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The role of the government's participation constraint in the relationship between the price of the medicine and the patients' co-payment

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Abstract

In the paper the relationship between the price of the drug set by the monopolist and the level of the patients' co-payment is reconsidered. I highlight the role of the government's participation constraint when studying this correspondence. I provide an alternative explanation for why the price of the pharmaceutical can be an increasing function of the level of the patients' co-payment.

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1 Introduction

In the paper I reconsider the relationship between the level of patients' co-payment and the price of the medicine. A commonly accepted logic tells us that an increase in the level of patients' co-payment (i.e. the proportion of the price of the drug financed by consumers) makes consumers more sensitive to the changes in the price of the drug. Higher own-price elasticity of demand is usually associated with a lower product's price set by the manufacturer (Tirole, 1988).[1] So, according to this logic one would expect a negative relationship between the level of patients' co-payment and the price of the drug. In this note I demonstrate that, contrary to this logic, there may be a positive link between the two variables of interest if to account for the government's participation constraint.

In this paper the government's participation constraint is based on the comparison of the benefits from the drug (measured by the consumer surplus) and the government's expenditure on the drug, that depend on the price of the drug and the level of the co-payment. The cost-benefit analysis (CBA) often conducted in reality when deciding about the drug reimbursement reminds the government's participation constraint considered here: under the CBA, the necessary condition for drug reimbursement is that benefits from the drug reimbursement are not lower than its costs (Brent, 2003).

The purpose of this paper is to highlight the role of the government's participation constraint when analyzing the relationship between the price of the pharmaceutical and the level of patients' co-payment. Using the same benchmark model as in Jelovac (2015) I demonstrate that accounting for the government's participation constraint may revert the conclusion about the relationship between the price and the level of the co-payment. Namely, if the participation constraint is not accounted for the level of the co-payment and the price of the drug are negatively related. On the contrary, when the government's participation constraint is taken into account, the price of the pharmaceutical may turn out being an increasing function of the level of the patients' co-payment. More precisely, the price of the drug set by the monopolistic producer is always an increasing function of the co-payment in case the producer can still enter the market if the government decides not reimbursing the drug. Under this scenario the consumers will pay the full price of the medicine. Under the alternative scenario (i.e. where the government's agreement to reimburse share (1-co-payment) of the price of the drug is a necessary condition for the producer to enter the market), the price of the medicine set by the monopolist is a non-monotonous function of the level of the patients' co-payment: it is an increasing function of the co-payment for the co-payment lower than some threshold, and it is a decreasing function of the co-payment, when the co-payment is above certain level.

The intuition for why the price of the drug set by the monopolist can be an increasing function of the patients' co-payment is as follows: an increase in the co-payment reduces the government's expenditures on the drug (for a given price). It implies that the price of the drug can be raised in response to an increase in the level of the patients' co-payment without violation of the government's participation constraint.

The result demonstrated in this note contrasts some of the outcomes in the related literature: Pavcnik (2002) finds that the switch from a flat prescription fee to a coverage regime at which patients' out-of-pocket expenses for a given pharmaceutical depend on its price results in lower drug prices. This finding is consistent with the common logic described at the start of the paper. Duggan and Scott Morton (2006) show that the rise in the Medicaid market share tends to increase the prices of the prescription medicines. This result is again in line with the common logic mentioned earlier: an increase in the Medicaid market share makes demand for the drug less price elastic. This leads to a higher price set by the drug producer. Conversely, Duggan and Scott Morton (2010, 2011) provide empirical evidences of an opposite conclusion: a rise in the Medicare market share may lower the prices of the prescription medicines. The authors explain this "surprising" result by the fact that an increase in the proportion of insured patients (other things being equal) not only lowers

[1] In the Seventh printing (1994) of the textbook by Tirole (1988), the inverse elasticity rule is derived for the case of the producer-monopolist in the section 1.1.1 (page 69).

own-price elasticity of demand, but it also raises a cross-price elasticity of demand as getting to the pool of insured customers enhances patients' awareness about the substitute products. Moreover, the insurer can exclude certain drugs from its plan if the agreement is not reached as a result of its price negotiations with the manufacturer of the drug. The results in Duggan and Scott Morton (2010, 2011) are in line with the ones represented in the current paper, however, the mechanisms explaining this outcome are different here and in the above-mentioned papers.

Jelovac (2015) also studies the relationship between the level of the patients' co-payment and the price of the drug in a theoretical framework. Jelovac (2015) highlights the role of the negotiations about the price between the payer and the producer when explaining the positive link between the drug price and the level of the co-payment. The current paper complements the analysis in Jelovac (2015) by showing that this positive relationship between the variables of interest is still possible in a setting without price negotiations if to account for the government's participation constraint. Moreover, in addition to the case considered in Jelovac (2015), where the manufacturer may enter the market even if the government decides not reimbursing its medicine, I study an alternative scenario, where government's (partial) reimbursement of the drug is a necessary condition for the producer's market entry.

The rest of the paper is organized as follows: Section 2 briefly presents the setup. Section 3 considers the benchmark case. Sections 4 and 5 examine the monopolist's choice of the price of the drug under two scenarios (that differ by whether or not the possibility to enter the market depends on the government's reimbursement decision). Section 6 concludes.

2 Model

The setup is taken from Jelovac (2015). The patients' demand for the drug is $q = a - \alpha \cdot p$, where q is the quantity demanded of the drug, p is a unit price of the medicine and $\alpha \in (0,1]$ is a co-payment (i.e. it is a share of the price of the pharmaceutical paid by the patients).

The consumers' surplus is $CS = \frac{(a-\alpha \cdot p)^2}{2}$. As in Jelovac (2015), assume that government's net utility is equal to the consumers' surplus net of the payments for the medicine. Government reimburses share $(1-\alpha)$ of the price of the drug. So, government's spending on the pharmaceutical is equal to $G = (1-\alpha)p \cdot q$. Government's net utility is

$$U^G = CS - G = \frac{(a - \alpha \cdot p)(a - (2-\alpha) \cdot p)}{2}. \tag{1}$$

Assume that there is a monopolist producer M of the drug. Assume that its marginal costs are equal to zero and that its fixed costs are equal to F. So, M's profit is $\Pi = p \cdot q - F = p \cdot (a - \alpha \cdot p) \cdot p - F$. For the sake of simplicity assume that $F = 0$. This latter assumption guarantees that M's participation constraint is always satisfied.[2]

The price of the drug is set by M from its profit-maximization problem. In the paper the producer takes into account the government's participation constraint when setting its price. The participation constraint is important since the government finances part of the drug and the size of government's spending depends on the price choice of M. It may turn out that at a price chosen by the monopolist the government's spending is so high that the government is better-off not reimbursing the drug.

The conditions under which the government's participation constraint is satisfied are studied for two scenarios. Under the first scenario, if the government does not reimburse the drug, then M cannot enter the market. Under this scenario if the government does not reimburse the drug, then $CS = G = 0$. Under the second scenario, if the government decides not reimbursing the drug, then M's medicine can still enter the market, but its price will be fully paid by the consumers (i.e. $\alpha = 1$).

[2]In other words $F = 0$ ensures that M's profit is always non-negative for $p \in (0; \frac{a}{\alpha})$.

3 Benchmark case

In order to highlight the role of the government's participation constraint in the relationship between the price of the medicine and the level of the co-payment, let us first consider the benchmark case, where this participation constraint is not accounted for. The same benchmark scenario is also represented in Jelovac (2015). The unconstrained profit-maximization problem of M is:

$$max_p \Pi = p(a - \alpha \cdot p) \tag{2}$$

The solution to (2) is $p^* = \frac{a}{2\alpha}$. In line with a common logic (that higher co-payment means higher price elasticity of demand that drives the profit-maximizing price downwards) we get a negative relationship between the price set by M and the patients' co-payment level.
In the following two sections the government's participation constraint is accounted for by M, when it decides on the price of its medicine.

4 Equilibrium price: Scenario 1

Under the first scenario the only way for M to enter the market is to be reimbursed by the government. It implies that if the government does not reimburse the drug, then its net utility is equal to zero. In other words the government reimburses the drug (i.e. its participation constraint is satisfied) whenever $U^G \geq 0$. From (1) government's participation constraint is satisfied if and only if $p \leq \frac{a}{(2-\alpha)}$ or $p \geq \frac{a}{\alpha}$. It should be noted that price of the drug should be below $\frac{a}{\alpha}$ in order the quantity demanded being positive.

Taking into consideration the participation constraint of the government and the constraint on the price that guarantees positive level of quantity demanded, the profit-maximization program of M is:

$$max_p \Pi = p(a - \alpha \cdot p) \quad s.t. \quad p \leq \frac{a}{(2-\alpha)} \tag{3}$$

Ignoring the "subject to" constraint in the above profit-maximization problem (i.e. (3)) we get that the optimal price for the monopolist is equal to $p^* = \frac{a}{2\alpha}$. This is an expression for the price of the drug in the benchmark case.

To check whether or not this unconstrained solution to M's profit-maximization problem is also a solution to (3) let us check if at this price level the "subject to" constraint is satisfied:

- $\frac{a}{2\alpha} \leq \frac{a}{2-\alpha}$ for $\alpha \in [2/3; 1]$.
- $\frac{a}{2\alpha} > \frac{a}{2-\alpha}$ for $\alpha \in (0, 2/3)$.

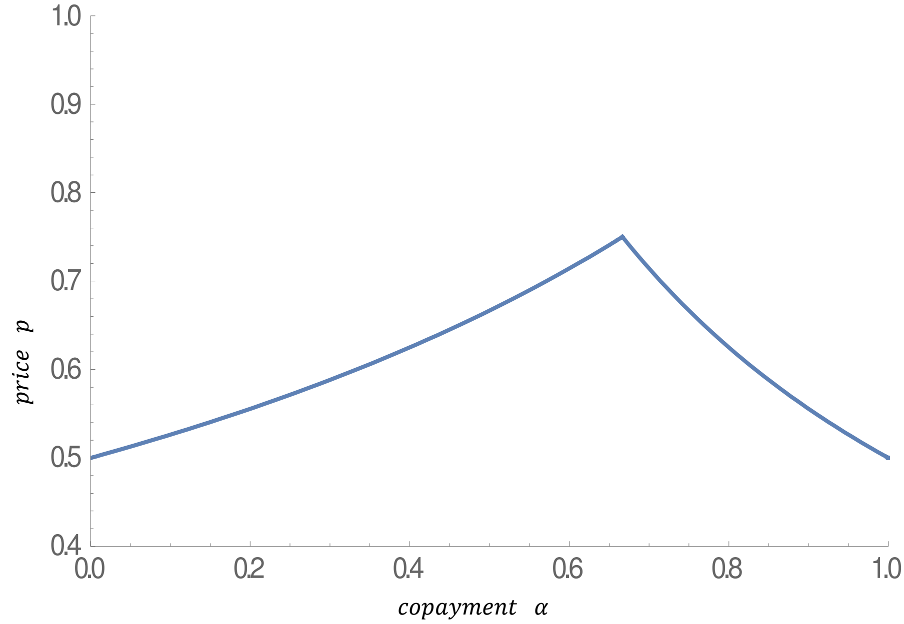
From the above discussion it follows that the solution to (3) is:

$$\begin{cases} p^* = \frac{a}{2\alpha}, \; if \; \alpha \in [2/3, 1] \\ p^* = \frac{a}{2-\alpha}, \; if \; \alpha \in (0, 2/3). \end{cases} \tag{4}$$

As for the change in the price with a change in α, from (4) we see that the price of the drug is a non-monotonous function of the patients' co-payment:

$$\begin{cases} \frac{\partial p^*}{\partial \alpha} = -\frac{a}{2\alpha^2} < 0, \; if \; \alpha \in (2/3, 1) \\ \frac{\partial p^*}{\partial \alpha} = \frac{a}{(2-\alpha)^2} > 0, \; if \; \alpha \in (0, 2/3). \end{cases} \tag{5}$$

Figure 1: Price of the drug- Scenario 1.
The graph shows how the price of the drug set by the monopolist depends on the size of the patients' co-payment. The expression of the price chosen by the manufacturer-monopolist is given in (4). The graph is constructed for the case $a = 1$.



So, the price set by the monopolist is decreasing in α only for $\alpha \in (2/3, 1)$. For $\alpha \in (0, 2/3)$ the price of the drug set by the monopolist is increasing in α. This result is in contrast to the common logic mentioned earlier, where it is implied that a higher own-price elasticity of demand (associated with a higher level of patients' co-payment) results in a lower price of the drug.

Here the equilibrium price is the same as in the benchmark case only for $\alpha \in [2/3, 1]$. If $\alpha \in (0, 2/3)$, the government's participation constraint does not hold at $p = \frac{a}{2\alpha}$ since for low α price $p = \frac{a}{2\alpha}$ is too elevated so that it makes the spending of the government prohibitively high. As it was demonstrated above, for $\alpha \in (0, 2/3)$ M sets the price at the level $\frac{a}{2-\alpha}$ and this price is increasing in α. The intuition for why it is increasing in α is as follows: for $\alpha \in (0, 2/3)$ M chooses the price at which the participation constraint of the government is binding. An increase in α means a reduction in the share of the expenses on the drug that is incurred by the government. It means that there is a room for raising the price of the drug without violating the participation constraint of the government. That is why M finds it optimal to respond to an increase in α by raising the price of the drug.

5 Equilibrium price: Scenario 2

In the scenario 1 just considered it was assumed that if the government does not reimburse the drug, then the medicine cannot enter the market. Under scenario 2 (studied in this section) it is assumed that in case the drug is not reimbursed by the government, it can still enter the market and the consumers pay the whole price of the pharmaceutical (i.e. $\alpha = 1$).

If the government decides not reimbursing the drug, then:

- $\alpha = 1$; $p^{nr} = \frac{a}{2}$; $CS^{nr} = \frac{a^2}{8}$.

- $G = 0$; $U^G = CS = \frac{a^2}{8}$; $\Pi^{nr} = \frac{a^2}{4}$.

For a given price of the drug, the government participates in the reimbursement of the drug if its utility from reimbursing the drug is not lower than its utility from not participating in the reimbursement of the drug (i.e. $\frac{a^2}{8}$). So, the participation constraint of the government is as follows:

$$U^G = \frac{(a-\alpha p)^2}{2} - (1-\alpha)p(a-\alpha p) \geq \frac{a^2}{8}. \tag{6}$$

The constraint (6) is satisfied for $p \leq \frac{a(2-\sqrt{(4-6\alpha+3\alpha^2)})}{2\alpha(2-\alpha)}$ or for $p \geq \frac{a(2+\sqrt{(4-6\alpha+3\alpha^2)})}{2\alpha(2-\alpha)}$. In addition to government's participation constraint, the following condition should hold: $p \leq \frac{a}{\alpha}$. This latter condition guarantees that the quantity demanded of the drug is non-negative. The system of these conditions (i.e. participation constraint of the government and the non-negativity of the quantity demanded) reduces to the following constraint: $p \leq \frac{a(2-\sqrt{(4-6\alpha+3\alpha^2)})}{2\alpha(2-\alpha)}$.

Thus, M solves the following profit-maximization problem:

$$max_p \Pi = p(a-\alpha \cdot p) \quad s.t. \quad p \leq \frac{a(2-\sqrt{(4-6\alpha+3\alpha^2)})}{2\alpha(2-\alpha)}. \tag{7}$$

The solution to the unconstrained profit-maximization problem (i.e. $p = \frac{a}{2\alpha}$) does not satisfy the "subject to" constraint of (7). Due to the concavity of the profit function, it can be concluded that the solution to the constrained profit-maximization problem (i.e. to (7)) is:

$$p^* = \frac{a(2-\sqrt{(4-6\alpha+3\alpha^2)})}{2\alpha(2-\alpha)}. \tag{8}$$

Let us verify that M is better-off by being reimbursed by the government and paying respect to the payer's participation constraint than operating without reimbursement and not taking into consideration the government's participation constraint. If M is reimbursed, then the price of the drug is equal to p^* defined in (8). The profit of M in this case is $\Pi^* = p^*(a-\alpha \cdot p^*)$. In case the drug is not reimbursed by the government M's profit is equal to $\Pi^{nr} = \frac{a^2}{4}$. The ratio of these profits is: $\frac{\Pi^*}{\Pi^{nr}} = \frac{(2-\sqrt{4-6\alpha+3\alpha^2})(2(1-\alpha)+\sqrt{4-6\alpha+3\alpha^2})}{\alpha(2-\alpha)^2}$.

Figure 2: Profit ratio.
The graph shows how the ratio of the profits that the monopolist earns in cases the government reimburses or does not reimburse its drug changes with the size of the patients' co-payment. This ratio of the profits is always above 1 for $\alpha \in [0,1)$. This implies that M earns higher profit when the government reimburses its drug. For $\alpha = 1$ the ratio of profits is equal to 1.

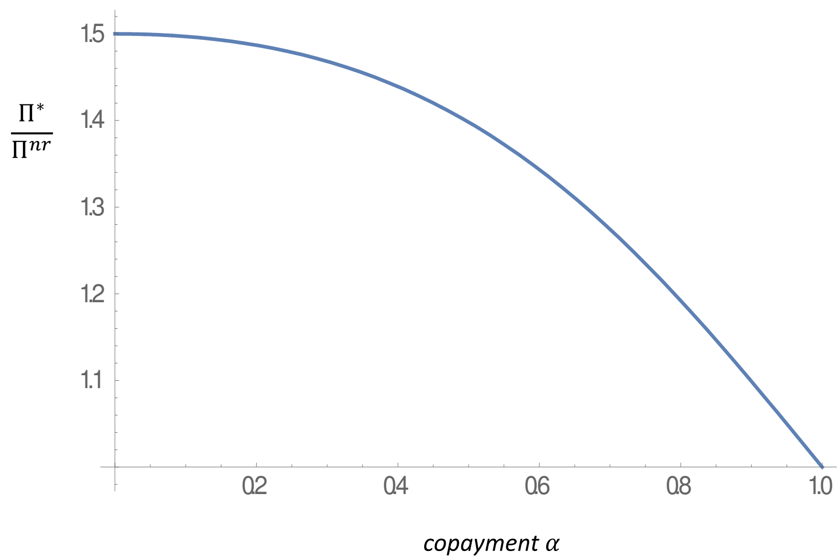
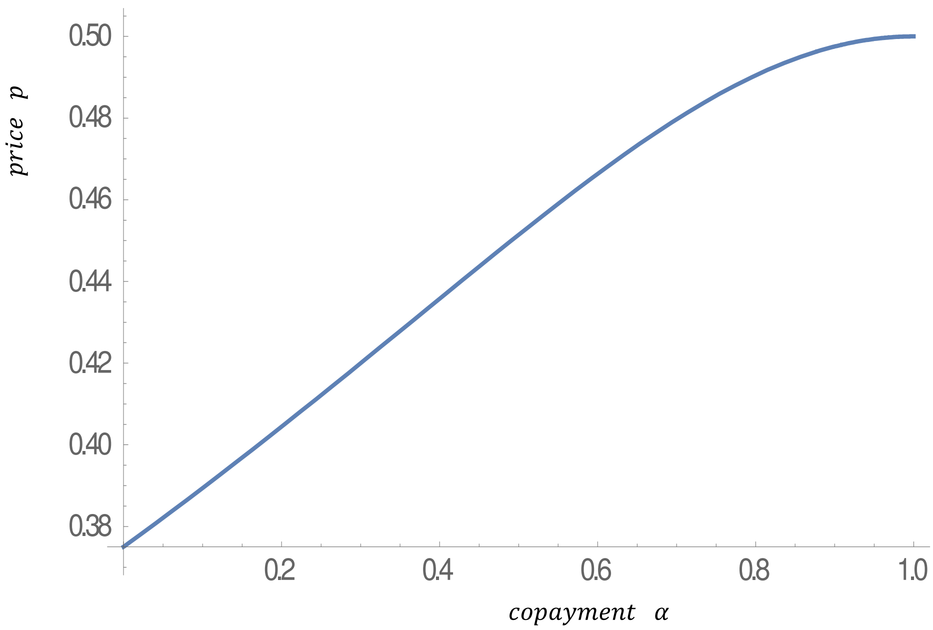


Figure 2 shows that for $\alpha \in [0,1)$ M is always better-off when the government reimburses its drug (compared to the case when the drug is not reimbursed). For $\alpha = 1$ M is indifferent between these two options.

So, p^* defined in (8) is indeed the equilibrium price under scenario 2. Let us now examine how this price changes with a change in the co-payment α.

Figure 3: Price of the drug.
The graph shows how the price of the drug set by the monopolist depends on the size of the patients' co-payment. The expression of the price chosen by the manufacturer-monopolist is given in (8). The graph is constructed for the case $a = 1$.



It is clear from Figure 3 that the price chosen by M is an increasing function of α. The intuition for this result is the following: higher α means less burden on the government's budget. It implies that increase in α allows increasing p^* without violating the government's participation constraint. Again this positive relationship between p^* and α is in contrast with the baseline case and with the common logic that higher price elasticity of demand is associated with a lower price level.

6 Concluding remarks

In this paper the role of the payer's participation constraint is highlighted when studying the relationship between the price of the drug and the level of the patients' co-payment. It was demonstrated that accounting for the participation constraint of the government can revert the conclusions about the link between the co-payment and the price of the pharmaceutical set by the producer. Namely, it was shown that contrary to the common logic (i.e. that the rise in the own-price elasticity of demand leads to a lower price), the price of the medicine set by the monopolist can be an increasing function of the patients' co-payment.

References

Brent, R. J. (2003). Cost-benefit analysis and health care evaluations. *Edward Elgar Publishing*.

Duggan, M., & Scott Morton, F. (2011). The medium-term impact of Medicare Part D on pharmaceutical prices. *American Economic Review*, *101*(3), 387–92.

Duggan, M., & Scott Morton, F. M. (2010). The effect of Medicare Part D on pharmaceutical prices and utilization. *American Economic Review*, *100*(1), 590–607.

Duggan, M. G., & Scott Morton, F. M. (2006). The distortionary effects of government procurement: Evidence from Medicaid prescription drug purchasing. *The Quarterly Journal of Economics*, *121*(1), 1–30.

Jelovac, I., et al. (2015). On the relationship between the negotiated price of pharmaceuticals and the patients co-payment. *Economics Bull 2015*, *35*, 481–93.

Pavcnik, N. (2002). Do pharmaceutical prices respond to potential patient out-of-pocket expenses? *RAND Journal of Economics*, 469–487.

Tirole, J. (1988). *The theory of Industrial Organization*. MIT press.