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Margins and Market Shares:

Pharmacy Incentives for Generic Substitution*

Kurt Richard Brekke† Tor Helge Holmås‡ Odd Rune Straume§

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Abstract

We study the impact of product margins on pharmacies' incentive to promote generics instead of brand-names. First, we construct a theoretical model where pharmacies can persuade patients with a brand-name prescription to purchase a generic version instead. We show that pharmacies' substitution incentives are determined by relative margins and relative patient copayments. Second, we exploit a unique product level panel data set, which contains information on sales and prices at both producer and retail level. In the empirical analysis, we find a strong relationship between the margins of brand-names and generics and their market shares. In terms of policy implications, our results suggest that pharmacy incentives are crucial for promoting generic sales.

Keywords: Pharmaceuticals; Pharmacies; Generic Substitution

JEL Classifications: I11; I18; L13; L65

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1 Introduction

In the current paper we study the incentives for pharmacies to promote generic drugs instead of brand-names. Physicians tend to prescribe higher priced brand-names rather than the cheaper, but therapeutically equivalent, generic versions. In order to reduce expenditures most insurers try to stimulate the sales of generic drugs. One important mechanism in this regard is to allow or require pharmacies to suggest a generic substitute to consumers that enter the pharmacy with a brand-name prescription. Generic substitution regulation is often combined with copayment schemes, where consumers that refuse to substitute will be charged a higher copayment. The generic sales are likely to depend not only on the prices (copayments) of brand-name and generics, but also on the pharmacies' incentives to spend time and effort convincing consumers to accept a generic version. But why should pharmacies expend effort on generic substitution? The obvious answer is the profitability of selling generics relative to brand-names. In this paper, we therefore study the role of pharmacies in promoting generic sales by analysing the relationship between the margins that pharmacies obtain for brand-names and generics and their respective market shares.

We find this issue interesting for the following reasons. First, pharmaceutical expenditures are growing in most Western countries, and stimulating generic competition is seen as one of the main instruments for regulators (payers) to contain costs in this field.[1] The off-patent market is becoming increasingly important as patents have expired (or will expire in the near future) for several blockbusters.[2] Second, many papers have adressed various aspects around competition between brand-names and generics, but our paper is the first to look at the role of pharmacies and the effect of generic substitution regulations.[3] Third, our study offers insight into retailer incentives more broadly, as we study

[1] See, for instance, the reports by Pharma (2008) and EGA (2009). According to EGA (2009) about half of the dispensed pharmaceuticals in the off-patent market segment in the European Union are generics, but there are large variations across the member countries. In the US, however, the generic market share (in volume) in this segment is about 90 percent. Thus, there should be great scope for regulatory policies to affect the generic sales and thus the pharmaceutical expenditures.

[2] See the report by EGA (2009).

[3] For example, Hellerstein (1998), Coscelli (2000) and Lundin (2002) study the role of physicians in prescribing brand-names or generics; Grabowski and Vernon (1992) and Frank and Salkever (1997) study

the promotional incentives for steering consumers towards more profitable products. Similar incentives are likely to be present in most downstream markets where the retailers sell rival products (e.g., grocery stores, electronic stores, toy stores, car dealers, etc.).

In the first part of the paper, we set up a vertical differentiation model where brand-names are perceived to be of higher quality than their generic versions. For consumers to be willing to purchase generics, they need to be priced lower (have a lower copayment) than the brand-names. Within this framework we introduce a (monopoly) pharmacy that may expend effort on persuading consumers to buy a generic version, for instance, by informing them that the products are therapeutically equivalent. A pharmacy will expend effort on persuading patients to substitute only if the generic margin is higher than the brand-name margin. Otherwise, the pharmacy will simply dispense the brand-name.[4] Naturally, the pharmacy's substitution incentive is increasing the higher the generic margin becomes relative to the brand-name margin, but the incentive is also increasing the lower the generic copayment becomes relative to the brand-name copayment. The latter is due to the fact that a larger copayment difference makes it easier for the pharmacy to persuade consumers to switch to a generic version.

We also study the role of pharmacy price setting, where we show that a marginal reduction in, say, the brand-name price has two counteracting effects on the substitution effort. On the one hand, the corresponding reduction in the brand-name margin increases incentives for generic substitution. On the other hand, the corresponding lower price difference makes consumers more difficult to persuade and therefore reduces the incentives for substitution. We derive the profit-maximising brand-name and generic retail prices under two different copayment schemes: coinsurance and reference pricing, where we show that the latter reinforces the incentives for generic substitution and reduces brand-name market shares.

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the brand-name producers pricing incentives when generics enter the market. Aronsson et al. (2001), Bergman and Rudholm (2003) and Brekke et al. (2009, 2010), study the impact of generic reference pricing on brand-name pricing and market shares. We review the literature more carefully in the next section.

[4] In some countries or health plans, generic substitution is mandatory. However, patients can still refuse to accept a generic version, which means that persuasion still plays a role also under mandatory generic substitution.

In the second part of the paper, we provide an empirical analysis of the pharmacies' substitution incentives by looking at the relationship between margins and market shares. We use a unique product level panel dataset from the Prescription database of the Norwegian Institute of Public Health. This database contains all prescription bound sales in Norway at pharmacy level from 2004 and onwards. We have obtained detailed sales and volume data at product level for 74 off-patent substances with generic competition for a four year period (2004-7). We match these data with data from a second database, called the Wholesale database (administrated by the same institute). These data contain information about producer (ex-manufacturer) prices at product level. Thus, we have both the producer price and the retail (pharmacy) price per product per wholesaler (or pharmacy). Since more than 85 percent of the pharmacies are vertically integrated with (owned by) the wholesalers, we observe the (gross) margin of the distributors.

From the descriptive statistics we observe that brand-names are priced higher than generics and still have significant market shares despite generics being therapeutically equivalent (identical).[5] We also observe that pharmacies have substantially higher margins on generics than brand-names measured either as percentage margins or absolute margins. We then proceed by testing whether higher margins lead to higher market shares. In estimating the effect of margins on market shares we control for relative retail prices of brand-names versus generics. This is important, because a higher, say, generic retail price increases the generic margin, but at the same time also reduces the price (copayment) difference between brand-names and generics. Since these two effects pull in opposite directions, the effect of margins on market shares will be underestimated if changes in relative retail prices are not taken into account. We also control for substance and wholesaler fixed effects and use lagged variables as instruments to account for potential endogeneity in the explanatory variables. Our empirical results show a strong and highly significant effect of brand-name and generic margins on their market shares. Thus, pharmacies seem to expend more effort in promoting generics when their margins are high relative to the

[5] This is consistent with our theoretical analysis, as well as previous empirical literature (e.g., Grabowski and Vernon, 1992, Frank and Salkever, 1997, Pavcnik, 2002, Brekke et al., 2009, 2010).

brand-names.

Our results suggest that pharmacy incentives are important when it comes to stimulating generic sales. In terms of policy implications, our analysis highlights the importance of taking pharmacy incentives, and in particular brand-name versus generic margins, into account when designing the optimal regulatory scheme for the pharmaceutical industry. For example, regressive mark-up regulation at pharmacy level might be a powerful regulatory instrument in order to promote generic sales. Furthermore, our results also suggest that the positive effect of reference pricing on generic sales is reinforced by pharmacies' substitution incentives. Thus, when taking pharmacy incentives into account, the cost-saving effect of generic reference pricing might be even higher than previously thought.

The rest of the paper is organised as follows. In section 2 we relate our study to previous literature. In section 3 we present a theoretical model of pharmacy incentives and derive some key results regarding the relationship between margins and market shares for brand-name versus generic drugs. In section 4 we describe the institutional background, while our data and some descriptive statistics are presented in Section 5. A description of our empirical method and a presentation and discussion of our main empirical results are given in Section 6. In Section 7 we briefly discuss some policy implications before the paper is concluded in Section 8.

2 Related literature

Several studies have examined the role of physicians in the prescription drug market. Hellerstein (1998) looks at the importance of physicians in the choice between brand-names and generics. Using US survey data on physicians, their patients and the drugs prescribed, she finds that almost all physicians prescribe both types of drugs to their patients. However, some physicians are more likely to prescribe brand-names, while others are more likely to prescribe generics. She finds that very little of the prescription choice can be explained by observable characteristics of individual patients. In particular, there is no indication that patients who do not have insurance coverage for prescription drugs are

more likely to have generic versions prescribed. The main conclusion is that the physician is the important agent in the prescription decision, though the reason why some physicians are more likely to prescribe generics or brand-names is largely left unexplained.[6]

Another paper in the same vein is Coscelli (2000), who studies the contribution of physician and patient "habit" to the persistence in market shares of brand-names and generics. Having Italian micro data on patients and physicians for prescriptions of anti-ulcer drugs over a 3-year period, allows him to control for individual heterogeneity and to explore time-dependence in drug choices. Estimating the probability of switching brands as a function of patient and physician attributes, he finds evidence for habit persistence for both physicians and patients. However, since prices are always the same for different versions of therapeutically equivalent drugs by regulatory fiat in the Italian drug market, there are no economic incentives for either physicians or patients to prefer one version over the other.

Lundin (2000) examines whether the choice made by physicians concerning drugs version (brand-name or generic) is subject to (ex post) moral hazard. Using prescription microdata with explicit costs for both the patients and the third party payer in Sweden over a 3 year period (for two pharmacies and seven substances), he finds that patient and physician "habits" matter. However, he also finds that patients that face large copayments are less (more) likely to receive a brand-name (generic) than patients that get most of their costs reimbursed, which contrasts the findings by Hellerstein (1998). This result is interpreted as (ex post) moral hazard – i.e., insurance leads to overconsumption – and suggests that physicians act more in the interest of the patient than the payer.

In the above-mentioned studies, and in most health care systems, physicians do not have any financial incentives to prescribe a brand-name or a generic. This is, however, not always the case. Iizuka (2007) examines the physician-patient agency relationship in the prescription drug market in Japan, where physicians often both prescribe *and*

[6] There are two notable shortcomings concerning the data. First, the data set has no price information, which means that relative branded-generic prices are not observed. Second, the physicians surveyed were asked to record information over a 2-week period only, which implies that patients' preferences (tastes) cannot be accounted for.

dispense drugs. Since the physicians can pocket the profits, the mark-up of drugs might distort their prescription choices from more suitable drugs for a given patient towards more profitable drugs for the physician. Using product level data on anti-hypertensive drugs, Iizuka (2007) finds evidence that prescription choices are influenced by the mark-up. However, physicians are also sensitive to patient's out-of-pocket costs, and even more so than the mark-ups, which is consistent with Lundin (2000). In contrast to the previous studies, Iizuka (2007) looks at physicians' choices between (chemically) different brand-names (anti-hypertensive drugs) and not on the choice between therapeutically equivalent drugs. Moreover, he does not have direct information on the wholesale prices.

There is also a recent paper by Liu et al. (2009) that looks at the financial incentives for physicians to prescribe brand-names or generics in Taiwan. As in Japan, physicians both prescribe and dispense drugs and can pocket the profits of doing so. Focusing on diabetic patients, they examine whether physicians tend to prescribe (and dispense) products with higher margins. A major problem with their study is that they only observe the reimbursement price and not the margins. They find that a lower reimbursement price leads to more generic sales, which is interpreted as physician rent seeking.

A second strand of literature focuses on the importance of regulation on generic sales. A related paper is Aronsson et al. (2001) who study the impact of generic competition (measured by relative branded-generic prices) on brand-name market shares. They find weak evidence that generic competition contributes to lower brand-name market shares. They also find that the introduction of reference pricing contributes to reducing brand-name market shares. A more rigorous study on the importance of reference pricing is Pavcnik (2002). She studies the introduction of (therapeutic) RP in Germany in 1989. Using data for two different therapeutic fields (oral antidiabetics and antiulcerants) for 1986 to 1996, she identifies significant price reductions of the RP system for both brand-names and generics, with the effect being stronger for brand-names. Similar results are obtained in Brekke, Grasdal and Holmås (2009) based on a Norwegian policy experiment.[7]

[7] Bergman and Rudholm (2003) study the effects of the Swedish RP system on brand-name (not generic) prices. Distinguishing between actual and potential generic competition, they find that RP only reduced prices of brand-names that faced actual generic competition.

Moreover, Brekke, Holmås and Straume (2010) study the impact of regulation on generic competition and pharmaceutical prices. They find that reference pricing stimulates generic competition resulting in lower brand-name market shares and prices compared with price cap regulation. They also find that reference pricing leads to lower pharmaceutical expenditures. Thus, there seems to be a fairly robust empirical finding that reference pricing reduces both brand-name and generic prices and increases generic market shares.

While the economics literature on the importance of the physicians and the regulation system for brand-name and generic sales – focusing on incentives for producers and consumers – is fairly large, our study is (to the best of our knowledge) a first attempt to study the role of pharmacies in promoting generics instead of brand-names. Our findings suggest that pharmacies do indeed play an important role in determining brand-name versus generic sales, with corresponding important implications for the magnitude of pharmaceutical expenditures.

Finally, we should also mention that our paper is related to a broader IO literature on vertical relations. The idea that retailers can influence consumers' purchase choices among competing brands, and that their incentives to do so depend on relative margins, goes back at least as far as Telser (1960), who argued that such incentives provide a rationale for manufacturers to prefer contracts imposing retail price maintenance.[8] This is particularly relevant to the literature on common agency, where competing upstream suppliers sell their products through the same retailer, as in the pharmaceutical industry. A well known argument for common agency (as opposed to exclusive dealing) is that such an arrangement facilitates collusion in the downstream market and is therefore in the interest also of upstream suppliers (Bernheim and Whinston, 1985, 1986). On the other hand, the retailer's ability to steer demand towards more profitable products can induce more competition between suppliers and therefore create a rationale for exclusive dealing.[9] However, the question of common agency versus exclusive dealing is less of an

[8] A recent paper considering such "steering" by retailers is Raskovich (2007), who shows that competition for steering by upstream suppliers can lead to double-marginalisation.

[9] In the case of asymmteric information between suppliers and retailers, Gal-Or (1991) and Martimort (1996) show that common agency could also lead to higher informational rents compared with exclusive dealing.

issue in our particular setting – generic competition in the pharmaceutical industry – since exclusive dealing contracts between producers and distributors are generally strictly regulated, in the sense each pharmacy is usually required to store and deliver the full range of pharmaceuticals that are prescribed by physicians.

3 A theoretical model of pharmacy incentives

There is a total mass of 1 consumers, each with a prescription for the same brand-name drug that is dispensed by a pharmacy. There is also a generic copy-drug available in case the consumer wants to substitute. Consumers differ in their willingness-to-pay for drugs. The net utility of drug consumption is given by

$$U = \begin{cases} v - c_b & if \quad \text{brand-name} \\ \theta v - c_g & if \quad \text{generic} \end{cases}, \tag{1}$$

where v is uniformly distributed on $[\underline{v}, \overline{v}]$. The parameter $\theta \in (0,1)$ represents the quality degradation that consumers attribute to the generic version of the drug, while c_b and c_g are the copayments of the brand-name and generic drug, respectively. Assuming that $\underline{v}$ is large enough to make the market fully covered (i.e., total demand is inelastic and equal to 1), the demand for the two drug versions are given by $D_g = \frac{\widehat{v}-\underline{v}}{\overline{v}-\underline{v}}$ and $D_b = \frac{\overline{v}-\widehat{v}}{\overline{v}-\underline{v}}$, where

$$\widehat{v} = \begin{cases} \overline{v} & if \quad c_b - c_g \geq 1-\theta \\ \frac{c_b - c_g}{1-\theta} & if \quad c_b - c_g \in (0, 1-\theta) \\ \underline{v} & if \quad c_b - c_g \leq 0 \end{cases}. \tag{2}$$

Thus, consumers are willing to buy the generic drug only if it involves a lower copayment. Otherwise, everybody purchases the brand-name drug. The demand sensitivity with respect to copayments crucially depends on the perceived quality difference: a lower θ implies less demand sensitivity.

The wholesale prices of the brand-name and generic drugs are, respectively, w_b and w_g. Since pharmacies generally have a stronger bargaining position towards producers

of generics, it is reasonable to assume that $w_b > w_g$.[10] Assume further that pharmacies can expend effort towards the individual consumer in persuading her to accept generic substitution. More specifically, assume that the perceived quality degradation of the generic drug (θ) depend on the effort (e) exerted by the pharmacy: $\theta(e)$, where $\theta'(e) > 0$, $\theta''(e) < 0$ and $\theta(0) = \underline{\theta} \in (0,1)$. The effort cost is given by $C(e)$, where $C'(e) > 0$ and $C''(e) \geq 0$.

Denoting the retail prices of the brand-name and the generic drugs by p_b and p_g, respectively, the profit of the pharmacy is given by

$$\pi = m_b D_b + m_g D_g - C(e), \tag{3}$$

where $m_b := p_b - w_b$ and $m_g := p_g - w_g$ are the margins of the brand-name and generic drug, respectively.

3.1 Pharmacy incentives for generic substitution

For given prices, the optimal choice of substitution effort is implicitly given by[11]

$$\frac{\partial \pi}{\partial e} = \frac{(m_g - m_b)(c_b - c_g)\theta'(e)}{(\overline{v} - \underline{v})(1-\theta)^2} - C'(e) = 0. \tag{4}$$

A strictly positive substitution effort requires that

1. the margin is higher for the generic than for the brand-name product, and
2. the brand-name copayment is larger than the generic copayment.

Otherwise, the pharmacy has no incentives to spend effort on persuading consumers to switch to the generic version. The optimal substitution effort increases with the generic-

[10] In the context of pharmacy incentives for generic substitution, the case of $w_b < w_g$, besides being less realistic, is also less interesting, since this implies that pharmacies would have no incentives for generic substitution as long as the retail price of generics is at or below the retail price of the brand-name drug (which is the realistic price regime).

[11] The second-order condition is

$$\frac{\partial^2 \pi}{\partial e^2} = \frac{(m_g - m_b)(c_b - c_g)}{(\overline{v} - \underline{v})}\left[\frac{\theta''(1-\theta) + 2(\theta')^2}{(1-\theta)^3}\right] - C'' < 0.$$

branded difference in margins ($m_g - m_b$). This implies that the pharmacy's substitution incentives are partly determined by the price setting of the brand-name and generic producers. A lower (higher) wholesale price on brand-names (w_b) will increase (reduce) brand-name profit margins and lead to reduced (increased) substitution effort. A similar effect applies to the wholesale price of the generic drug (w_g).

More interesting is perhaps the effect of the copayment system on substitution incentives. From (4) we see that, for given margins, the optimal substitution effort increases with the branded-generic copayment difference ($c_b - c_g$). Intuitively, the reason is that a larger copayment difference makes it easier to convince consumers to switch to the generic drug. Furthermore, a larger copayment difference will reinforce the positive relationship between relative margins ($m_b - m_g$) and substitution effort.

This result has clear-cut implications for the substitution effects of different types of copayment systems. Consider a simple coinsurance regime, where the copayment is defined as

$$c_i = \alpha p_i + f, \quad i = b, g, \tag{5}$$

where $\alpha \in (0, 1)$ is the coinsurance rate and f is a deductible. With this copayment scheme, the branded-generic copayment difference is given by $c_b - c_g = \alpha (p_b - p_g)$. Thus, the higher the coinsurance rate (α), the higher is the optimal substitution effort and the stronger is the effect of relative margins on substitution incentives.

Another widely used copayment regime is reference pricing, where consumers have to pay the full price difference between generic and brand-name drugs if choosing to purchase the latter. In this case, the copayment schedule is given by

$$c_i = \begin{cases} \alpha r + (p_b - r) + f & if \quad i = b \\ \alpha p_g + f & if \quad i = g \end{cases}, \tag{6}$$

where $r \in (p_g, p_g)$ is the reference price. The branded-generic copayment difference is now given by $c_b - c_g = p_b - \alpha p_g - (1 - \alpha) r$. We see that, compared with a simple coinsurance scheme ($r = p_b$), reference pricing ($r < p_b$) increases the branded-generic copayment

difference. Thus, for given retail prices, reference pricing increases the optimal substitution effort and strengthens the relationship between relative margins and substitution incentives.

What are the effects of retail price changes on substitution effort? If the copayments do not depend on prices, there are no demand effects, and price changes only affect the pharmacy margins. Thus, a higher brand-name retail price is equivalent to a lower brand-name wholesale price, with the corresponding effects on substitution effort as described above. Let us therefore assume a coinsurance regime, where the copayment is defined by (5). Total differentiation of the first-order condition for optimal effort, (4), gives

$$\frac{\partial e}{\partial p_b} = -\frac{\partial e}{\partial p_g} = -\frac{\alpha\left(\frac{(m_g-m_b)-(p_b-p_g)}{(\overline{v}-\underline{v})(1-\theta)^2}\right)\theta'(e)}{\frac{(m_g-m_b)(c_b-c_g)}{(\overline{v}-\underline{v})}\left(\frac{\theta''(1-\theta)+2(\theta')^2}{(1-\theta)^3}\right)-C''}, \tag{7}$$

where the denominator is negative due to the second-order condition.

Consider a marginal reduction in the brand-name retail price. There are two counteracting effects on incentives for substitution effort: 1) the corresponding reduction in the brand-name margin *increases* incentives for substitution effort, while 2) the corresponding lower price difference between the two drug versions makes consumers more difficult to persuade and therefore *reduces* incentives for substitution. If the difference in margins is higher than the price difference, the first incentive dominates and a brand-name price reduction leads to higher substitution effort. In this case, the pharmacy's incentive for inducing more generic substitution will *counteract* the direct demand effect of a brand-name price reduction, making the increase in brand-name market share less than it would otherwise have been. In the other case, where $(m_g - m_b)$ is smaller than $(p_b - p_g)$, the pharmacy's incentive to reduce substitution effort will *reinforce* the direct demand response of a lower brand-name price.

3.2 Endogenous retail prices

If the pharmacy can set the retail prices of the generic and brand-name drugs, it has another instrument to steer demand towards the most profitable drug version. Given

that copayments depend on prices, demand for the two drugs depend on the retail price difference between the brand-name and the generic drugs. For a given value of θ, the pharmacy faces the following trade-off when deciding the optimal retail price difference. If $p_b = p_g$, the generic drug is more profitable for the pharmacy to sell (since $w_g < w_b$), but in order to make consumers choose the generic drug, it has to be priced lower than the brand-name. The further p_g is reduced below p_b, the larger is the share of consumers choosing the generic. However, lowering p_g reduces the profitability of selling the generic drug. Thus, the pharmacy maximises profits by choosing a branded-generic retail price difference that optimally trades off these two incentives.

As long as total demand is inelastic, the pharmacy would obviously want to set the optimal price difference at the highest possible *level*. Thus, we assume that retail price setting is restricted by price cap regulation, that specifies the highest possible retail price that the pharmacy can set. From the above discussion, if follows that the price cap always binds for the brand-name drug. In the following, we will briefly discuss optimal retail price setting and implications for substitution incentives under different copayment scenarios.

3.2.1 Simple coinsurance

Assume that copayments are given by (5). Maximising (3) with respect to p_g, the optimal retail price difference is given by

$$p_b - p_g = \frac{(w_b - w_g)}{2} + \frac{(1-\theta)\,\underline{v}}{2\alpha}. \tag{8}$$

Notice that the retail price difference is constant, implying that any change in the brand-name retail price (e.g., due to stricter price cap regulation) will be exactly matched by a corresponding change in the generic retail price.[12] Demand for the generic drug is given by

$$D_g = \frac{\alpha\,(w_b - w_g) - (1-\theta)\,\underline{v}}{2\,(\overline{v} - \underline{v})\,(1-\theta)}. \tag{9}$$

[12] This property follows from the assumptions of full market coverage and uniform distribution of v.

Inserting the optimal price difference into (4), the first-order condition for optimal substitution effort is given by

$$\frac{\alpha\left(w_b - w_g\right)^2 \theta'\left(e\right)}{4\left(\overline{v} - \underline{v}\right)\left(1-\theta\right)^2} - C'\left(e\right) = 0. \tag{10}$$

When the generic price is optimally adjusted, substitution effort depends only on the branded-generic wholesale price difference. A higher wholesale price for the brand-name (generic) drug will increase (reduce) substitution effort. If we consider the relationship between wholesale prices and market shares, pharmacy incentives for expending substitution effort will have reinforcing effects when the branded-generic retail price difference is endogenous:

1. A reduction in the brand-name wholesale price leads to an increase in the generic retail price, which directly increases demand for the brand-name drug. This effect is reinforced by the fact that the pharmacy will spend less effort on generic substitution.

2. A reduction in the generic wholesale price leads to a reduction in the generic retail price, which directly increases demand for the generic drug. This effect is reinforced by the fact that the pharmacy will spend more effort on generic substitution.

3.2.2 Reference pricing

Consider a reference pricing scheme where copayments are given by (6). Assuming that $r \in (p_g, p_b)$, the optimal generic retail price (hence implicitly the optimal retail price difference), is given by

$$p_g = \frac{\left(1+\alpha\right)p_b - \left(1-\alpha\right)r - \alpha\left(w_b - w_g\right) - \left(1-\theta\right)\underline{v}}{2\alpha}. \tag{11}$$

This price is indeed below the reference price if $p_b < r + \frac{\alpha(w_b - w_g) + (1-\theta)\underline{v}}{1+\alpha}$. Demand for the generic drug is now

$$D_g = \frac{\left(1-\alpha\right)\left(p_b - r\right) + \alpha\left(w_b - w_g\right) - \left(1-\theta\right)\underline{v}}{2\left(\overline{v} - \underline{v}\right)\left(1-\theta\right)}. \tag{12}$$

If $r = p_b$, this solution is obviously identical to the solution under a simple coinsurance system. Thus, we can analyse the effect of reference pricing by considering a marginal reduction in r, evaluated at $r = p_b$. The effect on the optimal retail price is given by $\frac{\partial p_g}{\partial r} = -\frac{1-\alpha}{2\alpha} < 0$, implying that reference pricing reduces the optimal price difference between brand-names and generics. The reason is that reference pricing increases consumer incentives for generic substitution, as the demand becomes more price sensitive above the reference price. However, this means that the pharmacy's optimal substitution effort increases, since the difference in margins becomes larger (due to the higher generic retail price). This is easily seen by substituting p_g from (11) into the first-order condition for optimal substitution effort, yielding:

$$\frac{\left((1-\alpha)\left(p_b - r\right) + \alpha\left(w_b - w_g\right)\right)^2 - \left(\left(1-\theta\right)\underline{v}\right)^2}{4\left(\overline{v} - \underline{v}\right)\left(1-\theta\right)^2\alpha}\theta'\left(e\right) - C'\left(e\right) = 0. \tag{13}$$

So far we have considered an exogenous reference pricing system, where the reference price does not depend on actual retail prices. The alternative is an endogenous reference pricing system, where the reference price is a function of actual drug prices. A simple way to illustrate such a copayment scheme is to define the reference price as a linear combination of brand-name and generic retail prices: $r = \beta p_g + (1-\beta)\, p_b$. The optimal retail price difference is now given by

$$p_b - p_g = \frac{\left(w_b - w_g\right)}{2} + \frac{\left(1-\theta\right)\underline{v}}{2\left(\alpha + \beta - \alpha\beta\right)}, \tag{14}$$

which gives the following demand for the generic drug:

$$D_g = \frac{\left(w_b - w_g\right)\left(\alpha + \beta - \alpha\beta\right) - \left(1-\theta\right)\underline{v}}{2\left(\overline{v} - \underline{v}\right)\left(1-\theta\right)}. \tag{15}$$

A straightforward comparison between (8) and (14) shows that, compared with a simple coinsurance scheme ($\beta = 0$), endogenous reference pricing ($\beta > 0$) reduces the optimal retail price difference between generics and brand-names. Thus, the effects of exogenous and endogenous reference pricing are qualitatively similar. As before, as smaller

retail price difference increases the pharmacy's incentives for expending substitution effort. Substituting the optimal retail price difference from (14) into (4), the first-order condition for optimal substitution effort is given by

$$\frac{\left(\left(w_b - w_g\right)\left(\alpha + \beta - \alpha\beta\right)\right)^2 - \left(\left(1-\theta\right)\underline{v}\right)^2}{4\left(\overline{v} - \underline{v}\right)\left(1-\theta\right)^2\left(\alpha + \beta - \alpha\beta\right)}\theta'\left(e\right) - C'\left(e\right) = 0. \tag{16}$$

It is straightforward to verify that the marginal revenue of substitution effort is increasing in β.

We summarise our theoretical analysis as follows:

Proposition 1 *(i) For given retail prices, pharmacy incentives for expending effort towards generic substitution are stronger the larger the difference in margins between generics and brand-names ($m_g - m_g$), and the larger the difference in copayments between brand-names and generics ($c_b - c_g$).*

(ii) If pharmacies are free to set retail prices (but subject to price cap regulation), the introduction of reference pricing (exogenous or endogenous) will reduce the retail price difference between brand-names and generics and increase pharmacy incentives for expending substitution effort.

4 Institutional Background

The Norwegian pharmacy market was liberalised in 2001. Before the liberalisation, entry and location were determined by a governmental health agency, and ownership was restricted to pharmacists. The new act removed these restrictions, making Norway one of the pioneers in Europe in this regard. Most European countries still have strict restrictions on entry and ownership, though the European Commission is pushing for deregulation of the pharmacy sector.

The liberalisation in Norway caused dramatic changes to the pharmacy market structure. Almost over night most of the about 400 pharmacies owned by self-employed pharmacists were sold to three international wholesalers. The three wholesalers are Norsk

Medisinaldepot (owned by Celesio AG), Alliance Healthcare (owned by Alliance Boots Ltd) and Apokjeden (owned by Tamro Oy and Phoenix AG). Besides purchasing existing pharmacies, the wholesalers established many new pharmacies, especially in non-rural areas. The number of pharmacies has increased to 662 in 2009, which is an increase of almost 70 percent since 2001. Table 1 below illustrates the current market situation.

[Table 1 about here]

The market is dominated by four pharmacy chains (Alliance, Apotek 1, Vitusapotek and Ditt Apotek) covering more than 96 percent of the total number of pharmacies. The three largest chains are vertically integrated with the wholesalers, where Alliance apotekene is owned by Alliance healthcare, Apotek 1 is owned by Apokjeden, and Vitusapotek is owned by Norsk Medisinaldepot. The fourth chain, Ditt Apotek, is a franchise of Norsk Medisinaldepot consisting of 48 privately owned pharmacies and 33 publicly owned hospital pharmacies. The remaining pharmacies are independent, but have organised a joint procurement entity with a purchasing contract with Alliance. Thus, the three wholesalers serve the whole retail (outpatient) pharmacy market.

The market is extensively regulated. Several of the regulations have implications for market structure and firm behaviour. First, there are restrictions on the vertical relationship between producers and distributors of pharmaceuticals. Pharmaceutical companies are not allowed to own distributors (wholesalers and pharmacies). This is to our knowledge a general prohibition in all Western countries. Moreover, the wholesalers are required to store and deliver the full range of pharmaceuticals with a marketing licence that are demanded by patients (prescribed by physicians).[13] This means that distributors must carry all brand-names and cannot make (exclusive dealing) contracts with a subset of the brand-name producers. This regulation has also implications for the off-patent market segment in the sense that the wholesalers cannot make a contract with a generic producer

[13] "Important" drugs should be delivered within 24 hours, while less important drugs have a 48 hour delivery deadline.

that excludes the original brand-name product. However, the wholesalers can offer one generic producer a contract that excludes rival generic producers. Thus, the wholesalers' bargaining power is clearly stronger in the generic market.

Second, the demand for prescription drugs is extensively subsidised at the point of consumption due to insurance against medical expenditures. However, there is cost-sharing through coinsurance. As a general rule patients pay a fraction (36 percent) of the price of the drug they demand up to certain expenditure caps. Once these caps are reached, there is 100 percent coverage from the public insurer. Figures show that the *de facto* cost sharing is 30-70, where the public insurer covers 70 percent of total pharmaceutical expenditures (LMI, 2009).

Third, since insurance reduces the price elasticity of demand for pharmaceuticals, there are various restrictions on pricing. All prescription drugs are subject to price cap regulation. The price cap is based on international price comparisons (external referencing) and fixed at wholesale level.[14] Adding a maximum mark-up defines the price cap at pharmacy (retail) level. Brand-names and generics face the same price cap, though in practice the cap is usually binding only for the brand-name.

In 2003 the government introduced reference pricing (internal referencing) for a subsample of the off-patent molecules with generic competition. This system has been extended to all new molecules for which the patent expires and generic competition takes place.[15] The reference price, which is the maximum reimbursement for all products with a given molecule, is defined as a "discount" on the price cap for this molecule.[16] The firms are free to charge prices above the reference price (though constrained by the price cap). However, if a product is priced above the reference price, patients that demand this drug

[14] Producers must report their prices in nine reference countries (Austria, Belgium, Denmark, Finland, Germany, Irland, the Netherlands, Sweden and United Kingdom). The price cap is defined as the average of the three lowest prices in the reference countries and updated annually.

[15] There has also been a modification of the reference price system. The first version called "indekspris" defined the reference price as a sales weighted sum of brand-name and generic prices (see, Brekke et al. 2009, 2010). This system was replaced by "trinnpris" in January 2005, where the reference price is calculated as a discount on the price cap prior to generic competition.

[16] The discount is progressive. First, the reference price is 70 percent of the price cap before generic competition. Then after 6 months the reference price is reduced to 45 or 25 percent depending on it sales value. Finally, after 18 months the reference price is reduced to 35 or 20 percent.

must pay the difference between the charged price and the reference price out-of-pocket (in addition to coinsurance). This price difference will not be covered by the public insurer even if the patient's medical costs have reached the expenditure cap. The intention is to induce consumers to substitute to a lower priced generic and/or get the brand-name producer to reduce its price.

Notably, the price regulations restrict pricing at retail and wholesale level, but not at producer level. The producer prices are freely set by the pharmaceutical companies or in negotiations with the wholesalers.

5 Data and descriptive statistics

In the empirical analysis we use data from the Prescription and the Wholesale databases of the Norwegian Institute of Public Health. The Prescription database contains information about all prescription bound sales at pharmacy level in Norway from 2004 and onwards. From this database we have information about average prices and volumes per quarter over a four-year period (2004-7). Prices and volumes are in defined daily doses (DDD) per product (package) per pharmacy. The dataset also provides detailed information about product name, manufacturer, launch date, package size, presentation form, dosage, etc. In addition, we have information about ownership and chain affiliation for each pharmacy over the period. We merge these data with data from the Wholesale database, which contains information about producer (ex-manufacturer) prices (in DDD) per product for each wholesaler.

We aim at studying the incentives of pharmacies to steer consumers from (prescribed) brand-names towards potentially more profitable generic drugs. We therefore limit our data along two dimensions. First, we restrict attention only to off-patent molecules with generic competition.[17] Moreover, for each molecule we include only the products that are on the generic substitution list, as defined by the Norwegian Medicines Agency. This list consists of the products for which the pharmacies are allowed to dispense a generic to

[17] Table A1 in the Appendix provides a complete list of the molecules in our sample, as well as descriptive statistics of our key variables.

patients with a brand-name prescription. Thus, we are able to identify the set of products where pharmacy margins are likely to play a role for generic sales.[18] This leaves us with a sample of 74 off-patent substances with generic competition. Second, we restrict attention to vertically integrated pharmacies. We could potentially look at the product margins at pharmacy level. However, almost 85 percent of the pharmacies in the Norwegian market are owned by the wholesalers. For these pharmacies it makes little sense to look at only the downstream margins. Consequently, we exclude all transactions between wholesalers and vertically separated pharmacies.

For each of the three wholesalers (pharmacy chains) we calculate separate brand-name and generic prices as product averages for each substance at both producer (ex-manufacturer) and retail level. Based on this, we derive the gross margin for brand-names and generics for each vertically integrated pharmacy chain. We report margins both in absolute and in percentage terms. The absolute margin is the difference between the producer price and the retail pharmacy price. The percentage margin is simply the absolute margin divided by the retail pharmacy price. This measure corresponds to the Lerner-index, which is a common measure of mark-ups and market power in industries. Finally, we compute for each wholesaler (pharmacy chain) the brand-name market share as the brand-name sales volume (in DDD) divided by the total sales volume for each substance per period.

Table 2 below provides an overview of the means and standard deviations of our key variables across the three pharmacy chains, as well as the industry figures.

[Table 2 about here]

From the table we see that the average brand-name market shares vary from about 39 to 45 percent across the wholesalers. We also see that the average brand-name prices (per DDD) are higher than the average generic prices on retail level for all three wholesalers,

[18] In Table A1 in the Appendix, we have a variable called the "percentage changeable", which is the share of sales (measured in DDD) of products within a given substance that are on the substitution list. According to this measure, a significant share of the sales are subject to generic substitution.

though there is some variation in the levels across the chains. The figures are in Norwegian kroner (NOK), where 1 Euro is approximately 8 NOK.

If we look at product margins, we see that brand-names have a mark-up of about 47-49 percent, while the generic margins are about 67-68 percent. The percentage margins are quite high and fairly similar across the wholesalers, suggesting significant (and symmetric) downstream market power.

While the percentage margin is a convenient measure that is frequently used, one needs to be careful with its interpretation when products differ in prices. In particular, in our case, where we have high-priced brand-names and low-priced generics, the absolute margins might actually be higher for brand-names, though the percentage margins are not. However, as can be seen from Table 2, the absolute margins are also significantly higher for the generics. While the generic margin varies from 6.31 to 7.58 NOK per DDD across the wholesalers, the brand-name margins vary from 4.6 to 5.28 NOK per DDD.

Since we are interested in the relationship between product margins and market shares, it is useful to see how these variables develop over time. Figure 1-3 below plot the changes in our key variables for each of the three wholesalers (pharmacy chains) for the period of 2004 until 2008.

[Figures 1-3 about here]

Notice that the figures are based on products that are present in our sample for the whole period. The reason is, of course, that entry of new substances and/or products will shift the average prices, margins and market shares, so that trends over time will be hard to detect. Since most of the products are present in the sample for the whole period, the figures should be fairly representative.[19]

The figures show a clear tendency. On the one hand, the average percentage margin of generics increases quite steeply, while the brand-name margins are fairly stable. This pattern is relatively robust across pharmacy chains. On the other hand, the brand-name market shares are decreasing for all wholesalers, though with the steepest change for

[19] This can be readily verified from Table A1 in the Appendix.

wholesaler 1. The descriptive statistics in Table 2 and the graphs in Figure 1-3 indicate a relationship between brand-name and generic product margins and their market shares. We take a closer look at this in the next section.

6 Empirical method and results

In this section we aim at estimating the effect of product margins on market shares. Having detailed product level panel data for 74 substances over four years (2004-7), we use fixed effect regressions to estimate the impact of margins on brand-name market shares. More precisely, we estimate the following fixed effect model:

$$Y_{ikt} = a_{ik} + \delta_t + \beta \cdot \mathbf{m}'_{ikt} + \gamma \cdot \mathbf{X}'_{ikt} + \varepsilon_{ikt}, \tag{17}$$

where Y_{ikt} is the brand-name market share of substance i of wholesaler (pharmacy chain) k at time t. Moreover, a_{ik} is a substance fixed effect (dummy) for each wholesaler that captures unobserved factors that is constant over time. This is a very flexible specification, where we allow the intercepts for each substance to be different across wholesalers.[20] By including these fixed effects, we control for unobserved factors – e.g., brand-name marketing, physicians' prescription behaviour, wholesaler management and strategy differences, etc. – that are likely to effect brand-name market shares. Time trends in market shares are captured by period specific variables δ_t.

The variable $\mathbf{m}'_{ikt}$ contains our main observables of interest, namely the margins of brand-names and generics. A higher generic (brand-name) margin should provide stronger (weaker) incentives for the pharmacy to persuade consumers to substitute, suggesting a negative (positive) relationship with our dependent variable. We estimate the effects separately for the brand-name and generic margins, which allows us to account for potentially asymmetric effects.

We also control for price differences at pharmacy level between brand-names and gener-

[20] An alternative would be to have separate dummies for substances and wholesalers. However, this is a less flexible specification than having one dummy per substance per wholesaler.

ics. As described in Section 3, a change in the pharmacy retail price affects both the margin and the copayment. While copayments affect demand, margins are not observed by the consumers and thus only affect the pharmacy's incentives to promote generics. These effects pull in opposite directions. A lower, say, generic price makes it more likely that consumers will switch to a generic, but less likely that the pharmacy will suggest a generic substitute because of a lower generic margin. Controlling for pharmacy price differences between brand-names and generics allows us to disentangle these two counteracting forces with respect to market shares.

The results from the fixed effect regressions are reported in Table 3.

[Table 3 about here]

Our results indicate strong and highly significant effects on brand-name market shares of product margins measured either in percentage or absolute terms. We see that a one percentage point increase in the percentage brand-name (generic) margin results in a 0.37 (0.408) percentage point increase (decrease) in the brand-name market share. If we look at absolute margins, we find that an increase of 1 NOK of selling a brand-name (generic) leads to a 3.2 (1.1) percentage point increase (decrease) in the brand-name market shares. While the effects are fairly symmetric for percentage margins, this is not the case for absolute margins. However, an increase of 1 NOK is a larger change for brand-names than for generics, as they have a lower average margin, as reported in Table 2.

The effects of product margins on market shares emerge after controlling for brand-name and generic pharmacy price differences. In estimating the effect of percentage margins, we use the relative branded-generic prices as control variables. However, when estimating the effect of absolute margins, we instead use absolute price differences, as this also accounts for levels, not just relative differences in retail pharmacy prices. We see from Table 3, that a one unit increase in the relative pharmacy prices, which is a very large change in branded-generic price differences, results in a 13.1 percentage point reduction in the brand-name market share. Moreover, a 1 NOK increase in the absolute branded-

generic price difference reduces the brand-name market share with 2.6 percentage points. Thus, it is more likely that a consumer ends up with a generic drug if the price difference, and thus the copayment difference, between brand-names and generics becomes larger.

6.1 The role of the copayment structure

As shown in the theory section, the copayment structure might be important for the pharmacies' substitution incentives. If consumers face the same copayment for brand-names and generics, getting them to accept a generic substitute is hard, since they have no financial motive to switch. Coinsurance is a mechanism to directly link the copayments to the medical costs. By paying a fraction of the price, as a cost-sharing rule, a price reduction in, say, a generic drug directly translates into a reduction in the copayment for this product. Reference pricing extends the cost-sharing even further by requiring patients to pay the difference between the high-priced brand-name and the maximum reimbursement price (reference price), in addition to regular copayments.

The pharmaceuticals in our data are either under standard coinsurance or reference pricing, as explained in Section 4. Based on the theoretical analysis, we expect pharmacies to expend more effort on persuading consumers to switch to generics under reference pricing, since the copayment difference is generally larger than under simple coinsurance. Thus, there should be a stronger relationship between brand-name and generic product margins and their market shares for the drugs that are exposed to reference pricing. To test this, we split the sample according to the copayment schedule, and run separate regressions on the two subsamples of drugs, using the same fixed effect model as in (17). Table 4 below reports the empirical results.

[Table 4 about here]

When we look at absolute margins, we see, as expected, that the effects are stronger for both brand-name and generic margins for products under reference pricing compared with standard coinsurance. Moreover, we see that the effect of brand-name percentage

margins also become stronger for products under reference pricing, but for generics the result is opposite. However, the general trend is that reference pricing reinforces the effect of product margins on market shares. One obvious reason for this is that the copayment differences are much smaller under coinsurance than reference pricing, which make it more difficult to persuade consumers to purchase a generic version instead of the brand-name. In addition, the expenditure caps, as described in Section 3, applies only to the coinsurance part of the copayment, and not to the extra surcharges under reference pricing. These findings (with exception of generic percentage margins) are in line with our theoretical predictions in Section 2.

6.2 Potential endogeneity

A potential concern is that the empirical results reported above might be biased due endogenous explanatory variables. While it seems fairly obvious that pharmacies (or any retailer) would promote products with higher margins to their costumers, we cannot *a priori* rule out that product margins might be influenced by market shares. It could also be that pharmacy prices, and thus pharmacy price differences, are endogenous. We account for potential endogeneity, by applying a fixed effect IV estimator[21] that is robust to, and efficient in the presence of, arbitrary serial correlation and heteroskedasticity (see Baum, Schaffer and Stillman, 2007).[22] In this regression we treat margins and retail price differences as endogenous variables. As instruments we use first, second and third lags of the endogenous variables.[23] We find it reasonable to assume that the margins in period $t-1$ are correlated with the margins in period t, but not *directly* with the market share in period t.

Orthogonality of the instruments is tested by Hansen's J statistic, which is consis-

[21] IV models were estimated using the Stata module xtivreg2 (Schaffer, 2007).

[22] The long-run heteroskedasticity and autocorrelation consistent covariance matrix is generated using the Bartlett kernel function with a bandwidth of 4. According to Baum, Schaffer and Stillman (2007), a common choice of bandwidth for these kernels is a value related to the periodicity of the data (4 for quarterly, 12 for monthly, etc.).

[23] We have also estimated models where we use second and third lags of the endogenous variables as instruments. The estimated coefficients are very close to the ones reported in Table 3, but the standard errors are larger.

tent in the presence of heteroskedasticity and autocorrelation (the null hypothesis is that the instruments are uncorrelated with the error term). However, instrument exogeneity is only one of the two criteria necessary for instruments to be valid. If the instruments are uncorrelated, or only weakly correlated, with the endogenous variables, then sampling distributions of the IV statistics are in general non-normal, and standard IV estimates, hypothesis tests and confidence intervals are unreliable. Hence, tests for underidentification and weak identification are reported. The underidentification test is a Lagrange multiplier (LM) test of whether the excluded instruments are correlated with the endogenous regressors (the null hypothesis is that the equation is underidentified). The weak instrument test statistic is based on the Kleibergen-Paap rk statistic. As a "rule of thumb" this F-statistic should be at least 10 for weak identification not to be considered a problem (Staiger and Stock, 1997).

The results from the fixed effect IV model are reported Table 5.[24] We first notice that the Sargan-Hansen test of overidentifying restrictions fail to reject the null hypothesis (i.e., the instruments are uncorrelated with the error term), suggesting that the set of instruments is valid. Considering the underidentification test, the null hypothesis (i.e., the equation is underidentified) is rejected, which implies that the model is identified. Further, the weak identification tests suggest that the correlation between the instruments and the endogenous variables is sufficiently strong.

From Table 5, we see that the results have become stronger when looking at the impact of absolute margins. Now a 1 NOK increase in the brand-name margin (per DDD) results in a 4.13 percentage point increase in the brand-name market share. Also the effect of absolute generic margins has become stronger. Looking at percentage margins, we see that the effect of brand-name margins has become stronger, while the effect of generic margins has become weaker. Thus, with the exception of generic percentage margins, the IV fixed effect model tend to reinforce the effects of product margins on market shares, but the changes in the coefficients are modest, suggesting limited problems with endogenous explanatory variables.

[24] First step results are available upon request.

7 Policy implications

As mentioned in Section 2, the previous literature on generic competition has focused either on physicians' prescribing practices or on the design of the patient reimbursement system for prescription drugs. In the present paper, we have found that pharmacy incentives are also likely to play a crucial role in determining generic sales and thereby total pharmaceutical expenditures. What are the possible policy implications of this finding? We would here like to emphasise two different implications for optimal regulation of pharmaceutical markets that follow from our analysis.

First, our empirical results indicate that pharmacy margins on branded versus generic drugs have a sizeable impact on generic market shares. This suggests that mark-up regulation at the pharmacy level could potentially be an additional powerful instrument in order to stimulate generic competition and thereby obtain cost savings. However, the important lesson from our analysis is that the effect of mark-up regulation on generic competition depends crucially on the design of the regulation scheme. More specifically, a regressive mark-up scheme that provides lower absolute margins on higher priced drugs (brand-names) will provide pharmacies with incentives to steer demand towards cheaper generic drugs. On the other hand, a fixed percentage mark-up will automatically imply that pharmacies have higher margins on (higher-priced) brand-name drugs, which is detrimental for stimulating generic competition. Although these insights are not new, our empirical analysis suggests that the quantitative impact of qualitatively different mark-up schemes is potentially large.

Second, our analysis also casts additional light on the effects of a widely used instrument for stimulating generic competition, namely reference pricing. In our theoretical model, we show that reference pricing reinforces pharmacy incentives for expending effort on persuading consumers to switch from brand-names to generics. We are also able to confirm this effect in our empirical analysis. Thus, by explicitly taking pharmacy incentives into account, we are able to identify an additional channel through which reference pricing stimulates generic competition. Our analysis can therefore be seen as offering an

additional argument for introducing reference pricing (or any other reimbursement scheme that increases the relative patient copayment for branded versus generic drugs) in order to contain the growth in pharmaceutical spending.

8 Concluding remarks

The functioning of pharmaceutical markets is complex and far from perfectly understood. One of the most studied yet less understood issues, is that of generic competition in the off-patent market for prescription drugs. Compared to markets for ordinary consumption goods, a complicating factor is that demand for prescription drugs is partly determined as a result of interactions between prescribing physicians and patients. However, we argue that there are also other complicating, and less understood, factors. In the present paper we have examined a hitherto neglected factor in explaining generic competition, namely the role of dispensing pharmacies. More specifically, we have analysed – theoretically and empirically – the incentive for pharmacies to promote generic instead of brand-name drugs.

Based on a theoretical model of vertical differentiation, we show that pharmacy incentives to steer demand towards generic drugs are increasing in both relative margins and relative copayments between brand-names and generics. These effects are empirically confirmed in the second part of our paper, where we use Norwegian data on sales and prices at both producer (ex-manufacturer) and retail (pharmacy) level for 74 off-patent substances with generic competition over a four-year period (2004-7). Controlling for relative retail prices of brand-names and generics, we find strong and highly significant effects of brand-name and generic margins on their market shares, implying that pharmacies are expending more effort on promoting generics when their margins on generics are high relative to those on brand-names. Thus, our results strongly suggest that dispensing pharmacies are not perfect agents for patients and that pharmacy incentives are important for stimulating generic sales.

Before concluding the paper, we would like to stress some potential caveats with our

study. Our theoretical analysis takes producer prices as given. Obviously, this is a simplifying assumption. Producer prices are determined in negotiations between the (brand-name and generic) producers and the wholesalers. It would be of great interest to study the determination of the producer prices as a result of a bargaining game between these two parties, but this is clearly beyond the scope of the current paper and is therefore left for future research.

In our empirical study, we observe gross product margins. However, distribution costs might differ across wholesalers and pharmacy chains, and give rise to different net margins. Moreover, we do not observe potential side-payments between the producers and the wholesalers, which might affect the overall profitability of selling specific products. However, as long as these factors are fairly consistent over time, they should be captured by our substance-wholesaler fixed effect dummies. There are also regulations that restricts the use of side-payments. The government requires that discounts given to the wholesalers should be reflected in the producer prices and cannot be given as a fixed lump-sum transfer. It is also the case that the distributors' incentives are affected by the marginal profitability of selling a specific product, which is exactly what we find in our data.

References

[1] Aronsson, T., Bergman, M.A., Rudholm, N., 2001. The impact of generic drug competition on brand name market shares – Evidence from micro data. Review of Industrial Organization, 19, 425–435.

[2] Baum, C.F., Schaffer, M.E., Stillman, S., 2007. Enhanched routines for instrumental variables/GMM estimation and testing. Boston College Economics Working Paper No. 667.

[3] Bergman, M.A., Rudholm, N., 2003. The relative importance of actual and potential competition: empirical evidence from the pharmaceuticals market. Journal of Industrial Economics, 51, 455–467.

[4] Bernheim, B.D., Whinston, M.D., 1985. Common marketing agency as a device for facilitating collusion. RAND Journal of Economics, 16, 269–282.

[5] Bernheim, B.D., Whinston, M.D., 1986. Common agency. Econometrica, 54, 923–942.

[6] Brekke, K.R., Grasdal, A.L., Holmås, T.H., 2009. Regulation and pricing of pharmaceuticals: reference pricing or price cap regulation? European Economic Review, 53, 170–185.

[7] Brekke, K.R., Holmås, T.H., Straume, O.R., 2010. Regulation, generic competition and pharmaceutical prices: Theory and evidence from a natural experiment. Unpublished manuscript.

[8] Coscelli, A., 2000. The importance of doctors' and patients' preferences in the prescription decision. Journal of Industrial Economics, 48, 349–369.

[9] European Generic Medicines Association, 2009. How to Increase Patient Access to Generic Medicines in European Healthcare systems. Brussels.

[10] Frank, R.G., Salkever, D.S., 1997. Generic entry and the market for pharmaceuticals. Journal of Economics and Management Strategy, 6, 75–90.

[11] Gal-Or, E., 1991. A common agency with incomplete information. RAND Journal of Economics, 22, 274–286.

[12] Grabowski, H.G., Vernon, J., 1992. Brand loyalty, entry and price competition in pharmaceuticals after the 1984 Drug Act. Journal of Law and Economics, 35, 331–350.

[13] Hellerstein, J.K., 1998. The importance of the physician in the generic versus trade-name prescription decision. RAND Journal of Economics, 29, 108–136.

[14] Iizuka, T., 2007. Experts' agency problems: evidence from the prescription drug market in Japan. RAND Journal of Economics, 38, 844–862.

[15] LMI, 2009. Fact and figures. The Association of the Pharmaceutical Industry in Norway, Oslo.

[16] Liu, Y.-M., Yang Y.-H., Hsieh, C.-R., 2009. Financial incentives and physicians' prescription decisions on the choice between brand-name and generic drugs: Evidence from Taiwan. Journal of Health Economics, 28, 341–349.

[17] Lundin, D., 2000. Moral hazard in physician prescription behavior. Journal of Health Economics, 19, 639–662.

[18] Martimort, D., 1996. Exclusive dealing, common agency, and multiprincipals incentive theory. RAND Journal of Economics, 27, 1–31.

[19] Pavcnik, N., 2002. Do pharmaceutical prices respond to potential patient out-of-pocket expenses? RAND Journal of Economics, 33, 469–487.

[20] Pharma, 2008. Profile 2008 - Pharmaceutical Industry. Pharmaceutical Research and Manufacturers of America, Washington DC.

[21] Raskovich, A., 2007. Retail buyer power through streering. Economics Letters, 96, 221–225.

[22] Schaffer, M.E., 2007. xtivreg2: Stata module to perform extended IV/2SLS, GMM and AC/HAC, LIML and k-class regression for panel data models.

[23] Staiger, D., Stock, J.H., 1997. Instrumental variables regression with weak instruments. Econometrica, 65, 557–86.

[24] Telser, L.G., 1960. Why should manufacturers want fair trade? Journal of Law and Economics, 3, 86–105.

Tables

Table 1. Pharmacy chains, number of pharmacies, 2009.

Alliance apotekene	144
Apotek 1	244
Vitusapotek	169
Ditt Apotek (hospital pharmacies)	81 (33)
Independent pharmacies	24
Total	662

Table 2. Sample characteristics, means and standard errors in parentheses

	Wholesaler 1 (apokjeden)	Wholesaler 2 (holtung)	Wholesaler 3 (nmd)	Industry
Brand-name market share	38.71 (28.75)	44.65 (29.70)	45.38 (30.50)	42.98 (29.81)
Brand-name retail price	11.26 (23.60)	12.75 (24.97)	12.96 (26.39)	12.34 (25.04)
Generic retail price	9.68 (19.39)	10.80 (21.32)	10.58 (19.63)	10.37 (20.15)
Abs. brand-name margin	4.60 (8.20)	5.06 (12.58)	5.28 (9.17)	4.99 (8.67)
Abs. generic margin	6.31 (16.28)	7.58 (18.98)	7.16 (16.78)	7.03 (17.41)
% brand-name margin	47.31 (11.99)	46.69 (12.58)	48.98 (13.24)	47.66 (12.65)
% generic margin	66.76 (16.63)	67.60 (17.89)	67.42 (17.66)	67.27 (17.41)
Number of observations	901	952	942	2795

Table 3. The effect of pharmacy margins on brand-name market shares, fixed effect results with robust standard errors

	Percentage margin	Absolute margin
Brand-name margin	0.370^{***} (0.110)	3.199^{***} (0.647)
Generic margin	-0.408^{***} (0.059)	-1.075^{***} (0.295)
Relative price	-13.098^{***} (2.817)	-
Price difference	-	-2.600^{***} (0.475)
Constant	75.917^{***} (6.923)	51.337^{***} (2.267)
Wholesaler-product dummies	Yes	Yes
Period dummies	Yes	Yes
R-squared	0.332	0.263
Number ATC-groups	74	74
Number observations	2795	2795

Table 4. The effect of pharmacy margins on brand-name market shares, fixed effect results with robust standard errors

	Percentage margin		Absolute margin	
	Reference pricing	Co-insurance	Reference pricing	Co-insurance
Brand-name margin	0.514***	0.233	3.469***	0.996
	(0.134)	(0.208)	(1.154)	(0.688)
Generic margin	-0.310***	-0.466***	-1.321***	-0.851***
	(0.093)	(0.081)	(0.525)	(0.252)
Relative price	-12.751***	-14.729***	-	-
	(3.026)	(5.986)		
Price difference	-	-	-2.891***	-0.920**
			(0.765)	(0.470)
Constant	70.305***	84.739***	57.883***	56.854***
	(8.819)	(10.516)	(4.455)	(3.837)
Wholesaler-product dummies	Yes	Yes	Yes	Yes
Period dummies	Yes	Yes	Yes	Yes
R-squared	0.392	0.278	0.337	0.191
Number ATC-groups	32	42	32	42
Number observations	1171	1624	1171	1624

Table 5. The effect of pharmacy margins on brand-name market shares, IV fixed effect results with robust standard errors

	Percentage margin	Absolute margin
Brand-name margin	0.549***	4.126***
	(0.110)	(1.102)
Generic margin	-0.288***	-1.283***
	(0.062)	(0.410)
Relative price	-11.278*** (2.229)	-
Price difference	-	-2.957***
		(0.589)
Wholesaler-product dummies	Yes	Yes
Period dummies	Yes	Yes
Overidentification test (Hansen J statistics)	0.528	0.144
Underidentification test P-value	0.000	0.001
Weak identification test (Kleibergen-Paap rk Wald F statistic)	44.888	5.341
Number ATC-groups	71	71
Number observations	2128	2128

Table A1. Descriptive statistics (prices per DDD)

ATC code	Market share	Pharmacy price brand name	Producer price brand name	Pharmacy price generics	Producer price generics	Percentage changeable	Ref. pricing	Number of obs.
A02BA02	44.67	4.29	2.01	3.89	1.37	99.97	Yes	48
A02BA03	43.83	10.81	7.21	9.87	2.56	100.00	No	48
A02BC01	52.54	9.79	6.08	8.17	3.92	100.00	Yes	48
A02BC03	8.39	11.46	7.39	9.19	3.69	77.89	Yes	9
A03FA01	2.11	4.63	1.85	6.84	2.05	99.94	No	32
A04AA01	74.72	204.43	142.71	169.73	12.90	90.47	No	26
A07EC07	48.76	11.28	7.47	14.74	9.79	74.90	No	48
A10BA02	64.22	2.28	1.11	2.25	0.61	100.00	No	48
A10BB12	63.98	1.97	0.98	1.69	0.34	100	Yes	20
C01DA14	6.66	2.64	1.46	2.14	1.02	68.67	No	48
C03DA01	13.65	3.41	1.91	3.04	1.13	100	No	48
C03EA01	27.28	0.81	0.38	0.59	0.17	100	No	48
C07AA05	75.72	3.93	2.28	2.49	0.68	86.64	No	40
C07AB02	99.76	6.95	3.39	3.34	1.21	99.74	No	48
C07AB03	26.69	1.58	0.75	1.52	0.42	100	Yes	48
C08CA01	24.78	3.42	2.07	1.96	0.40	100	Yes	47
C08CA02	31.82	2.73	1.69	1.99	0.33	100	Yes	41
C08DA01	29.74	3.01	1.44	2.81	0.84	36.06	No	48
C09AA02	33.77	1.83	0.75	1.82	0.48	100	Yes	48
C09AA03	27.39	2.78	1.51	2.41	0.67	100	Yes	48
C09AA05	48.96	1.76	0.87	1.74	0.38	99.91	Yes	34
C09BA02	38.58	3.48	1.87	3.37	0.97	93.98	Yes	48
C09BA03	31.27	4.26	2.50	3.18	0.72	100	Yes	45
C10AA01	28.42	2.62	1.42	2.66	0.76	100	Yes	48
C10AA02	32.92	11.21	6.89	9.74	2.13	100	No	48
C10AA03	18.92	6.84	4.89	3.23	0.89	100	Yes	36
D01BA02	11.25	20.46	14.12	13.08	2.15	100	Yes	33
G03CA03	19.61	2.74	1.71	3.45	2.10	18.74	No	48
G03HB01	52.35	2.17	1.30	1.79	0.38	100	No	23
H01BA02	96.87	27.77	16.36	18.70	11.01	91.70	No	22
J01AA02	6.41	7.45	3.64	6.85	2.13	99.92	No	24
J01CA04	47.55	13.93	7.05	9.71	3.24	100	Yes	48
J01FA01	36.40	13.07	5.89	12.80	5.75	18.73	No	48
J01FA09	24.26	20.16	12.31	12.41	3.91	65.08	Yes	40
J01MA02	32.44	27.87	14.40	22.91	5.78	100	Yes	37
J02AC01	40.61	103.01	57.82	74.68	13.86	98.22	Yes	45
L02AE02	69.17	45.74	32.95	45.56	32.91	96.17	No	46
L02BA01	41.18	4.75	2.64	4.13	1.17	100	No	48
L02BB03	82.81	48.59	34.42	42.24	9.97	100	No	6
L04AX03	85.31	2.06	0.88	1.87	0.94	98.26	No	47
M01AB05	58.07	4.29	1.65	4.03	1.44	87.20	Yes	48
M01AC01	8.86	3.47	1.84	3.34	0.91	10.63	No	48
M01AC06	85.63	4.65	1.47	5.21	1.69	99.91	Yes	20
M01AE01	3.63	3.73	1.38	3.72	0.96	32.85	No	24
M01AE02	12.52	3.49	1.73	2.85	0.96	32.85	No	24
M01AX05	33.51	2.71	0.95	3.40	1.58	97.78	No	6
M04AA01	35.35	2.92	1.16	2.82	0.67	100	No	48
M05BA04	10.91	10.27	7.23	4.79	0.68	100	Yes	24
N02AB03	84.10	44.17	27.84	35.85	9.85	96.50	No	18
N02AX02	37.48	12.31	3.78	11.72	2.00	63.63	No	48
N02BE01	23.10	2.36	0.76	4.63	1.42	100	No	48
N02CC01	69.52	90.23	29.35	60.73	9.39	98.27	Yes	12
N03AF01	87.89	6.52	3.17	6.07	2.62	27.39	No	48
N03AG01	97.71	14.94	8.59	12.67	6.31	2.55	No	40
N03AX09	96.34	46.94	28.84	31.15	5.63	99.91	No	24
N03AX11	94.73	49.72	32.56	44.25	15.76	99.68	No	12
N03AX12	90.76	31.54	17.92	28.72	9.78	100	No	40
N05AH02	31.21	20.50	13.11	18.38	6.22	100	No	48
N05AX08	32.76	47.85	27.96	20.38	9.59	71.38	Yes	12
N05BA01	27.13	3.41	1.00	4.45	0.70	99.30	No	48
N05BA12	89.76	3.40	1.33	3.34	0.94	35.83	No	6
N05CD02	25.80	1.27	0.30	1.52	0.25	97.02	No	48
N05CF02	59.06	4.89	2.02	4.78	1.08	100	No	48
N06AB03	32.58	6.13	4.05	5.51	1.74	100	Yes	48
N06AB04	20.63	7.02	4.51	3.90	1.47	100	Yes	48
N06AB05	30.76	6.32	3.61	4.34	1.41	100	Yes	46
N06AB06	64.51	5.59	3.42	4.99	1.23	97.68	Yes	14
N06AX03	90.89	4.89	2.18	6.01	2.76	100	Yes	48
N06AX11	74.68	8.45	4.24	6.61	2.23	100	Yes	20
N06BA04	39.82	7.02	3.69	21.68	14.13	77.18	No	48
R05CB01	40.69	4.22	1.77	4.23	1.70	98.31	No	48
R06AE07	26.69	2.48	1.09	1.62	0.48	98.76	Yes	48
R06AX13	53.42	3.02	1.80	2.93	1.47	100	Yes	12
S01ED51	63.01	7.09	4.61	8.81	5.92	78.96	No	48

Figures

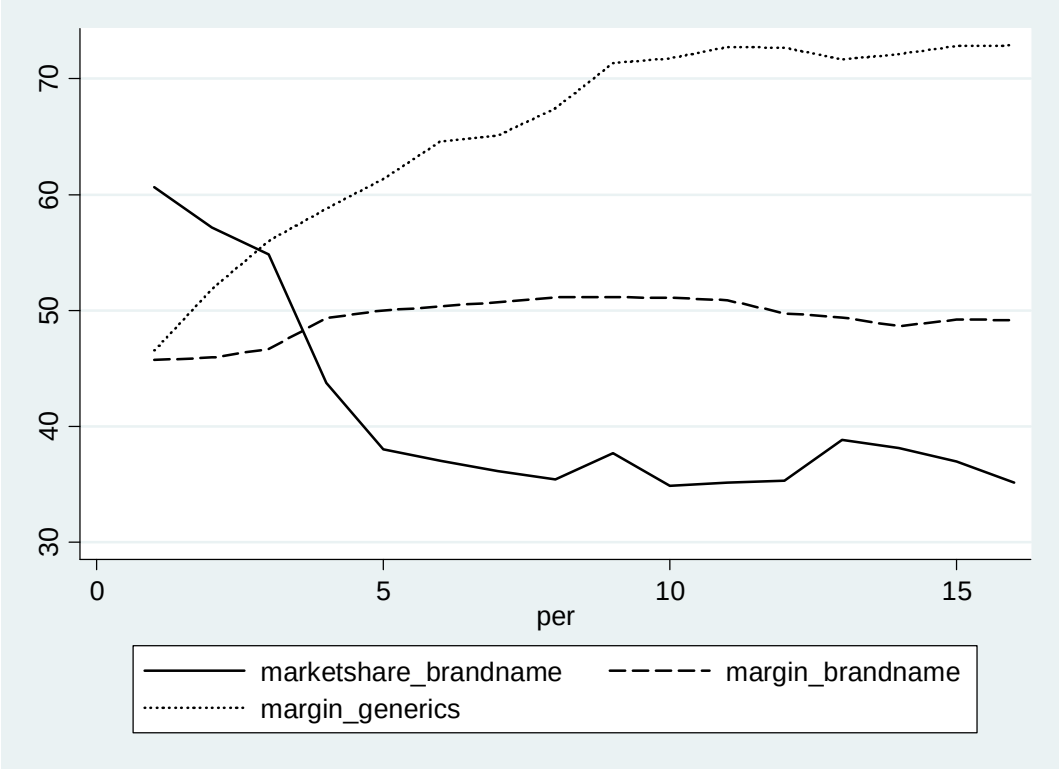

Figure 1. Percentage margins and market shares, wholesaler 1

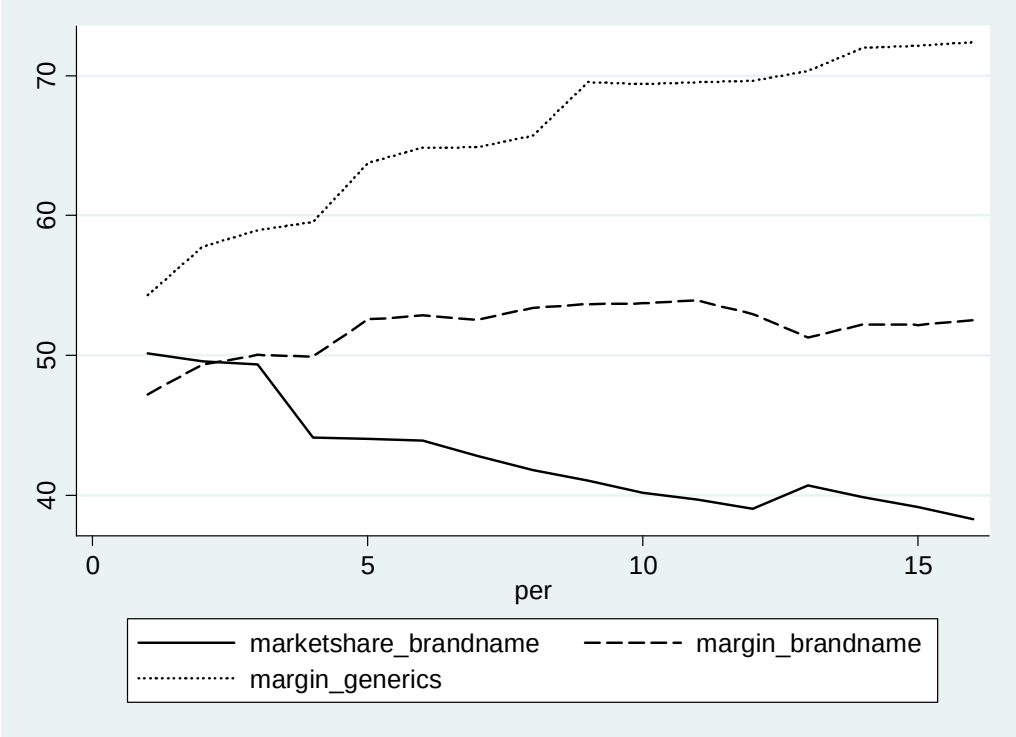

Figure 2. Percentage margins and market shares, wholesaler 2

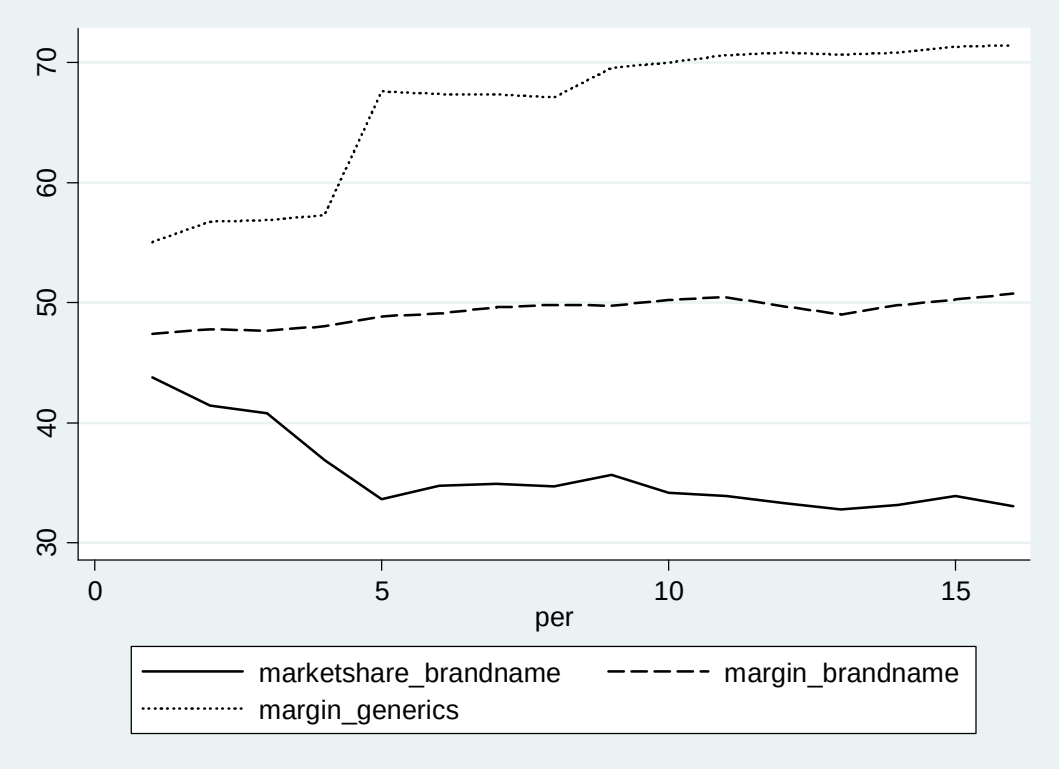

Figure 3. Percentage margins and market shares, wholesaler 3

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