Institut für
Volkswirtschaftslehre
und Statistik

No. 565-99

Health Insurance and Consumer Welfare: The Case of Monopolistic Drug Markets

Markus Anlauf and Berthold U. Wigger

Beiträge zur angewandten Wirtschaftsforschung

Universität Mannheim
A5, 6
D-68131 Mannheim

Health Insurance and Consumer Welfare: The Case of Monopolistic Drug Markets

by

Markus Anlauf

and

Berthold U. Wigger

Department of Economics
University of Mannheim
D–68131 Mannheim
Germany

anlauf@econ.uni-mannheim.de
wigger@econ.uni-mannheim.de

January 1999

Abstract

Individual moral hazard engendered by health insurance and monopolistic production are both typical phenomena of drug markets. We develop a simple model containing these two elements and show that private agents tend to overinsure themselves against health respectively drug expenses if drugs can be produced at low marginal costs. If marginal costs are negligible, health insurance should be abandoned at all.

Keywords: Prescription drugs, Health insurance, Moral hazard, Monopoly

JEL Classifications: I11, D42, H51

1. Introduction

Conventional health insurance, as available on private insurance markets, typically links insurance benefits to the costs of health care services incurred by the insured. It is well known that such insurance contracts induce the insured to excessively consume health care services in case of illness. The negative efficiency impact of this behavior, known as ex-post moral hazard, has received extensive consideration in the health economics literature.[1] It was Feldstein (1970, 1973) who first pointed out that moral hazard not only triggers an excessive demand for health care services but may also lead to higher prices in health care markets. These price effects, however, are not taken into account by the households when purchasing health insurance. Employing data of US health care markets, Feldstein showed that US households on average purchase too much health insurance. Reducing health insurance coverage would increase consumer welfare since the benefits of lower prices for health care services would outweigh the welfare losses due to higher risk taking.[2] Building on the studies of Feldstein, Chiu (1997) recently showed that in case of a complete price-inelastic supply of health care services conventional health care insurance should be entirely abandoned.

The approaches of Feldstein and Chiu rest on the assumption of an exogenously given supply function of health care services. Basically, the adverse welfare effects of an increased demand for health care services are due to a low elasticity of its supply. In the present paper we emphasize a different argument for excess insurance in private health insurance markets. Instead of considering a given supply function of health care services, we start out from the observation that real world health care markets are, to a large extend, characterized by considerable market power on the supply side. Especially the markets for prescription drugs are dominated by firms being endowed with far-reaching patent protection that guarantees monopolistic positions in particular drug markets. Moreover, there is substantial empirical evidence for serious moral hazard with respect to prescription drugs engendered by insurance.[3]

In this paper we consider a model whose ingredients are moral hazard with

---

[1] See, e.g., Arrow (1968), Pauly (1968, 1974), and Zeckhauser (1970).

[2] See also Feldman and Dowd (1991) for a more recent empirical estimation of the welfare loss of excessive health insurance.

[3] See, e.g., Coulson and Stuart (1995).

respect to drug consumption arising from insurance and a drug market dominated by a single monopolistic producer. First, we analyze the relationship between the monopolistic price for drugs and the extend to which households purchase insurance. We show that the price for drugs increases with insurance coverage if the marginal costs of the monopolist are rather low. Subsequently, we show that in case of small marginal costs individuals purchase an inefficiently high amount of health insurance coverage. If the monopolist faces negligible marginal costs, it is even optimal for consumers not to purchase insurance at all.

Our analysis also implies a redifinition of the public role in health insurance. Even though public health insurance is not able to overcome the moral hazard problem as such, a compulsory health insurance scheme with higher than market coinsurance rates reduces drug prices and increases consumer welfare.

2. The Model

We consider an economy with a large number of identical individuals with unit measure. A representative individual has a propability $\pi \in (0,1)$ of getting sick. In case of illness the individual suffers a loss which can be reduced by the consumption of a drug. The individual has the opportunity to purchase insurance to reduce the drug costs in case of illness. Expected utility is given by:

$$EU = \pi\, u(Y - z - L(X) - \lambda\, p\, X) + (1 - \pi)\, u(Y - z), \tag{1}$$

where u denotes a von Neumann-Morgenstern utility function with $u' > 0$ and $u'' < 0$, Y is the individual's disposable income, z is the insurance premium, X is the quantity of the drug consumed in case of illness, p is the price of the drug, and λ is the coinsurance rate chosen by the individual. $L(X)$ denotes the monetary loss suffered by the individual in case of illness. The loss L can be reduced by drug consumption. The function $L(\cdot)$ is assumed to be three times continuously differentiable and we further assume:

$$L > 0,\ L' < 0,\ L'(0) = -\infty,\ \text{and}\ L'' > 0, \tag{2}$$

implying that the marginal reduction of the loss the individual suffers when sick is decreasing. On the assumption that the loss L is private information of sick individuals, a contract between the insurer and the insured cannot depend on the monetary loss L. Instead, only the drug costs in case of illness $p\,X$ can be subject of an insurance contract. We restrict ourselves to linear insurance contracts implying that the insurer reimburses a constant share of drug costs.[4] We assume risk neutral insurers. Under perfect competiton only insurance contracts will be traded which imply residual profits of zero:

$$z = \pi\,(1-\lambda)\,p\,X. \tag{3}$$

In contrast, the drug is supplied by a monopolistic producer. We assume that the drug is produced with constant marginal costs c. Furthermore, the supply of the drug requires fixed costs F. Therefore, the monopolist's profit may be written as:

$$G = \pi\,(p-c)\,X - F. \tag{4}$$

The sequence of events is as follows: In the first period, individuals choose an insurance contract given by the bundle (z, λ). In the second period, the monopolist chooses a price for the drug. In the third period, nature decides which individuals become sick and which individuals stay healthy. Finally, in the fourth period, individuals choose the drug quantity. The sequence of events is illustrated in Figure 1. Note, that because of the large number of individuals, the single individual's insurance choice has no influence on the pricing decision of the monopolist. Consequently, all the results derived below would not change, if we considered a sequence of events in which the individuals and the monopolist move simultaneously in the first stage. However, if the monopolist set the drug price before the individuals undertake their insurance decision, he would have the opportunity to strategically influence the insurance decision of the individuals.

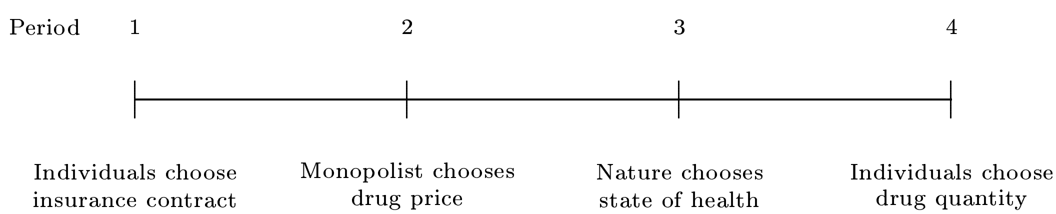

Figure 1: Sequence of Events

[4] Linear contracts allow for a simple treatment of the moral hazard problem. More sophisticated contracts, as discussed, for example, in Spence and Zeckhauser (1971) and Blomqvist (1997), would not alter the character of the results derived in this paper.

3. Insurance and Drug Market Equilibrium

The equilibrium in the insurance and drug market will be determined by backward induction. To start with, we determine the quantity of drugs demanded by the representative individual. Considering equation (1), a healthy individual will not consume any drugs, whereas a sick individual solves the following optimization problem:

$$\max_{X \geq 0} u(Y - z - L(X) - \lambda\, p\, X).$$

Assuming the disposable income Y to be sufficiently high, the first-order condition is given by:

$$-L' - \lambda\, p = 0. \tag{5}$$

Equation (5) implies that only insurance contracts with a positive coinsurance rate are traded in private insurance markets. A fully insured individual would expand his demand for drugs infinitely. This would imply insurance premiums to rise to infinity, too. Obviously, such an insurance is not feasible.

As shown by equation (5), in the optimum the marginal reduction of the monetary loss achieved by extra drug consumption equals the marginal personal costs of drugs. Equation (5) implies a demand function of the form $X(p, \lambda)$. Employing the implicit function rule, it follows:

$$\frac{\partial X}{\partial \lambda} = -\frac{p}{L''} < 0, \tag{6}$$

$$\frac{\partial X}{\partial p} = -\frac{\lambda}{L''} < 0. \tag{7}$$

Choosing the drug price, the monopolist will take the individual demand function $X(\lambda, p)$ into account. Thus, the monopolist solves:

$$\max_{p} \pi\,(p - c)\, X(\lambda, p) - F.$$

When the monopolist chooses the drug price, the coinsurance rate λ is already fixed. Hence, the first-order condition for maximum profit is given by:

$$(p - c)\frac{\partial X(\lambda, p)}{\partial p} + X(\lambda, p) = 0. \tag{8}$$

We assume that the profit maximizing price is strictly positive for all c including $c = 0$. Equation (8) implies that the profit maximizing price p is a function of the coinsurance rate λ. Implicit differentiation yields:

$$\frac{dp}{d\lambda} = \frac{-(p-c)\dfrac{\partial^2 X}{\partial p\,\partial\lambda} - \dfrac{\partial X}{\partial\lambda}}{(p-c)\dfrac{\partial^2 X}{\partial p^2} + 2\dfrac{\partial X}{\partial p}}. \tag{9}$$

Considering the second-order condition for a profit maximum of the monopolist, the denominator of the right hand side of equation (9) is negative. In contrast, the sign of the numerator is ambiguous. The following lemma, however, shows that the sign of the numerator and, henceforth, the sign of $dp/d\lambda$ can be determined for low marginal costs c.

Lemma 1: There is some $\bar{c} > 0$, so that for all $c < \bar{c}$ it follows: $dp/d\lambda < 0$.

Proof: See the Appendix.

To get an intuition for this result, it is helpful to consider first, how the equilibrium quantity for drugs X depends on the coinsurance rate. Considering equations (6), (7), and (9), X can in fact be written as a function of λ. The total effect of an increase of λ on X is as follows.

Lemma 2: $dX/d\lambda \leq 0$, with $= 0$ if $c = 0$.

Proof: See the Appendix.

Thus, if $c = 0$, moral hazard of the insured does not lead to higher drug consumption in equilibrium. From (6) we know that an increase in the coinsurance rate leads to a decrease in the demand for drugs. Facing this decrease in demand, the monopolist can generally adjust both price and quantity. However, if marginal costs are equal to zero, the monopolist gains nothing by simply reducing the quantity. Consequently, it will be more effective to lower the price. A similar argument can be applied if marginal costs are positive but small, since in all these cases a quantity reduction has only a minor effect on costs.

This result allows a comparison with the work of Chiu (1997). There, the assumption of a complete price-inelastic supply of health care which is justified by the role of nonmarket factors leads to an inflexibility of consumed health care with respect to the coinsurance rate λ. Here, in contrast, the interplay between moral hazard and monopolistic profit maximization results in an equilibrium quantity of drugs which is independent of the coinsurance rate when marginal costs are zero.

In period one, the representative individual will choose out of the set of all fair insurance contracts the one that maximizes his expected utility. Doing this, the individual takes into account his demand for drugs in case of illness as implicitly defined by equation (5). Because of the large number of individuals the choice of insurance of one individual does not influence the pricing decision of the monopolist. Consequently, the single individual takes the drug price as fixed. Therefore, the optimization problem in the first period can be written as:

$$\max_{0<\lambda\leq 1} \pi\, u[Y - \pi\,(1-\lambda)\,p\,X(\lambda,p) - L(X(\lambda,p)) - \lambda\,p\,X(\lambda,p)] \\ + (1-\pi)\,u[Y - \pi\,(1-\lambda)\,p\,X(\lambda,p)].$$

The first-order condition is given by:

$$-\pi\,(1-\pi)\,p\,X\,(u'_s - u'_h) - \pi\,(1-\lambda)\,p\,\frac{\partial X}{\partial \lambda}[\pi\,u'_s + (1-\pi)\,u'_h] \geq 0, \\ \text{with } = 0, \text{ if } \lambda < 1, \qquad (10)$$

where u'_s and u'_h denote marginal utility in case of illness and health, respectively. Condition (10) describes the trade-off between additional utility resulting from reduced risk and additional utility resulting from a lower insurance premium. Condition (10) implies that the representative individual chooses a strictly positive amount of insurance ($\lambda < 1$). To see this suppose, on the contrary, that $\lambda = 1$. Then the first term of the left hand side of condition (10) is negative, because in the absence of insurance marginal utility in case of illness is larger than in case of health, while the second term is equal to zero. This, however, is a contradiction to condition (10). Thus, for the optimal λ, denoted as λ^* below, $0 < \lambda^* < 1$ holds.[5] Hence, the equilibrium of the economy under consideration is characterized by the insurance contract $(\lambda^*, z(\lambda^*))$, the drug price $p(\lambda^*)$, and the quantity of drugs $X(\lambda^*, p(\lambda^*))$.

4. Choice of Insurance and Individual Welfare

In this section we address the question whether or not the individually chosen

[5] A similar result is derived in Zeckhauser (1970), Blomqvist (1991), and Chiu (1997).

coinsurance rate λ^* maximizes individual welfare. Therefore, we examine how a marginal change in the coinsurance rate will effect the individual's expected utility when λ equals λ^*. Differentiation of (1), while considering (3) and (10), yields:

$$\frac{dEU}{d\lambda}|_{\lambda=\lambda^*} = -\pi\,(1-\lambda^*)\left(\frac{dp}{d\lambda}X + p\frac{\partial X}{\partial p}\frac{dp}{d\lambda}\right)[\pi\,u_s' + (1-\pi)\,u_h'] - \pi\,\lambda^*\frac{dp}{d\lambda}X\,u_s'. \tag{11}$$

Equation (11) indicates that a marginal change of the individually chosen coinsurance rate influences the welfare of the representative individual only via price effects but not via quantity effects. When choosing the insurance contract, the individual considers the quantitative moral hazard effect on his drug demand, but has no incentive to internalize its price effect. Generally, the price effect influences consumer welfare in two ways. It affects expected utility by altering the insurance premium [first term of the right hand side of equation (11)] and by altering the individual drug costs in case of illness [second term of the right hand side of equation (11)]. Considering the first-order condition of the monopolist (8), the price effect can be broken down in a premium effect and a drug cost effect.

$$\frac{dEU}{d\lambda}|_{\lambda=\lambda^*} = \underbrace{-\pi\,(1-\lambda^*)\,c\frac{\partial X}{\partial p}[\pi\,u_s' + (1-\pi)\,u_h']\,\frac{dp}{d\lambda}}_{\text{premium effect}} \underbrace{-\pi\,\lambda^*\,X\,u_s'\,\frac{dp}{d\lambda}}_{\text{drug cost effect}}. \tag{12}$$

Considering Lemma 1, we know, that $dp/d\lambda < 0$ holds if the marginal costs of drug production are rather low. Consequently, equation (12) states a negative premium effect and a positive drug cost effect if c is small. It turns out, however, that the drug cost effect always dominates the premium effect. Therefore, the overall effect of an increase in the coinsurance rate on expected utility can be related to the level of marginal costs so that the following result obtains.

PROPOSITION 1: The individuals choose an inefficiently low coinsurance rate λ if $c < \bar{c}$.

PROOF: See the Appendix.

Considering Lemmata 1 and 2, we know, that for $c = 0$ a variation of the coinsurance rate implies only a change in the price of the drug but does not imply a change in the equilibrium drug consumption. Therefore, a lower coinsurance rate only changes the monopolistic profit, whereas the individual drug costs in case of illness, $\lambda\, p\, X$, remain unchanged. Equation (5) clearly shows that with drug consumption fixed a reduction of the coinsurance rate leads to an equi-proportional rise in the drug price. In the end, the individual pays a higher insurance premium but faces the same risk of drug expenditure. Consequently, any insurance leads to a welfare loss if $c = 0$. This result will also hold for c sufficiently small, because, considering our assumptions about $L(\cdot)$, $dX/d\lambda$ is continuous in c. Therefore, we receive the following result:

PROPOSITION 2: There is some $\bar{\bar{c}} \in (0, \bar{c}]$, so that the individuals should choose a coinsurance rate of 1 for all $c < \bar{\bar{c}}$.

A straightforward implication of Propositions 1 and 2 is that a compulsory health insurance scheme might be superior to market health insurance. Depending on marginal costs of drug production, such a scheme should imply higher than market coinsurance rates for drug expenses or should even exclude them at all.

5. Concluding Remarks

In the present paper we have shown that households purchase excessive insurance if the drugs that they need in case of illness are supplied on monopolistic markets and if these drugs are produced at low marginal costs. Consequently, the question arises whether these characteristics in fact prevail in drug markets.

Monopoly power in the drug market can be attributed to patent protection. Patents are commonly used to induce private firms to meet the enormous costs of developing drugs. It could be argued that patent protection for drugs does not lead to the establishment of pure monopolies because for most patented drugs more or less close substitutes are available. Nevertheless, at least patents granted recently provide substantial scope for setting prices above marginal costs since otherwise producers would avoid the costs of patent application. It is this price setting power which drives our results. Moreover, even pure monopolies can be found in drug markets as, for instance, the drug for erectile dysfunction *Viagra*.

Drugs protected by patents account for a significant share of drug markets in all developed countries indicating the importance of price setting power in these markets. In Germany, for example, patent protected drugs that have been introduced since 1985 reached a revenue of 6 billion deutschmarks in 1996 which means a share of 17.4% of the entire drug market.[6]

The second condition for overinsurance in private markets derived in this paper also seems to be quite plausible. The major part of the costs a drug producer incurs arises during the phase of developing the drug. For instance, the development of a drug until its introduction into the market lasts 12 to 15 years on average and the probability that a particular synthesized substance in fact leads to a marketable drug is about 0.01%.[7]

Our results suggest that introducing compulsory public health insurance may have a positive effect on consumer welfare if the public health insurance exhibits lower insurance coverage for drugs protected by patents than individuals choose on private markets. It is a well known fact that public health insurance is not able to remove the moral hazard problem as such, because it faces the same information constraints as private insurance. Nevertheless, in contrast to the single individual, government can internalize the price increasing effects of moral hazard and can help to overcome the following prisoner's dilemma. Individuals would be better off if coinsurance rates were higher, but every single individual has an incentive to purchase more insurance than socially optimal. Such a role of public health insurance, however, would require that households were not allowed to purchase additional health insurance in private markets.

In the present paper we have only analyzed how consumer welfare is affected by health care insurance. We have not considered how monopoly rents are altered by a change in health care coverage and the possible repercussions on individual welfare. Generally, a change in monopoly profits affects the welfare of shareholders in the drug industry and, in this way, has a redistributional impact. The consideration of redistributive aspects, however, would render any welfare conclusions rather difficult.

[6] See Schwabe (1997).

[7] See Bartling and Hadamit (1982), Walker and Parrish (1988), and Weisbrod (1991).

Appendix

Proof of Lemma 1

Considering (9), we can write $dp/d\lambda = N/D$, with:

$$N = -(p-c)\frac{\partial^2 X}{\partial p\,\partial\lambda} - \frac{\partial X}{\partial\lambda}, \tag{A.1}$$

$$D = (p-c)\frac{\partial^2 X}{\partial p^2} + 2\frac{\partial X}{\partial p}. \tag{A.2}$$

Because p is the profit maximzing price of the monopolist, the respective second-order condition implies $D < 0$. Furthermore, differentiation of (6) and (7) yields:

$$\frac{\partial^2 X}{\partial p^2} = -\frac{\lambda^2\,L'''}{L''^3} = \frac{\partial^2 X}{\partial p\,\partial\lambda}\frac{\lambda}{p} - \frac{1}{p}\frac{\partial X}{\partial p}. \tag{A.3}$$

Considering (A.3), (6), and (7), straightforward manipulation of (A.2) leads to:

$$D = -\frac{\lambda}{p}\left[-(p-c)\frac{\partial^2 X}{\partial p\,\partial\lambda} - \left(1+\frac{c}{p}\right)\frac{\partial X}{\partial\lambda}\right] < 0. \tag{A.4}$$

Substituting into (A.1) yields:

$$N = -\frac{p}{\lambda}D + \frac{c}{p}\frac{\partial X}{\partial\lambda}. \tag{A.5}$$

Since, by assumption, p is strictly positive for $c = 0$, drug demand $X(\lambda, p)$ is finite for $c = 0$, and Lemma 1 follows with a standard continuity argument. *Q.E.D.*

Proof of Lemma 2

Considering (6), (7), (A.1) and (A.2), we find:

$$\frac{dX}{d\lambda} = \frac{\partial X}{\partial\lambda} + \frac{\partial X}{\partial p}\frac{dp}{d\lambda} = -\frac{p\,D + \lambda\,N}{L''\,D}. \tag{A.6}$$

Furthermore, from (A.5) we get:

$$D = -\frac{\lambda}{p}N + \frac{\lambda\,c}{p^2}\frac{\partial X}{\partial\lambda}. \tag{A.7}$$

Finally, considering (A.6), (A.7), (6), and $D < 0$, yields:

$$\frac{dX}{d\lambda} = \frac{\lambda\, c}{L''^2\, D} \leq 0, \quad \text{with } = 0 \text{ if } c = 0. \quad Q.E.D. \tag{A.8}$$

Proof of Proposition 1

Straightforward manipulation of (10) while considering (6), (7) and $0 < \lambda^* < 1$ yields:

$$(1-\lambda^*)\,\frac{\partial X}{\partial p}\,[\pi\, u_s + (1-\pi)\, u_h'] = -\frac{\lambda^*}{p}\,(1-\pi)\, X\, (u_s' - u_h'). \tag{A.9}$$

Substituting into (12) leads to:

$$\frac{dEU}{d\lambda}_{|\lambda=\lambda^*} = -\pi\, \lambda^*\, X\, \frac{1}{p}\,[(p-(1-\pi)\, c)\, u_s' + (1-\pi)\, c\, u_h']\,\frac{dp}{d\lambda}. \tag{A.10}$$

Since $p > (1-\pi)\, c$, the proposition follows with Lemma 1. *Q.E.D.*

References

Arrow, K. (1968): "The Economics of Moral Hazard: Further Comment"; *American Economic Review*, 58, 537-539.

Bartling, D. and Hadamit, H. (1982):"Development of a drug; It's a long way from Laboratory to Patient"; Darmstadt.

Blomqvist, A. (1991): "The Doctor as Double Agent: Information Asymmetry, Health Insurance, and Medical Care"; Journal of Health Economics, 10, 411-432.

Blomqvist, A. (1997): "Optimal Non-Linear Health Insurance"; *Journal of Health Economics*, 16, 303-321.

Chiu, H. (1997): "Health Insurance and the Welfare of Health Care Consumers"; *Journal of Public Economics*, 64, 125-133.

Coulson, N.E. and Stuart, B.C. (1995): "Insurance Choice and the Demand for Prescription Drugs"; *Southern Economic Journal*, 61, 1146-1157.

Feldman, R. and Dowd, B. (1991): "A New Estimate of the Welfare Loss of Excess Health Insurance," *American Economic Review*, 81, 297-301.

Feldstein, M. (1970): "The Rising Price of Physicians' Services"; *Review of Economics and Statistics*, 52, 121-132.

Feldstein, M. (1973): "The Welfare Loss of Excess Health Insurance"; *Journal of Political Economy*, 81, 251-280.

Pauly, M. (1968): "The Economics of Moral Hazard: Comment"; *American Economic Review*, 58, 531-537.

Pauly, M. (1974): "Overinsurance and Public Provision of Insurance: The Roles of Moral Hazard and Adverse Selection"; *Quarterly Journal of Economics*, 88, 44-62.

Schwabe, U. (1997): "Überblick über die Arzneiverordnungen im Jahre 1996"; in: Schwabe, U. (ed.) *Arzneiverordnungsreport '97*; Stuttgart: G. Fischer, 1-20.

Spence, M. and Zeckhauser, R. (1971): "Insurance, Information, and Individual Action"; *American Economic Review, Papers and Proceedings*, 61, 380-387.

Walker, S.R. und Parrish, J.A.(1988): "Innovation and New Drug Development"; in: Walker, B.C. and Walker, S.R. (ed.): *Trends and Changes in Drug Re-*

search and Development; Dordrecht: Kluwer, 1-28.

Weisbrod, B.A. (1991): "The Health Care Quadrilemma: An Essay on Technological Change, Insurance, Quality of Care, and Cost Containment"; *Journal of Economic Literature*, 29, 523-552.

Zeckhauser, R. (1970): "Medical Insurance: A Casestudy of the Tradeoff between Risk Spreading and Appropriate Incentives"; *Journal of Economic Theory*, 2, 9-26.