impact of biosimilars on the drug price and the effect of the number of brands on the intensity of competition. Both the entry of biosimilars and new branded drugs have increased competition and reduced prices. According to our estimates, an increase in the market share of biosimilars from 10 % to 60 %, will be accompanied with a 50 % reduction in the expected price. Only two years after entry, the first biosimilars in this drug category had gained a market share of 40 % in Norwegian hospitals. Although entry barriers for biosimilars are higher than for generics of chemical substances, significant cost savings are expected from patent expirations of expensive biologics as well. The centralized design of the tenders is an important institutional factor behind the strong competition effect.

JEL classification: D43, I18, I11, L11

Key words: pharmaceuticals; biosimilars; procurement; pharmaceutical competition

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1 Introduction

Biologics have brought pharmaceutical prices to new levels, supported by patent protection and ability to offer better treatment outcomes than conventional drugs based on small-molecule substances (see for example (see for example Ward *et al.*, 2019)). Patent protection, however, is of limited duration. Several of the top-selling biologics have already lost their patent protection, and many more will do so in the near future. Without patent protection, branded biologics can be challenged by biosimilars, which are drugs with an approved similarity to the original drug.

Norway has gained considerable experience in introducing competition from biosimilars in these centralized tenders. As of 2018, two of the TNF-inhibitor brands, Enbrel and Remicade, faced competition from biosimilars. In 2019, Humira was the third original brand in this group of drugs to face biosimilar competition. Detailed market data for TNF-inhibitors allow us to observe the entry strategy of competitors, together with the response of the original brands and their close substitutes.

Experience with patent expiration in pharmaceutical markets indicates that substantial price discounts are to be expected. However, this has mostly been seen for conventional drugs (see for example, Aalto-Setälä, 2008, Berndt and Dubois, 2016, and Reiffen and Ward, 2005). The same experience does not necessarily carry over to markets for biologics. For small-molecule drugs, it is relatively easy to prove equivalence with the original patented drug. With biologics, however, the same degree of equivalence cannot be proven since the different cell lines may behave differently as a therapeutic drug (European Medicine Agency, 2014). To obtain status as "biosimilars", entrants are instead required to provide evidence of similarity. The guidelines covering this issue are published by the European Medicine Agency (2014): *"Comparability studies are needed to generate evidence substantiating the similar nature, in terms of quality, safety and efficacy, of the similar biological medicinal product and the chosen reference medicinal product authorized in the EEA (European Economic Area)."*

Consequently, the legislation developed for small-molecule generics, with its procedures for granting market access and for allowing generic substitution by doctors and pharmacists, could not be applied directly to biosimilars. There was a separate need for developing the concept of a similarity of biological drugs in the legislation. This was first introduced into EU-legislation in 2001 (Directive 2001/83/EC), and further developed in 2003, with the incorporation of annex 1 into the Directive, which clarified the process for marketing authorization and preparation of biosimilars medicinal products (Directive2003/63/EC). The first biosimilar drug entered the market in Europe in 2006 (Minghetti *et al*., 2012)

With the increasing importance of biologics in pharmaceutical treatment, it is important to learn to what extent patent expiration will deliver benefits to patients and health care providers by lowering prices and increasing usage. The main objective of our study is to investigate the competition effect of biosimilars in centralized hospital procurements.

2 Background

TNF-inhibitors are used to treat a variety of auto-immune disorders, including rheumatoid arthritis (RA), psoriasis, psoriatic arthritis, ulcerative colitis, and Crohn's disease. Due to a combination of both high prices and prevalence, these drugs now account for approximately 1/3 of total pharmaceutical expenditure by Norwegian hospitals.

The responsibility of providing specialized health care services in Norway is delegated to four regional health authorities (RHAs), funded by the central government. In order to exercise buyer power on behalf of all hospitals, the RHAs have jointly established

a procurement corporation – Sykehusinnkjøp (Eng. "Hospital procurement"). The mandate of Sykehusinnkjøp is to design procurement strategies and to implement these on behalf of the four RHFs. The responsibility of pharmaceutical budgets and expenditure remain with the hospitals, but the prices are determined by the centralized tenders.

When several substitutable drugs are available, the drug with the lowest price has the status as the "preferred drug" by hospitals. Crucial for successful centralized tenders is the ability to align the behavior of hospital doctors and clinics with the agreements reached between Sykehusinnkjøp and the suppliers, including the selection of preferred drug. Since an agreement signed with a pharmaceutical company does not legally bind the treatment choice made by the individual doctor, buyer power can only be leveraged if the choice of "preferred drug" significantly affects doctors' actual choice within the hospital clinics. To establish loyalty to the preferred drug, the recommendation provided by Sykehusinnkjøp is endorsed by an expert group. A separate expert group is established for TNF-inhibitors, with medical expertise from all four RHFs. The expert group is involved in designing the tender, identifying the preferred drug for each diagnosis, and in communicating these choices to local hospitals.

Since the entry of the first two TNF-inhibitor drugs, Remicade and Enbrel, in 2000 there are by now several branded biologics available in the market considered to be sufficiently close substitutes to use price as the sole criterion for selecting the preferred drug for starting new treatment. Importantly, to be treated as substitutable, a drug does not need to be a biosimilar. Within this drug category, all brands and available biosimilars are considered as substitutes when starting treatment of new patients. For biosimilars, switching from the original brand is allowed also for patients already under treatment.

The analysis by Curto *et al*., 2014, is an earlier example of empirical investigation of the price effect of biosimilars in tenders. They look at the first generation of biosimilars in Italy, and find strong negative price effects of competition for two out of the three drugs included in their study. The main difference between their study and ours is that we undertake an in-depth study of the expensive TNF-inhibitors and that the Italian evidence is derived from decentralized tenders by 8 Italian regional health authorities.

Scott Morton *et al*., 2018, explore a rich data set with information about entry and prices, as well as procurement design (strength of tender) in European countries. They observe relatively few entrants of biosimilars, and these are found to have a slow market penetration, with moderate effects on prices. They list three reasons why we might see a weaker price effect of patent expiration for biologics than for conventional drugs:

1. Uncertainties about equivalence with original brand drug.
2. Higher variable costs of production.
3. Higher entry costs, which lead to fewer entrants.

The first reason is by now less of a concern for TNF-inhibitors than just a few years ago. Biosimilars have proven to be sufficiently close to the off-patent original biologics to accept substitution practice similar to generic substitution. One such study has been NOR-SWITCH, that examined switching from an originator TNF-inhibitor to a biosimilar version with regard to efficacy, safety, and immunogenicity. Jørgensen *et al*., 2017, conclude that the NOR-SWITCH trial showed that switching from original brand (Remicade) to the biosimilar was not inferior to continued treatment with the original brand.

Higher variable costs of production and higher entry costs for biosimilars compared with generic drugs remain valid, and our analysis of the Norwegian case contributes to the understanding of how these factors affect the market response to patent expiration. In contrast to Scott Morton *et al*., 2018, we find strong price effects of biosimilar entry.

3 Data: Brand versus its biosimilar in Norway

We received the data from Farmastat[1], providing us with information about monthly sales value and volume for all brands, spanning 11 years from January 2006 to December 2016. Volume is measured by the number of Defined Daily Doses (DDD) per month. Since a drug comes in different package sizes and with different strengths, we aggregate sales value and volume per drug to get one observation per drug and month. This gives us an unbalanced panel with 799 observations and 10 drugs.

We derive the price, NOK per DDD, by dividing sales value on the number of DDD sold per month. Importantly, these prices are calculated based on actual transaction values, and not on list prices before rebates. From 2017, however, transaction prices in this market have been treated as trade secrets. This is why we chose not to include observations from 2017 and 2018 in our study. Prices from these two years would have shown the regulated price cap only, normally far above the actual prices and not responding to submitted prices in the tenders. Table 1 lists the drugs that are present in the data, showing date of market entry in Norway and its category (original or biosimilar). The appendix provides summary statistics for the variables included in our data set, in addition to calculated average prices and market share for all 10 drugs, from 2006 to 2016.

Enbrel and Remicade entered the Norwegian market in 2000. Enbrel experienced strong growth during the first year, and became the leading drug in this category. During the fall 2003, a third drug, Humira, entered, and had a steady growth in the fast growing market. During the first 5 years with TNF-inhibitors, the reimbursement scheme varied between brands, depending on the drug's form of administration (see Dalen *et al*., 2014). From 2006, which is the start year of our data set, the costs of all TNF-inhibitors are covered by the hospital budgets.

Table 1: Biologics included in the analysis.

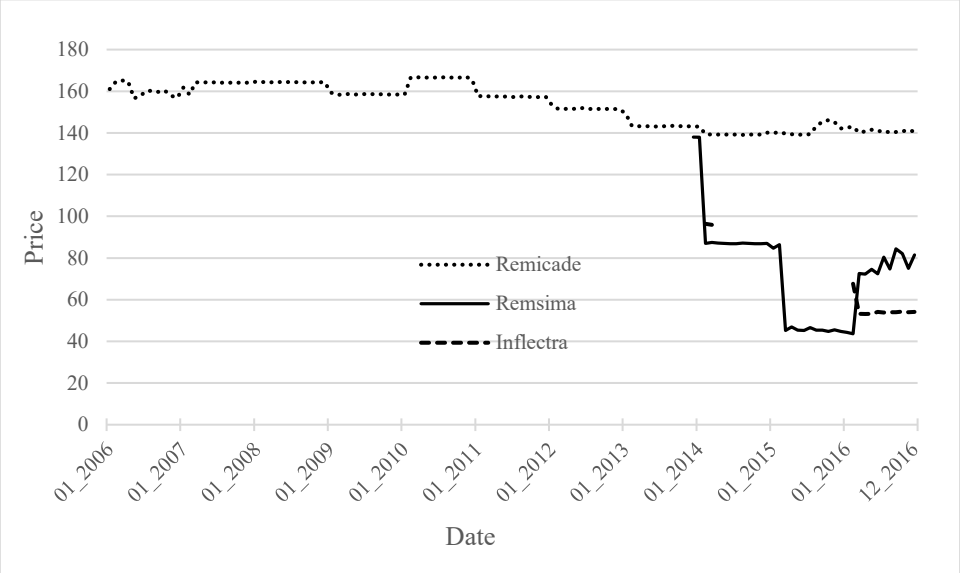
Brand name	Company	Entry in Norway	Drug type – name
Remicade	Janssen	2000	Original – rituximab
Remsima	Celltrion	12/2013	Biosimilar- rituximab
Inflectra	Celltrion	2/2014	Biosimilar- rituximab
Enbrel	Amgen	2000	Original – etanercept
Benepali	Biogen	2/2016	Biosimilar- etanercept
Humira	AbbVie	2003	Original – infliximab
Roactemra	Roche	5/2009	Original - tocilizumab
Stelara	Janssen	12/2009	Original - ustekinumab
Cimzia	UCB	2/2010	Original - certolizumab
Simponi	Janssen (Schering-Plough in Europe)	2/2010	Original - golimumab

Source: Farmastat

[1] Farmastat is a provider of market data owned by the Association of the Pharmaceutical Industry in Norway (LMI).

In Figure 1 we show the price development for the original brand Remicade and the two biosimilars. The original brand Remicade faced biosimilar competition from late 2013. The price per DDD for Remicade at that time was close to 140 NOK, and there is no sign of price adjustments due to entry. In the first competitive bidding, for the 2014-contracts, the biosimilar drug Remsima entered with a price close to 90 NOK per DDD, representing a price cut of approximately 40% compared with the original brand. In the next bidding, for the 2015-contracts, the biosimilar producer lowered its price to approximately 45 NOK per DDD, whereas the original drug maintained its price at the pre-competition level. Hence, the biosimilar operated in the market with a price cut close to 70 %. When Celltrion, the producer of Remsima, enters with another biosimilar version (Inflectra) in 2016, they replaced Remsima and entered with a price cut of 60 % compared with the price of the original brand.

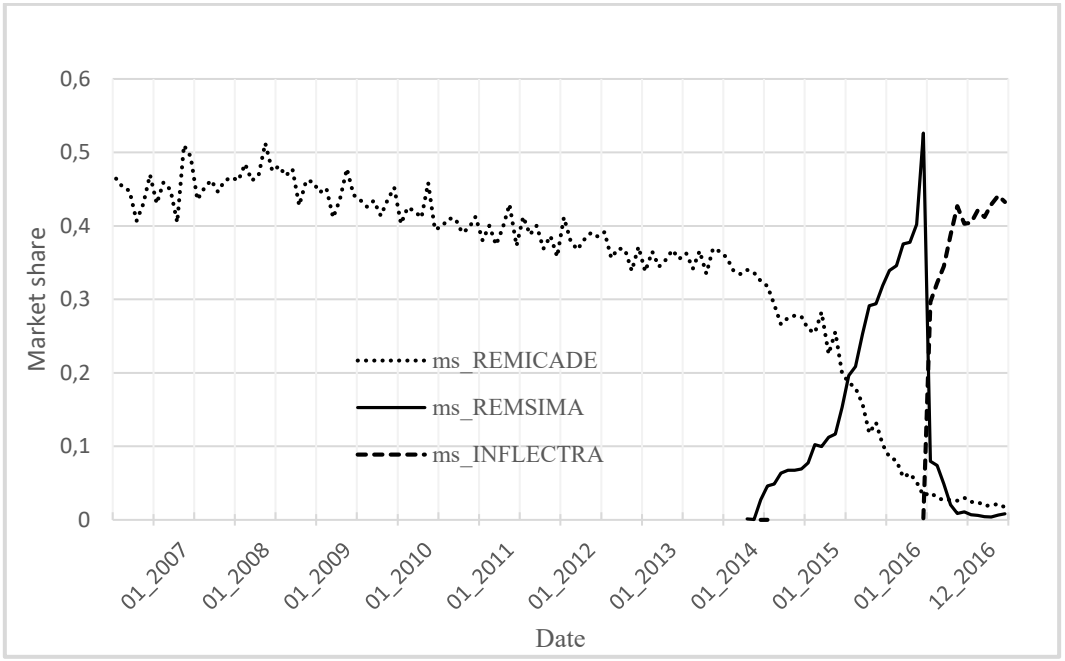
Figure 1: Calculated monthly prices for Remicade (original brand) and the two biosimilars.



Source: Farmastat and our own calculations.

The low prices of the biosimilars to Remicade caused a substantial and rapid rebalancing of market shares, see Figure 2. After one year in the market, the biosimilar drug gained 10 % of the entire TNF-market in Norway. After two years in the market, the market share has risen to 40 %. It took the biosimilar only two years to replace the original brand in the Norwegian hospitals.

Figure 2: Market shares of Remicade (original brand) and the two biosimilars per month.



Source: Farmastat and our own calculations.

The next brand to face biosimilar competition was Enbrel. The price of Enbrel had been stable at approximately 250 NOK per DDD for two years when the biosimilar drug Benepali entered in 2016, with a price at 150 NOK per DDD, representing a price cut of 40 %. See data in the appendix.

It is clear that the coordinated procurement mechanism for biologics attracted biosimilars with low-price entry strategies. The immediate demand response, due to coordinated substitution towards the lowest bidder, is crucial for the profitability of such strategies: Biosimilars had taken over more than 50 % of the TNF-inhibitor market, two years after they first entered. With price cuts in the range of 40-60%, for drugs that account for 1/3 of total pharmaceutical costs in Norwegian hospitals, this has had an economically significant effect on hospital budgets.

4 An econometric investigation

The previous section gave a brief snapshot of the price response of one brand confronting biosimilar. However, this is a market with 10 different drugs, including 7 brands and 3 biosimilars that enter at different stages during the period from 2006 to 2016. An econometric investigation is needed to explore the competition effects. To get estimates of how the entries of biosimilar drugs affected prices and the average price level of biologics drugs, we first run a regression using observed prices for all the different drugs in the market from 1/2006 to 12/2016.

Model 1: Prices at product levels and the presence of biosimilars

Let p_{it} denote the price (in NOK) per DDD of product i in month t. At maximum there are 10 different products in the market. At the start of our data set, January 2006, there were three branded biologics in use in Norway (Humira, Enbrel and Remicade), but other brands and biosimilars were introduced in the market at different points in time, see Table 1. We observe prices and quantities on a monthly basis, from Jan. 2006 to Dec. 2016.

The variable representing biosimilar is $1(bio>0)_t$. The notation means that the dummy variable equals 1 if the drug is a biosimilar, otherwise it equals zero. From Table 1 we observe that the first biosimilar to enter the market was Remsima in December 2013. Then Inflectra came in February 2014, and Benepali in March 2016. Note that the expected value of $1(bio>0)_t$, $E(1(bio>0)_t)$, equals the probability $P(bio>0)_t$. The empirical counterpart to this probability is the market share for biosimilars, here denoted $m_{bio,t}$. We assume the following linear relationship:

$$p_{it} = \alpha_1 + \rho_1 p_{i,t-1} + \beta_1 1(bio>0)_t + \varepsilon_{1it}; i = 1,2,,,N_t; t = 1/2006,,,12/2016 \quad (1)$$

Because of autocorrelation we need to include lagged prices. This means that the number of observations drop from 799 to 789.

The expected prices, using the empirical counterpart of $P(bio>0)_t$, are

$$Ep_{it} = \alpha_1 + \rho_1 Ep_{i,t-1} + \beta_1 E(1(bio)_t > 0) = \alpha_1 + \rho_1 Ep_{i,t-1} + \beta_1 m_{bio,t} \quad (2)$$

Summing over drugs and dividing by the number of drugs, we get

$$\frac{1}{N_t}\sum_{i=1}^{N_t} Ep_{it} = \alpha_1 + \rho_1 \frac{1}{N_t}\sum_{i=1}^{N_t} Ep_{i,t-1} + \beta_1 m_{bio,t}\,. \quad (3)$$

Let $\hat{p}_t = \frac{1}{N_t}\sum_{i=1}^{N_t} Ep_{it}$. We then have

$$\hat{p}_t = \alpha_1 + \rho_1 \hat{p}_{t-1} + \beta_1 m_{bio,t} \quad (4)$$

The short run effect of a marginal change in $m_{bio,t}$ on the expected price, or average price, $\hat{p}_t$ equals β_1, while the marginal impact of a change in the market share of biosimilars on the steady state level of the price level is $\frac{\beta_1}{1-\rho_1}$.

Table 2: Estimates - model 1

Variables	Estimates
Constant	2.9665***
	(1.18)
Lagged price	0.9834***
	(0.01)
Biosimilars (market share)	-3.3248***
	(1.24)
Number of observations	789
Adj. R-Squared	0.9854

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

A problem with this regression could be that the empirical counterpart of the expected value of the variable Biosimilars, the market share of biosimilars, could depend on the price. That would imply that the variable Biosimilars is correlated with the price. In order to check for this we have run a regression of the squared value of the empirical value of the random term, defined as the squared value of $e_{it} = p_{it} - 2.9665 - 0.9834\,p_{i,t-1} + (3.3248)1(bio > 0)_t$ against the dummy variable for the biosimilars. We find a positive correlation, but it is not significant different from zero (t-value 1.6).

In Model 1 the short and long run effects of biosimilars on the expected market price are as follows:

Short run effects, β_1 = -3.3248

Long run effects, $\frac{\beta_1}{1-\rho_1}$ = -200.2892

According to these estimates, moving from a market share of 10 % to a market share of 60 % for biosimilars, will over time reduce the expected market price with 100 NOK. This represents a price drop close to 50 % compared to the average price over the entire sample period (see the data appendix).

As shown in Table 1 the number of brands also increased during the considered period. To test whether the entry of new brands also had an effect on prices, we run a regression (see Model 2) of the price level on number of brands and the dummy for biosimilars. To account for a possible non-linear effect of the number of brands we also include number of brands squared.

Model 2: Price level, number of brands and biosimilars.

The regression thus is:

(5) $\bar{p}_t = \alpha_2 + \rho_2 \bar{p}_{t-1} + \gamma_1 n_t + \gamma_2 n_t^2 + \beta_2 1(biosmilar)_t + \varepsilon_{2t}$

where $\bar{p}_t$ is the weighted average price for month t, using market shares as weights.

Table 3. Estimates - model 2

Variables	Estimates
Constant	63.150***
	(8.11)
Lagged average price	0.721***
	(0.04)
Number of brands	-18.275***
	(2.55)
Number of brands squared	1.468***
	(0.23)
Biosimilars (market share)	-3.143***
	(0.89)
Number of observations	131
Adjusted R-Square	0.993

Standard errors in parentheses, * p<0.05, ** p<0.01, *** p<0.001.

Note again that the "Biosimilar" variable captures the effect of increased probability of having a biosimilar transaction in the market (with the empirical counterpart being the market share for biosimilars) on the expected market price. Compared to the estimates in Model 1 the estimates of the impact of lagged price level and biosimilars are now empirically weaker, but still highly significant. The reason why is that lagged prices now play a minor role and that an increase in the number of branded drugs contribute rather strongly to a reduction in the price level. The impact of the number of branded drugs on the price level is a convex function, with a minimum at 6-7 number of brands. One more branded product, given that there are initially 3 brands, reduces the price level in the short run by NOK 10 and in the longer run by NOK 36.

5 Summary and discussion

With detailed data of TNF-inhibitors drugs from a centralized procurement of biologics in Norwegian hospitals, we have been able to analyze the effects of entry of biosimilars on price competition. An increase in the market share of biosimilars is shown to have a significant and negative impact on the expected price in the procurement market.

As such, our results confirm the findings by Curto *et al.*,2014, on Italian data. They studied the first three biologics to attract biosimilar entry in Europe (Rovira *et al*., 2013), but relied upon more limited data – both with respect to the time span and type of competition. In their study, there is almost complete overlap between the number of competitors and presence of biosimilars. Therefore, they were not able to disentangle the competition effect from the pure effect of biosimilar entry. This contrasts our study of the TNF-inhibitor, where we see multiple entry of new branded biologics into the same procurement market. Since the first entry in 2000 (Remicade), there have been several entries of patented TNF-inhibitor brands. These are treated as substitutes for starting up treatment with new patients. The difference between a biosimilar TNF-inhibitor and patented new TNF-inhibitor brand is that a biosimilar can substitute the previously patented drug also for patients already in treatment. A new, patented TNF-inhibitor, therefore, can only gain market shares by offering the lowest treatment cost to new patients, or to patients that are starting to be less responsive to the existing one.

Although market penetration of new branded drugs will be slower for a given market price compared with biosimilars, we see from regression model 2 that intra-brand competition is intensified as more patented brands enter the market: More brands entering the tenders work to lower the average market price.

During the period May 2009 to February 2010 three new patented brands entered, after which we saw a strong downward movement of the prices of all brands, with the exception of Humira and Remicade (see the average product prices per year and market shares in appendix). The price curves for the branded drugs, however, flatten when biosimilar competitors enter. When experiencing direct biosimilar competition, the producers of Enbrel and Remicade responded, in effect, with an "exit strategy", accepting dramatic losses of market shares by increasing or maintaining a higher price level. The next brand to face direct biosimilar competition is Humira. Future research should take advantage of these additional observations of patent expirations to gain a better understanding of how original brands respond.

One reason for a more passive response to biosimilar competition could be the risk of undermining their position in other countries. For the entire period of observation, procurement prices were public information. A company could risk undermining its bargaining position in other countries if price cuts in Norway become known. This was the main argument for the government to accept price secrecy from 2017.

Institutional factors will be important for the competition effect of patent expiration and entry of biosimilars. For the Norwegian experience, which has been the objective of this study, the centralized procurement design, including its mechanism for building loyalty to the "preferred drug" among doctors, is most likely important for the strong competition effect. The value of winning the "prize" as the preferred drug becomes higher, and the companies are willing to submit lower prices per unit in order to get the "prize".

Although, our analysis shows significant and strong price effects of competition from biosimilar entry in the context of hospital procurement of TNF-inhibitors, we do not claim to have identified a regularity that necessarily holds for other pharmaceutical procurements in other countries and regulatory frameworks. As already pointed out, institutional factors are expected to be important, as well as market size. TNF-inhibitors represents a large market with high prices on original brands. This makes the market attractive for new entrants in spite of the entry costs pointed out by Scott Morton *et al*., 2018. Nevertheless, our results show that "high stake"-markets for biologics can benefit from competition with a good market design.

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References

Aalto-Setälä, V. (2008). The impact of generic substitution on price competition in Finland. *Eur J Health Econ,* 9, 185–191.

Berndt, E. R. , P. Dubois (2016). Impacts of Patent Expiry on Daily Cost of Pharmaceutical Treatments in Eight OECD Countries, 2004–2010. *Int. J. of the Economics of Business*, 23 (2), 125–147.

Curto, S., S. Ghislandi, K. van de Voorena, S. Duranti, L. Garattini (2014). Regional tenders on biosimilars in Italy: An empirical analysis of awarded prices. *Health Policy*. 116, 182-187.

Dalen, D. M., M. Locatelli, E. Sorisio, S. Strøm (2014). Does the Identity of the Third-Party Payer Matter for Prescribing Doctors? *Applied Economics and Finance*,1, 39-54.

Directive 2001/83/EC of the European parliament and of the council of 6 November 2001 on the community code relating to medicinal products for human use.

Directive 2003/63/EC of 25 June 2003 amending Directive 2001/83/EC of the European Parliament and of the Council on the Community code relating to medicinal products for human use.

European Medicine Agency (2014). Guideline on similar biological medicinal products. Committee for Medicinal Products for Human Use (CHMP). Version: 23 October 2014.

Grabowski, H., I. Cockburn, G. Long (2006). The Market For Follow-On Biologics: How Will It Evolve? *Health Affairs*, 25 (5), 1291-1301.

Jørgensen, K. K., I. C. Olsen, G. L. Goll, M. Lorentzen, N. Bolstad, E. A. Haavardsholm, K. E. A. Lundin, C. Mørk, J. Jahnsen, T. K. Kvien. (2017). Switching from originator infliximab to biosimilar CT-P13 compared with maintained treatment with originator infliximab (NOR-SWITCH): a 52-week, randomised, double-blind, non-inferiority trial. *The Lancet*. 389, 2304-2316.

Minghetti P, Rocco P, Cilurzo F, Vecchio LD, Locatelli F. (2012). The regulatory framework of biosimilars in the European Union. *Drug Discovery Today*,17,63–70.

Reiffen, D., M. R. Ward (2005). Generic Drug Industry Dynamics. *The Review of Economics and Statistic*s, 87(1), 37–49.

Rovira, J., L. Lindner, E. Giménez, et al. (2013). Biosimilars in the European market. *GaBi Journal*, 2 (1), 30-35

Scott Morton, F. M., A. D. Stern, S. Stern (2018). The Impact of the Entry of Biosimilars: Evidence from Europe. *Review of Industrial Organization,* 53, 173–210.

Ward D. J., L. Doos, and A. Stevens (2019). Trends in the costs of drugs launched in the UK between 1981 and 2015: an analysis of the launch price of drugs in five disease areas. *BMJ Open*, 9(5).

Appendix

Summary statistics of the data set used in the estimates (number of observations 789)

Variable	Description	Mean	Std. Dev.	Min	Max
Year				2006	2016
Month	Month (1-12)			1.00	12.00
DDD	Number of Defined Daily Doses	75474.29	64045.34	26.66	477760.30
Units	Number of packages (Units).	2597.41	2277.64	1.00	13075.00
Value	Value of sales, 1000 NOK[2]	14600.00	11500.00	2.56	37700.00
Price	price per DDD - calculated by Value/DDD. NOK	208.74	61.97	43.62	319.13
TotalDDD	Sum of DDD per month over all drugs	516446.00	170931.60	175516.70	907796.40
MS	Market share of the drug – calculated as DDD/TotalDDD	0.17	0.15	0.00	0.54
atc_DDD	Sum of DDD per month within each ATC.	95273.36	87575.30	132.00	509733.50
MS_atc	Market share of drug within its ATC (always equal to 1 if there is still patent protection – less than one if "biosimilars" have entered)	0.92	0.22	0.00	1.00
New variables generated:					
$\bar{p} = \frac{\sum_{i=1}^{n} p_{it} \cdot DDD_{it}}{\sum_{i=1}^{n} DDD_{it}}$	Weighted average price per month	194.61	30.45	120.91	247.61
BIO	BIO = 1 if a biosimilar, 0 otherwise	0.08	0.26	0.00	1.00

[2] As of May 1, 2020 1 USD equals ca 10 NOK.

Yearly average prices for all drugs. NOK per DDD

Year	BENEPALI	CIMZIA	ENBREL	HUMIRA	INFLECTRA	REMICADE	REMSIMA	ROACTEMRA	SIMPONI	STELARA
2006			298.34	311.82		160.43				
2007			281.88	312.42		163.50				
2008			279.29	292.22		164.38				
2009			267.95	273.80		158.60		281.76		313.58
2010		228.63	256.54	272.38		165.86		277.43	254.63	266.93
2011		185.66	232.44	258.21		157.40		239.97	250.51	213.56
2012		178.06	217.40	256.14		151.72		236.50	233.23	205.72
2013		154.26	209.03	256.20		143.73	137.94	236.52	210.85	190.35
2014		123.34	246.84	256.30	96.18	139.63	91.25	233.92	198.83	195.84
2015		135.34	249.54	278.99		141.61	52.19	217.94	172.15	190.29
2016	153.12	126.93	243.08	281.83	55.04	141.09	71.49	226.75	218.38	181.55

Yearly average of market shares of all drugs, per year

Year	BENEPALI	CIMZIA	ENBREL	HUMIRA	INFLECTRA	REMICADE	REMSIMA	ROACTEMRA	SIMPONI	STELARA
2006			0.404	0.147		0.449				
2007			0.375	0.158		0.467				
2008			0.370	0.171		0.459				
2009			0.348	0.218		0.431		0.004		0.001
2010		0.006	0.295	0.246		0.402		0.010	0.041	0.004
2011		0.013	0.285	0.227		0.388		0.013	0.064	0.008
2012		0.024	0.296	0.228		0.364		0.017	0.057	0.013
2013		0.044	0.259	0.226		0.353	0.001	0.018	0.080	0.019
2014		0.098	0.213	0.206	0.00005	0.282	0.065	0.020	0.085	0.031
2015		0.111	0.176	0.169		0.135	0.273	0.023	0.078	0.036
2016	0.088	0.121	0.084	0.145	0.350	0.029	0.099	0.021	0.068	0.038