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Positioning and negotiations: The case of pharmaceutical pricing

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ABSTRACT

We study a positioning game prior to negotiations where each party invests into influential activities in order to raise voter support for their preferred bargaining outcome. The case chosen for our analysis is a bilateral monopoly where a purchaser meets a pharmaceutical firm and where the two negotiate on the price of a new and innovative medicine. We identify factors that influence on the negotiated price such as treatment effects of the new and the existing drug, production costs of the new drug, the price of the existing drug, the marginal cost of public funds and patient group size. Furthermore, it is shown that the negotiated price, depending on the characteristics of a political cost function with regard to the influential activities, is influenced by the order of moves taken by the parties. Regardless of the strategic interrelationships between the two parties, likely positioning games to be played are those where one of the two negotiating parties acts as a leader while the rival acts as a follower.

1. Introduction

The introduction of the new, sometimes extremely costly, medical technologies represents a challenge for policymakers in the sense that turning down life-extending drugs becomes controversial. The decision not to reimburse often comes under intense criticism from patient groups, patient associations and clinicians for example by presenting stories about families taking desperate measures to raise funds to pay for treatments. The debates are vivid, attract significant media attention, and often narrow through a consistent concentration on the negative. Purchasers claim own innocence and accuse manufacturers for unethical pricing (not accepting reasonable prices), while the manufacturers accuse the purchasers of being unwilling to cover foregone R&D costs. These blaming games appear as being part of an opinion-forming process, occurring in advance of price negotiations, where both parties invest into influential activities to affect the outcome of subsequent price negotiations (a positioning game). Such processes are complex and the significance of the political pressure will depend on the interplay of factors such as media coverage, previously assimilated perceptions and people's own daily experiences. Consumers (voters) are often marginally affected by a firm's practices or regulatory reforms thus having poor incentives to be informed about such issues. For this reason, media coverage becomes a way of gaining influence since informing voters might bring about unpopularity to politicians (Baron, 2003).[1] In this perspective, media coverage acts as a link between influential activities and voter support thus representing a mechanism for facilitating the process of mobilizing consumers.[2]

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[1] Baron and Diermeier (2007) analyze how activist groups are able to achieve certain goals by threatening to organize boycotts against corporations if demands are not met ("activist campaigns").

[2] According to Manheim (2001), media campaigns are designed to locate, exploit, and exaggerate in order to create drama in the communication with the public.

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Our idea is to analyze the game occurring in advance of the price negotiations for costly innovative pharmaceuticals by applying a political economy framework in order to provide a better understanding of the positioning that takes place in association with bilateral negotiations and how this might affect the outcome of negotiations. Bilateral negotiations are especially important for newly registered hospital medicines intended to treat serious or life-threatening conditions, drugs that demonstrate a potential to address unmet medical needs and drugs against auto-immune diseases. The negotiated contracts are typically price or price-volume contracts where prices typically are kept confidential.[3] Recently we also observe a process towards an increased centralization of health care procurement decisions. In some countries hospitals go together to establish Group Purchasing Organizations (GPOs), while in others the responsibility is, at an increasing rate, left with national organizations. For drugs not being subsidized, prices are typically set freely (maximum price) while to be listed for reimbursement, tendering approaches, reference pricing, or negotiations are applied.[4] Calls for tender require available competitors (analogue competition) and are typically organized as price sealed-bid auctions that state conditions such as contract length, the exact substance and package size. External referencing consists in setting a price cap based on prices of similar products in other countries. Some apply prices from a selected group of countries whereas others take as the reference the minimum price observed among a group of countries. In situations with no direct competitor available (on-patent drugs), bilateral negotiations between pharmaceutical companies and procurement organizations are important.

Since being concerned with how firms and organized groups influence policy-makers and sponsors to achieve favorable outcomes, our work relates to literature on public procurements, see e.g. Sorenson and Kanavos (2011) and Kastanioti et al. (2013) for the public procurement of health technologies and Hessami (2016), Dastidar and Mukherjee (2014) and Baldi et al. (2016) for more general approaches. In the lobbying literature, the links between influential activities and outcomes are modeled in various ways. Early models applied a reduced-form approach (political influence functions) that maps lobbying into influence (Becker, 1983; Tullock, 1980). Later approaches portray such activities as transfers (e.g. bribing) or as the provision of information to policy-makers, i.e. communication that sways decisions in own favor. There are also electoral competition models with campaign funding as a tool for buying votes.[5] Several works apply Nash bargaining models in connection with drugs.[6] Pecorino (2002) studies pharmaceutical reimports for a home country monopolist selling in a foreign market and where price determination is modeled as a bargaining game between the firm and the foreign government. Wright (2004) presents a multi-stage model of a pharmaceutical price regulation system. Here the regulator and firms bargain over the subsidies firms are to receive in return for selling their drug at the regulated price. Ramani and Urias (2015) study the role that compulsory licensing may have in drug price negotiations. In doing that, a model of price bargaining in lieu of issuing a compulsory license is developed. They show that compulsory licenses can only occur under incomplete information. Marinoso et al. (2011) uses a model with two countries to analyze how the commitment to engage in external referencing affects price negotiations. Various cases are considered and the main finding is that reference pricing is preferred by countries having a relatively high co-payment rate and a low population.[7]

Our model is set up to characterize optimal negotiations and the strategies of the various parties and explain how such factors influence the negotiated outcome, i.e. under what conditions is it optimal to await the decisions of the rival (defensive) and when it is optimal to act before the rival (aggressive). The model portrays pricing as being the result of bilateral negotiations between a monopoly firm and a monopsony (bilateral monopoly). Thus we are concerned with the price formation of medicines without clear competitors and our model fits well with national health systems having centralized purchasing organizations. Moreover, we study a purchaser being sensitive to the pressure that arises from not reaching an agreement and this pressure is a function of influential activities conducted by both the firm and the purchaser to mobilize support among voters. These investments are made in order to strengthen the bargaining position of each party.[8] In the first stage of the game (the positioning phase), the parties invest into influential activities. At this stage, the following order of moves are analyzed; (*i*) the influential activities are taken simultaneously by the firm and the purchaser, (*ii*) the purchaser chooses its level before the firm, and (*iii*) the firm chooses its level before the purchaser. In the second part of the game, the two parties meet to negotiate on the contract price of a particular drug. In order make the model as simple as possible, the analysis is carried through by assuming perfect information and symmetric information.

The paper is organized in seven subsections. In section 2, we derive a political cost function. In section 3, using backward induction, we define the potential gains for the two parties from obtaining an agreement relatively to a non-agreement. Furthermore, we derive the outcome of the negotiations, defined as a contract price, as a Nash-cooperative solution. Section 4 presents the non-cooperative game (the positioning game) taking place before the Nash negotiations. Here the monopsony and the firm choose their engagement into influential activities under different assumptions regarding the order of moves. Section 5 compares the various positioning games, while

[3] However, in a national health system, since the target groups are well-defined (inclusion criteria), price contracts and price-volume contracts converge.

[4] See Danzon (1997) and Anis and Wen (1998) for overviews of price regulation and Lopez-Casanovsa and Puig-Junoy (2000) for a survey of reference pricing systems. Garcia-Alonso and Garcia-Marinoso (2008) discuss prices of new drugs and reimbursement by studying interactions between a pharmaceutical firm and a government when there is a mix between public and private provision of care.

[5] See for example Dal Bo (2006) and Gregor (2011) for reviews on the literature on lobbying.

[6] Some studies explore interdependencies between political and health factors using median voter models. See Breyer (1995), Gouveia (1997) and Bethencourt and Galasso (2008).

[7] Other bargaining approaches on health care are Clark (1995), studying how to share a budget between two patients, Ellis and McGuire (1990), where providers and patients bargain about treatment intensity, and Siciliani and Stanciole (2013) comparing different bargaining institutions.

[8] Examples of campaigns against pharmaceutical firms are the Association of Retired Persons using media to put pressure on pharmaceuticals to achieve lower prices (Baron, 2003) and pressure to introduce discount AIDS drugs for sub-Saharan Africa. In our work the focus is both on campaigns initiated by pharmaceutical firms to put pressure on purchasers and purchaser campaigns against firms ("counteractive campaigning").

section 6 discusses and sets into perspective our findings. Section 7 contains our main conclusions.

2. The political benefits of reaching an agreement

The process by which pharmaceutical companies seek public reimbursement attracts significant attention. Both before and after reimbursement decisions are taken there are heated debates, and we observe media coverage of patients that define formulary admissions as their "the last hope" on the same time as receiving moral support from clinicians and patient associations. The actions taken and their timing can be understood as being part of a positioning game where the parties, a pharmaceutical firm and a purchaser, mobilize support as a means to influence the outcome of the subsequent bilateral negotiations. The two parties can be said to invest into activities to put pressure on each other since the outcome of the price negotiations (agreement or not) triggers support and non-support among voter groups depending on their preferences for the drugs in question (the new drug relatively to the existing drug). In a democracy, political decision-makers are typically concerned with voters' reactions to a particular choice, if believing that such choices have an impact on future voting decisions.

The arguments presented in the debates suggest that the parties disagree on the size and significance of treatment effects. Patient advocates emphasize the expected treatment effects for the patient group in question while purchasers are concerned with the possible negative consequences for other patient groups if granting reimbursement. This disagreement is also a result of the inherent uncertainty associated with new drugs due to clinical trials being performed for short periods with few participants that again leaves room for discretion and subjective beliefs. The concept of opportunity cost (and its significance) may be difficult to understand for voters. Furthermore, treatment benefits of innovative drugs typically come in the form of life-extension possibilities which reinforces the gap between the purchaser's valuation of treatment effects through health technology assessments ("the willingness to pay for a statistical life") and patients' own valuations ("the valuation of own life"). This point relates to the criticism of the willingness to pay methodology for which benefits of projects are decided ex-ante (before the identity of those benefiting is known). The tendency for patients to value own lives more than the "objective" economic valuation is commonly discussed in the literature, see for instance Broome (1978, 1982, 1985).

In order to formalize our reasoning, let $E = E(e,x)$ represents voters' beliefs in the treatment effect from the new drug depending on the two influential activities where *e,* in the following denoted "lobbying", refers to the firm's influencing activities, and *x*, in the following denoted "campaigning" refers to the purchaser's activities. $E(e,x)$ is supposed to be increasing in lobbying and decreasing in campaigning, Moreover, let $C = C(e,x,M)$ measure the beliefs among voters in the foregone treatment effects (opportunity costs) from the new drug. We assume that $C(e,x,M)$ is decreasing in lobbying and increasing in campaigning. Furthermore, it seems likely that the patient group size, *M*, also might influence voters' beliefs about treatment costs. This stems from an often heard argument that costly medicines should be reimbursed only if the target group is small in numbers, i.e. there might exist a "budget-impact" effect in foregone treatments as the number of patients increases.[9] The above assumptions imply;

$$E = E(e,x) \text{ and } C = C(e,x,M) \text{ where } E_e > 0,\ E_x < 0\ , C_e < 0\ ,\quad C_x > 0 \text{ and } C_M \geq 0 \tag{1}$$

Generally, the purchaser's choice of campaigning, *x*, could both increase and decrease the marginal influence from lobbying, *e,* implying the cross partial derivatives of the functions in (1), E_{ex} and C_{ex}, could be both positive, zero and negative. In what follows we describe how voters' beliefs about treatment effects and opportunity costs transform into a political cost function.

Let the voter utility, v^i, for the two drug alternatives ($i = 0, 1$) be described by the following expressions;

$$v^0 = \theta E^0 - \omega C^0 \quad \text{and } v^1 = \theta E(e,x) - \omega C(e,x,M) \tag{2}$$

It follows from (2) that voters are concerned with treatment effects and opportunity costs and have stable and exogenous preferences. The first expression in (2) defines individual voter utility if the negotiating parties do not reach an agreement meaning that the existing drug will continue to be reimbursed. E^0 is the beliefs among voters in treatment effects from the existing drug, while C^0 is the beliefs among voters about foregone treatment effects (the opportunity costs). The parameters θ and ω represent the voters' valuation of treatment effects and opportunity costs, respectively. The second expression in (2) defines voter utility, if reaching an agreement, as a function of both lobbying and campaigning. It is assumed that voters believe that the new drug is more effective and more costly than the existing drug, thus, $E(e,x) > E^0$ and $C(e,x,M) > C^0$ for all possible values of *e* and *x*. The voters vary with respect to the weight given to each effect (i.e. the parameters θ and ω take different values among voters). Using (2), the indifferent voter, defined by $v^0 = v^1$, is determined by

$$\frac{\theta}{\omega} \equiv \widehat{\varepsilon} = \frac{C(e,x,M) - C^0}{E(e,x) - E^0} \equiv L(e,x,M) \tag{3}$$

From (3) we see that the indifferent voter is characterized by equality between her relative valuation of the treatment effect measured in foregone treatment effects, $\frac{\theta}{\omega} = \widehat{\varepsilon}$, and the ratio between the believed foregone treatment effect and the believed treatment effect. We observe that $L(e,x,M)$ in (3) has resemblance to the incremental cost-effectiveness ratio (*ICER*) and can be said to reflect a subjective *ICER*. Moreover, the definition of the indifferent voter depends on the influential activities, *e* and *x*, and the number of

[9] This might be perceived as being an ad-hoc assumption but is introduced since the "budget-impact" effect is frequently mentioned in the literature. See for example the literature on orphan drugs (McCabe et al., 2005; Desser et al., 2010).

patients involved, M. By using the assumptions in (1), $L(e,x,M)$ has the following properties:

$$L_e = \frac{C_e(E-E^0) - E_e\left(C-C^0\right)}{\left(E-E^0\right)^2} < 0,\ L_x = \frac{C_x(E-E^0) - E_x\left(C-C^0\right)}{\left(E-E^0\right)^2} > 0 \text{ and } L_M = \frac{C_M}{E-E^0} \geq 0 \tag{4}$$

This means that $L(e,x,M)$ is decreasing in lobbying and increasing in campaigning and the number of patients. Also note that the cross partial derivative, L_{ex}, given our prior assumptions, could be both positive, zero and negative, i.e.

$$L_{ex} = \frac{C_{ex}(E-E^0) - E_{ex}\left(C-C^0\right) - C_eE_x - C_xE_e + 2E_xE_eL}{\left(E-E^0\right)^2} \tag{5}$$

This means that the marginal effect from e on the subjective *ICER* might be weakened, unchanged or increased as the purchaser steps up its campaigning x. In other words we do not find any reasons a priori to make specific assumptions regarding the sign of L_{ex}.

Assume now that the relative valuation of treatment effects, ε, is uniformly distributed on the interval $[\underline{\varepsilon}, \overline{\varepsilon}]$. From the above assumptions, the number of supporters becomes $s = \overline{\varepsilon} - L(e,x,M)$ and the number of non-supporters becomes $n = L(e,x,M) - \underline{\varepsilon}$. Additionally, let Y be the number of voters that supports the agreement, s, minus the number of voters that do not support the agreement, n, i.e. $Y = Y(e,x,M) \equiv s - n = \overline{\varepsilon} + \underline{\varepsilon} - 2L(e,x,M) > 0$., where $Y > 0$ reflects the assumption that the opinion among voters is biased towards reaching an agreement for the new drug.[10] Now, we define a voter influence function, $b = b(Y,M) > 0$, where the b-function is assumed to be positive for all values of Y and M and increasing in the number of voters, i.e. $b_Y > 0$. Additionally, it seems likely that b increases with the number of patients involved, i.e. $b_M \geq 0$. This is because a higher patient group represents a higher number of people (patients and their next of kin, relatives and friends) that can be mobilized into lobbying ("the mobilizing effect).[11] Generally, the b-function reflects issues such as patient group characteristics (age, life-threatening diseases, quality of life), time to next election and the intensity of media coverage (visibility) that again may depend on the number of media outlets that picks up the case and other news competing for media attention. By inserting Y in b, we obtain

$$b = b(Y,M) = b(\overline{\varepsilon} + \underline{\varepsilon} - 2L(e,x,M), M) \equiv B(e,x,M) \tag{6}$$

The B-function defined in (6) is hereafter termed the political cost function and measures the political burden for the government if a new drug is not reimbursed. From the discussion above, it follows that the political cost function has the following first derivatives

$$B_e = -2b_YL_e > 0,\ B_x = -2b_YL_x < 0 \text{ and } B_M = -2b_YL_M + b_M \geq (<)0 \tag{7}$$

By using (4), it follows that this function is increasing in e and decreasing in x (see the first and second equation in 7). Regarding B_M in the third expression in (7), it is seen that the first term is non-positive, and represents a "budget-impact effect", see (1) and (4). The second element is non-negative and points to the possibility that more patients makes it easier to mobilize individuals to lobby for the new drug ("mobilizing effect"). Thus political costs might be increasing, independent or decreasing in the number of patients. The cross partial derivative of the political cost function becomes

$$B_{ex}(e,x,M) = 4b_{YY}L_eL_x - 2b_YL_{ex} \tag{8}$$

From (8) we observe that the sign depends on the technological properties of the subjective *ICER*, $L(e,x,M)$, which again depend on the properties of the E- and C-functions (see 5 and 6), and the voter influential function, $b(Y,M)$. Since we do not find any a priori reason to make a specific assumption regarding the sign of b_{YY}, and since L_{ex} is indeterminate, the cross partial derivative (see 8) can be both positive, negative or equal to zero. If $B_{ex} < 0$, the purchaser, by increasing campaigning, will reduce the marginal lobbying effect. One interpretation might be that a high share of voters is convinced about the arguments provided by the purchaser meaning that more campaigning "takes the wind out of the firm's sail". On the other hand, if $B_{ex} > 0$, the stepping up of campaigning increases the marginal lobbying effect in this way reinforcing the political costs of not reaching an agreement. Now a more intensive campaigning from the purchaser can be said to "add fuel to the fire". Hence, our formalized model reasoning covers both cases where increased campaigning works to reduce the incentives for the firm's lobbying, and the opposite, where campaigning stimulates the firm to increase lobbying.

Result 1: *It is ambiguous whether increased campaigning from the purchaser reduces or increases the marginal political cost from firm lobbying. Given $B_{ex} < 0$, increased campaigning reduces the marginal political cost from lobbying. In the opposite case, $B_{ex} > 0$, the marginal political cost from lobbying increases in response to more campaigning. If $B_{ex} = 0$, the marginal political cost in lobbying is unaffected by campaigning.*

[10] This assumption may be the result of the debates being biased in favor of the new drug. Media attention seems to work in favor of those benefiting from the new innovative drug ("the potential winners") since being the identifiable ones, while the identity of the potential losers (foregone benefits) remains unknown. Given profit maximizing media, the stories covered, and how they are covered, become part of strategies to maximize the size of their audience. A consequence may be that reported stories become unbalanced in the sense that some stories are more likely than others and because only one side of a story get published. Media may also favor particular groups considered as being weak or vulnerable from the perspective of the consumers of media news (see for example Dean, 2012; Salzman, 1998).

[11] Electorate power of the patient group in question is in principle another reason for M to be a positive argument of $b(.)$, however, in practice such effects are believed to play a marginal role. More important than patient group size, is probably characteristics of the patient group in question.

3. The Nash-bargaining solution

It is supposed to be a common understanding (common knowledge) among the parties that the price of the drug will be decided on by using the Nash-bargaining solution. A cooperative Nash-bargaining equilibrium claims that both parties obtain a positive gain compared to the alternative where no agreement is reached. If so, both the purchaser and the firm decide to take part in the negotiations. The Nash-bargaining solution[12] is defined by solving $max\ H = \Delta W^{\beta}\Delta\pi^{1-\beta}$ with regard to the negotiation price, where ΔW is the purchaser's gain from obtaining an agreement compared to no deal after having decided to participate, $\Delta\pi$ is the firm's gain when the parties are signing an agreement compared to the result with no deal after the firm has decided to participate, and, β is the purchaser's bargaining power, $0 \leq \beta \leq 1$. Both parties are assumed to obtain a positive gain if signing an agreement compared to the alternative where there is no agreement, i.e. $\Delta W \geq 0$ and $\Delta\pi \geq 0$.[13] The payoffs for the purchaser in the situation where both parties have chosen to take part in the negotiation and when there is no agreement upon the new drug, W^0, is supposed to be defined by $W^0 = [V^0 - (1+\lambda)R]M - (1+\lambda)k(x) - B(e,x,M)$. V^0 is the individual utility of the treatment effect of the existing drug, R is the unit price of this drug and λ is the marginal cost of public funds where $\lambda \geq 0$, while $B(e,x,M)$ (defined by 6) is the political cost from not reaching an agreement. Finally, $k(x)$ is campaigning costs and may reflect resources spent by strategic communication departments to coordinate public relations, to inform the public and to manage relations with the media. Campaigning costs may also follow from expenditures that arise from the inclusion of various programs that provide public funding of the new drug, although an agreement is still not reached. Examples are national clinical studies, experimental treatment programs and various pilot schemes. In addition, we also observe exemption rules for subgroups of patients with particular characteristics. These initiatives can all be understood as costly investments into reducing the political costs associated with not reaching an agreement.[14] The costs into campaigning activities follow from the positioning part of the game, and will be the same, either the negotiation leads to an agreement or not. We suppose that the marginal cost is positive and increasing in campaigning, $k_x > 0$ and $k_{xx} > 0$.

As most pharmaceuticals are multinational corporations it is supposed that the purchaser's utility is unaffected by the profits obtained in producing and selling drugs. When an agreement is signed, the utility is defined by $W^1 = [V^1 - (1+\lambda)P]M - (1+\lambda)k(x)$, where V^1 is the individual utility of the treatment effect from the new drug and P is the unit price.[15] It is assumed that the number of treated patients is the same for the new and the existing drug, where the new drug, in the event of an agreement, will replace the old drug, and that the purchaser's valuation of the treatment effect (individual utility) from the new drug is higher than the valuation of the existing one, i.e. $V^1 > V^0$.

The profit of the firm must also be defined. First, if no agreement is reached and the firm has already decided to take part in the negotiations, the profit will be $\pi^0 = A - g(e)$, where A is the profit from selling the new drug in other markets while $g(e)$ is the costs of the firm's lobbying effort. Such costs may reflect communication activities including the management of relations with media, patient groups and clinicians and various programs for which pharmaceutical companies provide free medicine to particular patient groups ("named patient programs" and compassionate funding schemes).[16] Such arrangements typically occur before negotiations start and can be understood as costly investments into raising the political costs of not reaching an agreement.[17] However, the firm's costs into lobbying will be the same, independent of the outcome of the negotiation. We suppose that the marginal cost is positive and increasing in lobbying, i.e. $g_e > 0$ and $g_{ee} > 0$. Furthermore, we assume that the identity of the producer of the existing drug differs from the producer of the new drug. Moreover, the profit in case of an agreement, is defined by $\pi^1 = A + (P-c)M - g(e)$, where c is the firm's unit cost in producing and selling the new drug. In order for the firm to make positive profit the unit price must be significantly higher than the drug unit cost due to the sunk R&D investments costs.[18]

The gains, for each of the two parties who already have decided to participate in the negotiations, from reaching an agreement, now become;

$$\Delta W = W^1 - W^0 = \left(V^1 - V^0\right)M - (1+\lambda)(P-R)M + B(e,x,M) \geq 0 \tag{9a}$$

[12] See for instance the seminal works by Nash (1950, 1953).

[13] Following the reasoning from Nash-bargaining, the potential gains arrived at for the parties are calculated as the difference between what they obtain by signing the agreement and the outcome if there is a break down in the negotiations. As our model is characterized by perfect and symmetric information, it follows from our assumption that the parties will know before starting to negotiate that there will be an agreement. This feature is standard when applying the Nash-cooperative solution in situations with perfect and symmetric information.

[14] An NHS example is the use of the Cancer Drugs Fund (CDF) for drugs that have yet to be appraised by NICE.

[15] P is the drug cost for a treatment - assumed to be the same for all patients.

[16] An example of a clinician initiative is media announcements in terms of "letters of concern".

[17] Such initiatives are believed to put additional pressure on the purchaser on reaching an agreement. It has been claimed that some pharmaceutical companies deliberatively have delayed the negotiating process by submitting insufficient documentation as a means of creating impatience among patients.

[18] Pharmaceutical companies are typically marketing several drugs but there is no guarantee that the average price for all their products will exceed the marginal production cost. How much the unit price deviates from the marginal cost depends on factors such as the size of the R&D investments and the effectiveness of the drug in question. Another question is whether the unit drug cost, c, relevant for our case could be equal or just slightly above the marginal production cost. This can be the case if the pharmaceutical firm has a strategy to let other purchasers (in other countries) paying for the investments. We do not pursue this point further in our model. Pharmaceuticals are typically in markets with different drugs and there is no guarantee that the average price of all products will exceed their marginal costs.

$$\Delta\pi = \pi^1 - \pi^0 = (P-c)M \geq 0 \tag{9b}$$

Inserting (9a) and (9b) into the Nash-bargaining maximalization problem presented above, the first order condition becomes[19]

$$\frac{dH}{dP} = \Delta W^{\beta-1}\Delta\pi^{-\beta}\left[\beta\Delta\pi\frac{d\Delta W}{dP} + (1-\beta)\Delta W\frac{d\Delta\pi}{dP}\right] = 0 \tag{10}$$

By using (9ab), solving (10) with regard to P, provides us with the following equilibrium value, P^*

$$P^* = \beta c + (1-\beta)\frac{1}{1+\lambda}\left\{V^1 - \left[V^0 - (1+\lambda)R\right] + \frac{B(e,x,M)}{M}\right\} = \beta c + (1-\beta)Q \tag{11}$$

From (11) we see that the optimal price is a weighted average of the firm's unit drug cost, c, and the net utility gain per patient for the purchaser from procuring the new drug instead of the existing one, $Q \equiv \frac{1}{1+\lambda}\left\{V^1 - [V^0 - (1+\lambda)R] + \frac{B(e,x,M)}{M}\right\}$, where β and $1-\beta$ are the weights, respectively. When calculating the net utility gain per patient, Q, one must first calculate the utility gain from reimbursing the new drug, $V^1 - V^0$, deflated by the factor $1+\lambda$ due to efficiency losses from taxation. Secondly, one has to take into account the saved resources from abandoning the existing drug, R. Thirdly, obtaining an agreement also means one has to take into account the "saved" political costs per patient deflated by the factor, $1+\lambda$.

Since both parties must have positive gains from an agreement, the price must satisfy the following inequalities:

$$c \leq P^* \leq Q = \frac{1}{1+\lambda}\left\{V^1 - \left[V^0 - (1+\lambda)R\right] + \frac{B(e,x,M)}{M}\right\} \tag{12}$$

The contract price is equal to or above the unit drug cost, c, or equal to or below the net utility gain per patient, Q. A binding first inequality means no gain for the firm ($\Delta\pi = 0$), while a binding second inequality means no gain for the purchaser ($\Delta W = 0$). If the purchaser has all bargaining power, i.e. $\beta = 1$, then $P^* = c$, thus $\Delta\pi = 0$. On the other hand, if the firm has all bargaining power, i.e. $\beta = 0$, $P^* = Q = \frac{1}{1+\lambda}\left\{V^1 - [V^0 - (1+\lambda)R] + \frac{B(e,x,M)}{M}\right\}$, thus $\Delta W = 0$.[20]

Note that if the unit drug cost is above the net utility gain per patient, i.e. $c > Q$, the parties will not choose to take part in the negotiations since both of them cannot obtain positive payoffs. As the parties are supposed to have perfect and symmetric information, they will know whether (12) holds or not. If (12) does not hold, there is no point in entering into negotiations and, as a consequence, there are no incentives for the firm to engage in a non-cooperative positioning game.[21]

Result 2: *Given an agreement, the contract price of the new drug becomes a weighted average of the firm's unit cost of producing and selling the drug and the purchaser's net utility gain per patient from the new drug, where the weights reflect the bargaining power of purchaser and the firm, respectively.*

It is also of interest to evaluate how the contract price is affected by changes in exogenous variables. Based on differentiations of (11), we find

$$P^*_\beta = -(Q-c) < 0, P^*_\lambda = -\frac{1-\beta}{(1+\lambda)^2}\left[V^1 - V^0 + \frac{B(e,x,M)}{M}\right] < 0, P^*_R = (1-\beta) > 0,$$

$$P^*_c = \beta > 0, \quad P^*_{(V^1-V^0)} = \frac{1-\beta}{1+\lambda} > 0, P^*_B = \frac{1-\beta}{(1+\lambda)M} > 0 \text{ and } P^*_M = \frac{1-\beta}{(1+\lambda)M}\left(B_M - \frac{B(e,x,M)}{M}\right) \tag{13}$$

First, it is seen from (13) that when the purchaser's bargaining power β, is increased, the contract price is reduced, $P^*_\beta < 0$. If the marginal cost of public funds increases λ, the net utility gain per patient becomes higher that again reduces the contract price, $P^*_\lambda < 0$. If the price of the existing drug, R, increases, the purchaser's potential gain from introducing the new drug becomes higher, and this again increases the contract price, $P^*_R > 0$. Increased drug unit costs, c, also increases the contract price, $P^*_c > 0$. If the valuation of an increase

[19] When the equation in (10) holds, it is easily seen that the second order condition is satisfied, i.e. $\frac{d^2H}{dP^2} = H_{PP} = -\Delta W^{\beta-1}\Delta\pi^{-\beta}(1+\lambda)M^2 < 0$.

[20] The contract price in (11) can be compared with other pricing rules, for instance the case where the firm is acting as a monopoly and the purchaser plays a passive role. Then the firm will set a price equal to the maximal willingness to pay, i.e. that all bargaining power belongs to the firm, i.e. $\beta = 0$. Additionally, assuming no political costs in the monopoly case, the monopoly price is defined by $P^m = \frac{1}{1+\lambda}\{V^1 - [V^0 - (1+\lambda)R]\}$. Then it is seen that if the political costs are not too high, i.e. $B = B(e,x;M) < \frac{M\beta}{1-\beta}\{V^1 - [V^0 - (1+\lambda)(R-c)]\}$, the monopoly price, P^m, will be higher than the contract price, P^*. Most reasonably, a monopoly price would also imply some type of "political noise or costs" that further increase the disadvantages in realizing a monopoly price compared to the contract price stemming from bargaining.

[21] As pointed out to us by one of the journal's reviewers, in cases where no agreement is signed, i.e. where c > Q, the purchaser, unlike the firm, might have incentives to use resources in campaigning to reduce the political pressure. However, in our reasoning, we have limited ourselves to discuss lobbying and campaigning in the case where the inequalities in (12) are satisfied. A sufficient condition for (12) to be satisfied is that it holds for B = 0, i.e. $\frac{V^1-V^2}{1+\lambda} + R > c$.

in the treatment effect of the new drug becomes higher, $V^1 - V^0$, this will raise the contract price, $P^*_{(V^1-V^0)} > 0$. Finally, as patient group size increases, the price becomes higher if the marginal political cost is positive and higher than the political cost per patient, i.e. $B_M > \frac{B(e,x,M)}{M}$. On the other hand, if the marginal political cost is negative and below the political cost per patient, i.e. $B_M \leq \frac{B(e,x,M)}{M}$, the price stays unchanged or decreases as patient group size becomes higher.[22]

Result 3: *The contract price decreases with the purchaser's bargaining power and the marginal cost of public funds while it increases with the price of the existing drugs, the unit drug cost and the utility gain from the new drug compared to the existing one. It is ambiguous whether a higher patient group size increases or decreases the contract price. Given an increase in the political cost for an extra patient being lower (higher) than the political cost per patient, the contract price decreases (increases) for an increasing patient group size.*

4. Three positioning games

If each party benefits from investing into influential activities prior to the negotiations, it seems likely that they will do so. Such a positioning game is here portrayed as a non-cooperative game[23] where the purchaser chooses x and the firm chooses e, and where the price P^*, is defined by (11). Note that the forthcoming analyses reveal possible strategic considerations that the parties engage in (actual choices of lobbying and campaigning) before they enter into negotiations. We first study the case where the parties move simultaneously, thereafter the situation where the purchaser acts a leader (firm as follower), and, finally the case were the firm acts as leader (purchaser as follower).

4.1. The simultaneous game

In the simultaneous game the influential decisions are taken simultaneously by the firm and the purchaser. From (11) it follows that $P^* = P^*(e,x)$, where $P^*_e = \frac{(1-\beta)}{(1+\lambda)}\frac{B_e}{M} > 0$ and $P^*_x = \frac{(1-\beta)}{(1+\lambda)}\frac{B_x}{M} < 0$, implying that more intensive lobbying and less intensive campaigning increases the political costs and the contract price. The purchaser maximizes $W^1 = [V^1 - (1+\lambda)P^*(e,x)]M - (1+\lambda)k(x)$ w.r.t. x, implying a first order condition defined by

$$W^1_x = -(1-\beta)B_x - (1+\lambda)k_x = 0 \tag{14}$$

where the second order condition, given by $W^1_{xx} = -(1-\beta)B_{xx} - (1+\lambda)k_{xx} < 0$, is supposed to be satisfied.[24] The firm maximizes $\pi^1 = (P^*(e,x) - c)M + A - g(e)$ w.r.t. e. This implies a first order condition defined by

$$\pi^1_e = \frac{1-\beta}{1+\lambda}B_e - g_e = 0 \tag{15}$$

where the second order condition, given by $\pi^1_{ee} = \frac{1-\beta}{1+\lambda}B_{ee} - g_{ee} < 0$, is supposed to be satisfied.[25] It follows from (14) and (15) that the optimal levels of lobbying and campaigning depend on the voters' sensitivity to the influential activities (B_x and B_e) and their marginal costs (k_x and g_e). In addition, the bargaining power of the purchaser (β) and the marginal cost of public funds (λ) have direct effects. Optimal campaigning (see 14) implies that the marginal gain, measured as the marginal decrease in the political costs multiplied by the firm's bargaining power, $-(1-\beta)B_x$, is equal to the marginal campaigning cost including the funding costs, $(1+\lambda)k_x$. Optimal lobbying (see 15) is characterized by equality between the marginal increase in the political costs multiplied by the firm's bargaining power $(1-\beta)B_e$, and the marginal lobbying cost including funding costs, $(1+\lambda)g_e$.[26] Denote the optimal values of e and x, being implicitly defined by the solution of the two equations in (14) and (15) in this simultaneous case as (e^s, x^s). If we now use (11), the value of the contract price can be determined. Denote the price of the new drug in this simultaneous case by $P^*(e^s, x^s)$.

4.2. The purchaser as leader

Given the purchaser as leader, we first derive how the firm reacts to different levels of campaigning. The reaction function, $e = e(x)$, is implicitly defined by (15). Differentiation of (15) w.r.t. x, yields

[22] Using (7), it follows that $P^*_M = \frac{1-\beta}{(1+\lambda)M}\left(-2b_Y L_M + b_M - \frac{B(e,x,M)}{M}\right)$. In the brackets, we identify three different effects from M affecting the price. The non-positive term, $-2b_Y L_M$, measures the "budget-impact effect" (the less patients being eligible for the drug in question, the less concerned are voters about the per patient opportunity cost) working in the direction of a lower price. The non-negative term b_M measures the "mobilizing effect" working in the direction of a higher price. Finally, the term B/M shows that an increasing patient group size will mean that there are more people to divide the "fixed" level of political costs among, working in the direction of a reduced price. Hence, generally, we do not know whether an increased number of patients increases or reduces the price and this conclusion is valid independent of the "budget-impact" effect being present or not.

[23] The outcomes following from these positioning games are non-cooperative Nash-equilibria, see for instance the original work by Nash (1951).

[24] It is presumed that $W^1_{xx} = -(1-\beta)B_{xx} - (1+\lambda)k_{xx} = -(1-\beta)[4b_{YY}(L_x)^2 - 2b_Y L_{xx}] - (1+\lambda)k_{xx} < 0$.

[25] This implies that $\pi^1_{ee} = \frac{1-\beta}{1+\lambda}B_{ee} - g_{ee} = \frac{1-\beta}{1+\lambda}[4b_{YY}(L_e)^2 - 2b_Y L_{ee}] - g_{ee} < 0$.

[26] It is easily seen from (14) and (15) that the optimal choices of e and x are directly influenced by the values of β and λ. This means that the political costs, B, and hence the contract price, P^*, in addition to the direct effects caused upon by changes in β and λ (see Result 3) will be indirectly influenced by such changes through the optimal values of e and x.

$$\frac{de}{dx} = -\frac{\frac{1-\beta}{1+\lambda}}{\pi^1_{ee}} B_{ex} < (\geq) 0 \text{ as } B_{ex} < (\geq) 0 \tag{16}$$

This means that more campaigning reduces (increases) the incentive for the firm to invest in lobbying, when $B_{ex} < (\geq) 0$. In terms of Bulow et al. (1985), e and x are, from the purchaser's perspective, strategic substitutes (complements) because more (less) aggressive behavior from the purchaser leads to less (more) aggressive behavior from the firm. The purchaser now chooses x to satisfy[27]

$$\frac{\partial W^1}{\partial x} = -(1-\beta)\left(B_x + B_e \frac{de}{dx}\right) - (1+\lambda)k_x = 0 \tag{17}$$

By comparing (14) and (17), it is easily seen that the marginal gain from increasing x for the purchaser becomes higher when moving first compared to the simultaneous case when $\frac{de}{dx} < 0$. In the opposite case, where the firm increases e as x is stepped up, i.e. $\frac{de}{dx} \geq 0$, the marginal gain becomes lower for the purchaser as leader if compared with the simultaneous case. This means that the purchaser chooses a higher (lower) value of x as leader compared to what the purchaser will do in the simultaneous case as $\frac{de}{dx} < (\geq) 0$. The intuition behind this finding lies with the purchaser having an incentive to choose a higher (lower) x, in the case where acting as leader compared to the simultaneous case, in order to force the firm to reduce lobbying.

Given the situation where aggressive purchaser behavior reduces lobbying ($B_{ex} < 0$), the purchaser, by moving first, makes it less worthy for the firm to use resources into lobbying, i.e. the purchaser, by choosing a relatively high campaigning level reduces the efficiency of lobbying ("takes the wind out of the firm's sail"). In the opposite case, where an aggressive behavior from the purchaser increases lobbying ($B_{ex} > 0$), the leading purchaser chooses to restrict campaigning to avoid "adding fuel to the fire". Denote the case where the purchaser is leader (and the firm follower) by (e^F, x^L). It now follows that $x^L > (\leq)\, x^S$ as $\frac{de}{dx} < (\geq) 0$ and $e^F \leq e^S$ where equality appears when $B_{ex} = 0$. Now, inserting the values for e and x into equation (11), gives us a contract price denoted $P^*(e^F, x^L)$.

4.3. The firm as leader

Given the firm as leader, we find the purchaser's reaction function, $x = x(e)$, from (14). We get

$$\frac{dx}{de} = \frac{(1-\beta)B_{ex}}{W^1_{xx}} > (\leq) 0 \text{ as } B_{ex} < (\geq) 0 \tag{18}$$

This implies that the purchaser, if the marginal impact on the political costs from lobbying is weakened (strengthened) as campaigning is increased, will increase (decrease) campaigning as lobbying becomes higher. This means that e and x, from the firm's perspective, are strategic complements (substitutes) because a more (less) aggressive behavior by the firm induces the purchaser to react aggressively. Then it follows that the firm as leader will choose e to satisfy the following condition[28]

$$\frac{\partial \pi^1}{\partial e} = \frac{1-\beta}{1+\lambda}\left[B_e + B_x \frac{dx}{de}\right] - g_e = 0 \tag{19}$$

From comparing (15) and (19) it follows that the marginal gain from lobbying is lower (higher) in the case where the firm is leader compared with the simultaneous case when $\frac{dx}{de} > (\leq) 0$. This is because the purchaser will increase (decrease) campaigning when lobbying is stepped up, which again, when the firm acts as leader, reduces (increases) the marginal gain from lobbying. Hence, the firm as leader, chooses to use less (more) resources in lobbying relatively to the simultaneous case. Denote this case by (e^L, x^F). Then it follows that $e^L < (\geq)\, e^S$ as $\frac{dx}{de} > (\leq) 0$ and $x^F \leq x^S$, where the equality appears when $B_{ex} = 0$. Using (11), the value of the contract price for this case can now be determined. Denote the price of the new drug when the firm acts as leader (and the purchaser as follower) by $P^*(e^L, x^F)$.

5. A comparison of the three positioning games

In the following we compare the outcomes from the games of section 4. The games give the same results when the marginal political costs from lobbying is unaffected by campaigning. This means if $B_{ex} = 0$, the order of moves in the positioning game is irrelevant, i.e. $x^F = x^S = x^L$ and $e^L = e^S = e^F$. Hence, in the following, when comparing possible outcomes of the games, we first consider the case where $B_{ex} < 0$ and thereafter the case where $B_{ex} > 0$. However, before doing so we sum up the findings arrived at from (16) and (18) saying that the strategic properties of the two influential activities are depending on both the sign of the cross partial derivative of the political cost function and the decision-maker in question.

Result 4: *When the marginal political costs in lobbying decrease in campaigning, $B_{ex} < 0$, campaigning and lobbying, seen from the purchaser's perspective, become strategic substitutes, while from the firm's perspective they become strategic complements. When the marginal political costs in lobbying increase with campaigning, $B_{ex} > 0$, campaigning and lobbying seen from the firm's perspective become strategic*

[27] The second order condition in this case is: $W^1_{xx} = -(1-\beta)\left[B_{xx} + 2B_{ex}\frac{de}{dx} + B_{ee}\left(\frac{de}{dx}\right)^2 + B_e\frac{d^2e}{dx^2}\right] - (1+\lambda)k_{xx} < 0$. In our further discussions, we presume that this condition is satisfied.

[28] The second order condition for this case is $\pi^1_{ee} = \frac{1-\beta}{1+\lambda}\left[B_{ee} + 2B_{ex}\frac{dx}{de} + B_{xx}\left(\frac{dx}{de}\right)^2 + B_x\frac{d^2x}{de^2}\right] - g_{ee} < 0$. Our discussion is based on the presumption that this condition holds.

substitutes, while from the purchaser's perspective they become strategic complements.[29] *When* $B_{ex} = 0$*, lobbying and campaigning are strategic independent meaning that the order of moves has no consequence for the outcome of the positioning game.*

When campaigning reduces the marginal political cost from lobbying, $B_{ex} < 0$, we get

$$x^F < x^S < x^L \text{ and } e^L < e^S \text{ and } e^F < e^S \tag{20a}$$

and when campaigning increases the marginal political cost from lobbying, $B_{ex} > 0$, we get

$$e^F < e^S < e^L \text{ and } x^L < x^S \text{ and } x^F < x^S \tag{20b}$$

The rankings in (20a) say that when the marginal impact from lobbying is decreasing in campaigning, lobbying will be lower in both non-simultaneous games relatively to the simultaneous game. However, we do not know whether it will be lowest in the case where the purchaser acts as leader or when the firm acts as leader. Moreover, the purchaser will spend least resources in campaigning if acting as follower and most resources if acting as leader. The rankings in (20b) say that when the marginal impact from lobbying is increasing with campaigning, campaigning will be lower in both non-simultaneous games relatively to the simultaneous game. However, we do not know whether it will be lowest in the case where the purchaser acts as leader or when the firm acts as leader. Moreover, the firm spends least resources in lobbying if acting as follower and most resources if acting as leader.

When $B_{ex} < 0$, it follows from (20a) that the purchaser both has a first and second mover advantage (Gal-Or, 1985).[30] To see this notice that the purchaser's utility is decreasing with lobbying, i.e. $W_e^1 = \frac{\partial W^1}{\partial e} = -(1-\beta)B_e < 0$. By being leader, the purchaser chooses a high x, forcing the firm to set a low e. This strategy is better than simultaneous moves. An awaiting behavior, however, where the firm first chooses lobbying, means that the lobbying intensity will be relatively low in order to reduce x, which again is favorable for the purchaser. Such an awaiting behavior is also preferred by the purchaser relatively to the outcome of the simultaneous game. However, whether the first or the second mover's position is the best one for the purchaser depends on whether or not the first (second) mover advantage dominates the second (first) mover advantage. Consequently, for $B_{ex} < 0$, using (20a), we arrive at the following inequalities:

$$W^1(e^L, x^F) > W^1\left(e^S, x^S\right),\ W^1(e^F, x^L) > W^1\left(e^S, x^S\right), W^1(e^L, x^F) < (>) W^1(e^F, x^L) \tag{21a}$$

For the firm there is an unambiguous ranking, where the leading position is better than moving simultaneously that again is better than acting as a follower. Using (20a), combined with the fact that firm profit decreases with campaigning, i.e. $\pi_x^1 = \frac{\partial \pi^1}{\partial x} = \frac{1-\beta}{1+\lambda}B_x < 0$, the firm ranking becomes;

$$\pi(e^L, x^F) > \pi\left(e^S, x^S\right) > \pi(e^F, x^L) \tag{22a}$$

When $B_{ex} > 0$, the situation is symmetric to the one described above. Now from (20b) the firm has both a first and second mover advantage (Gal-Or, 1985) since the firm's profits decrease with campaigning, i.e. $\pi_x^1 = \frac{\partial \pi^1}{\partial x} = \frac{1-\beta}{1+\lambda}B_x < 0$. By becoming the leader, the firm chooses a high e, forcing the purchaser to set a low x. This strategy is better than simultaneous moves. However, an awaiting behavior, where the purchaser first chooses campaigning, means that campaigning will be relatively low in order to reduce e, which again is favorable for the firm. Such an awaiting behavior is also better than the outcome from the simultaneous game. However, whether the first or the second mover's position is preferred by the firm is ambiguous since depending on whether the first (second) mover advantage dominates the second (first) mover advantage. Consequently, for $B_{ex} > 0$, using (20b), we arrive at the following inequalities

$$\pi^1(e^L, x^F) > \pi^1\left(e^S, x^S\right),\ \pi^1(e^F, x^L) > \pi^1\left(e^S, x^S\right), \pi^1(e^L, x^F) > (<) \pi^1(e^F, x^L) \tag{21b}$$

For the purchaser the ranking is unambiguous. Now the leading position is better than moving simultaneously that again is better than acting as follower. Using (20b), and that fact that purchaser's utility decreases with lobbying, i.e. $W_e^1 = \frac{\partial W^1}{\partial e} = -(1-\beta)B_e < 0$, the ranking becomes

$$W(e^L, x^F) > W\left(e^S, x^S\right) > W(e^F, x^L) \tag{22b}$$

Result 5: *When the marginal political costs in lobbying decrease (increase) with campaigning,* $B_{ex} < 0$ $(B_{ex} > 0)$ *the purchaser (the firm) has both a first and a second mover advantage while the firm (the purchaser) has a first mover advantage and a second mover disadvantage. It is ambiguous whether the purchaser's (firm's) first or second mover advantage dominates.*[31]

[29] The asymmetric strategic properties concerning lobbying and campaigning are different from what we find in standard duopoly theory. For instance, when firms produce goods being substitutes in demand, Cournot competition gives the quantities as strategic substitutes for both agents while Bertrand competition gives the prices as strategic complements for both firms, see Bulow et al. (1985).

[30] Unlike Gal-Or (1985), who only compares the two different non-simultaneous equilibria in a one-stage two-agent model and ranks these two outcomes, we have also deduced and ranked the possible simultaneous equilibrium. Hence, we are able to identify and define games where there at the same time exist first and second mover advantages when comparing the non-simultaneous cases to the simultaneous one. Particularly, in games with asymmetric strategic properties, as in our model, such rankings become interesting.

[31] The ranking asymmetry between the purchaser and the firm is different from what we find in standard duopoly theory where, given firms that produce substitutes, Cournot duopoly competition gives a first mover advantage for both firms while Bertrand competition gives a second mover advantage for both, see Gal-Or (1985).

Suppose now that $B_{ex} < 0$. If the firm as leader chooses a lobbying intensity lower (or equal to) than the lobbying intensity chosen if acting as follower, i.e. $e^L \leq e^F$, we know that the purchaser's second mover advantage will dominate the first mover advantage, i.e. $W^1(e^L, x^F) > W^1(e^F, x^L)$. Since knowing that the firm as leader benefits from moderate lobbying, we arrive at a response where the purchaser prefers moderate campaigning. Hence, we have a situation where both parties save resources in the positioning game compared to other possible equilibria. However, if the purchaser's first mover advantage dominates the second mover advantage, this could possibly lead to a race towards becoming the first mover that again may lead to the unfavorable simultaneous game. When the purchaser realizes this, it might be reasonable to expect that also in such cases the purchaser will prefer to play the more favorable game of being the follower. In the opposite case where $B_{ex} > 0$, the purchaser as leader chooses a campaigning level being lower to (or equal) the level chosen if the firm acts as leader, i.e. $x^L \leq x^F$, the firm's second mover advantage will always dominate his first mover advantage, i.e. $\pi^1(e^L, x^F) < \pi^1(e^F, x^L)$. Consequently, the purchaser as leader will benefit from choosing relatively moderate campaigning that again induces the firm to choose relatively moderate lobbying. Hence, we have a situation where both parties save resources in the positioning game compared to other possible equilibria. If the firm's first mover advantage dominates the second mover advantage, one might expect a race for becoming the leader that ends up with outcomes similar to the simultaneous game. When the firm realizes this, it seems reasonable that the firm will prefer acting as follower to avoid the less favorable outcome of the simultaneous game.

Result 6: *If the marginal political costs in lobbying decrease (increase) with campaigning, $B_{ex} < 0$ ($B_{ex} > 0$), both parties prefer the firm (purchaser) to act as leader when the purchaser's (firm's) second mover advantage dominates the purchaser's (firm's) first mover advantage. Particularly, this will hold if the firm (purchaser) acting as leader chooses a level of lobbying (campaigning) that is lower or equal to the level chosen if acting as follower, $e^L \leq e^F (x^L \leq x^F)$. Generally, when the purchaser's (firm's) first mover advantage dominates the purchaser's (firm's) second mover advantage, the purchaser (the firm) may choose to act as a follower to avoid a race to become leader that will result in the unfavorable simultaneous game.*[32]

Now it is possible to compare and discuss the contract prices in the different games. When $B_{ex} < 0$, based on the political cost function and the rankings in (20a), it is seen that the price, for the case where the purchaser acts as leader, is lower than the price that follows from the simultaneous game, i.e. $P^*(e^F, x^L) < P^*(e^S, x^S)$. Moreover, if the lobbying activity is lower, when the firm acts as follower relatively to the case where it acts as leader, $e^F \leq e^L$, the political costs and the price become lowest when acting as follower, i.e. $B(e^F, x^L) < B(e^L, x^F)$ and $P^*(e^F, x^L) < P^*(e^L, x^F)$. If $B_{ex} > 0$, it follows from the political cost function and the rankings in (20b) that the price for the case where the firm acts as leader, is higher than the price for the simultaneous case, i.e. $P^*(e^S, x^S) < P^*(e^L, x^F)$. Additionally, if campaigning is lower if the purchaser act as follower, relatively to when acting as leader, i.e. $x^F \leq x^L$, the political costs and the price are both lower when the purchaser is acting as follower, i.e. $B(e^F, x^L) < B(e^L, x^F)$ and $P^*(e^F, x^L) < P^*(e^L, x^F)$.

Result 7: *The contract price that arises from the simultaneous game is higher (lower) than the contract price that arises when the purchaser (firm) acts as a leader when $B_{ex} < 0$ ($B_{ex} > 0$) . The contract price that follows from the firm acting as leader is always higher than the contract price arising from the firm acting as follower when we have cases where $B_{ex} < 0$ and $e^F \leq e^L$ or cases where $B_{ex} > 0$ and $x^F \leq x^L$.*

6. Discussion

The worldwide market for pharmaceuticals is projected to grow from around $1 trillion in 2015 to $1.3 trillion by 2020, representing an annual growth rate of 4.9 percent (ITA, 2016) and the annual R&D investments of this sector amounts to USD 120 billion representing 17.7% of the R&D expenditures of the world (European Commission, 2012). Additionally, a new generation of drugs (innovative drugs) now enters the markets (Roughead et al., 2007).[33] According to the European Federation of Pharmaceutical Industries and Associations there are over 7000 medicines in development for treatment of cancer, diabetes, hepatitis C, cardio-vascular diseases and neurological conditions (Efpia, 2015). Parallel to the growth in the number of innovative drugs we observe structural reforms in the sense that institutions that govern pharmaceutical prices are changing. For instance, bilateral negotiations between pharmaceutical companies and procurement organizations have gained importance at the expense of traditional price-determining institutions such as reference pricing and tendering approaches. This is especially so for newly registered hospital medicines intended to treat serious or life-threatening conditions, drugs that demonstrate a potential to address unmet medical needs and drugs against auto-immune diseases.[34] Persson

[32] In symmetric games, like in Cournot and Bertrand duopolies, the firm's strategies are symmetric. In Cournot they may compete to become the leader, and may end up in the simultaneous game, while in Bertrand they are both in favor of playing an awaiting behavior, and may end up in drawing prices simultaneously. In competing in quantities both players will, in the simultaneous case, end up with their second best alternative, while the simultaneous case when competing in prices is the worst alternative for both. Unlike our asymmetric case above, where it from the players' ranking of outcomes seems likely that the firm (purchaser) becomes the leader and the purchaser (firm) the follower, there might be "more ambiguity" in the Bertrand case in how the agents could coordinate in order to avoid the unfavorable simultaneous outcome.

[33] In the US, innovative (specialty) drugs represent 1% of total prescriptions but accounts for 25% of total prescription drug spending (Express Scripts, 2015) and since 2010, one out of every two FDA approvals is an innovative drug (Lotvin et al., 2014). OECD (2015) defines specialty medications as the drugs entering the market with increasingly high prices and includes most injectable and biologic agents used to treat complex conditions (rheumatoid arthritis, multiple sclerorsis, cancer).

[34] Hospital medicines include all pharmaceuticals administered in a hospital setting, whether in-patient or out-patient departments (COWI, 2009). On average this group makes up between 10 and 15% of the total market in OECD countries (OECD, 2008). In many countries the selection, procurement, pricing and distribution of such medicines are radically different to the supply chain that operates in the retail sector (Brereton, 1999; Leopold et al., 2008; Hostenkamp, 2017).

and Jonsson (2016) predict that the current reference pricing systems over time will cease to exist. Moreover, we observe a process towards a higher degree of centralization of procurement decisions. A reflection of this trend is the recent initiation taken by the Danish and Norwegian governments by signing a letter of intent that confirms that they will develop the conditions for joint negotiations on the same time as inviting other governments to join this initiative.[35]

It is not obvious what the price effects from centralization and bilateral negotiations will be. On the one hand, such changes may strengthen the position of the pharmaceutical firms since allowing for price discrimination across countries. On the other hand, more centralized purchasing could mean a transfer of power to the demand side that provides benefits in terms of volume discounts. We also observe that the reimbursement decisions as concerning the new, sometimes extremely costly, drugs attract more attention. It is our clear impression that the public debates on pharmaceutical pricing and affordability have intensified recent years and we observe that the decision not to reimburse comes under intense criticism of various stakeholders.

In order to obtain a better understanding of the various developments described above, we have proposed a model with an explicit treatment of lobbying and campaigning, prior to price negotiations, as activities that may influence future voter behavior and in this way affecting the political burden of not introducing innovative drugs. In a static perspective, the influential activities of our model represent directly unproductive investments (wasteful activities). Hence, one may think that the parties realize this and go directly to negotiations (rule out the positioning game). If so, the resources in lobbying and campaigning are saved, i.e. moving directly to the bargaining stage means a Pareto-improvement. However, if the parties move directly to the bargaining stage there is also a possibility that lobbying and campaigning might occur if no agreement is reached (an ex post blaming game). Lobbying and campaigning then affect the political costs thus representing threats in the ongoing negotiations. However, such threats might be non-credible since the potential gains of the influencing activities will disappear when negotiations break down while the costs of the same activities, at least for the firm, remain. Hence, playing an ex post blaming game seems less realistic. Moreover, even in situations when there is a common understanding of the gains from playing an ex post blaming game, it is not likely that such a game will appear. Prior to the bargaining, each party will be tempted to realize own gains by starting to invest into influencing activities (prisoner's dilemma). For instance, for any level of campaigning (including a campaigning level equal to zero), the firm has an incentive to start lobbying as long as the marginal profit in lobbying is positive, i.e. $\pi_e^1 = \frac{1-\beta}{1+\lambda}B_e - g_e > 0$ (if the profit-increase, due to an extra effort in lobbying, is positive). This will be the case when the increase in the political costs produces an increase in the negotiated price which dominates the costs of lobbying. Moreover, the monopsony will have an incentive to start campaigning, for any level of lobbying, prior to the negotiations, as long as its marginal utility is increasing in campaigning, i.e. $W_x^1 = -(1-\beta)B_x - (1+\lambda)k_x > 0$ (when the reduction in the negotiated price that follows from reduced political costs means a revenue increase which dominates the increase in campaigning costs).

Given a dynamic perspective, however, investments into influential activities could in principle be welfare-improving. This is possible if the dynamic incentives (innovation) were distorted for example through suboptimal patent lengths and widths. If so, negotiations could improve welfare relatively to other pricing models (monopolistic pricing). It is also possible that influential activities can be beneficial via their effect on the contract price of the new drug. For instance, our analysis predicts that low firm lobbying levels and high purchaser campaigning levels may lead to relatively low prices. On the other hand, one might get an outcome where the price of a new medicine is relatively high, and such a price level could be better for the purchaser due to saved resources in the positioning game. In this perspective it is worth noticing that as long as the firm makes use of lobbying to produce political costs, the purchaser's best response is not to stay passive, but to use campaigning to reduce the political costs that arise from lobbying. The most likely games produce values of lobbying and campaigning that are modest compared to other games considered. Despite this, depending on technology (voter sensitivity and costs), the investments into such activities may well be significant. It should also be remarked that lobbying and campaigning seen in a dynamic perspective, where the voters initially are imperfectly informed, may potentially work as an effective channel for the exchange of relevant information related to the new medicine.

Our model ignores some factors that potentially could affect the outcome of negotiations. First, we do not consider the possibility of the negotiating parties to meet in future periods. To the extent that pharmaceuticals demand uptake for other medicines in later periods, this may represent an opportunity for both parties to influence the outcome of the present negotiations. Second, we only consider price contracts although price-volume contracts are also observed. The inclusion of volume may introduce some additional flexibility, however, in a national health system, the target groups are often well-defined (inclusion criteria), thus price contracts and price-volume contracts are likely to converge. Third, in our model reasoning we have ignored any connections between voters' valuations of the existing and the new medicine and the purchaser's valuations, however, it is a possibility that the purchaser might be influenced by voters' valuations.

In many countries, purchasing decisions are supported by cost-effectiveness analysis to assess whether a given technology provides sufficient "value for the money". On the same time, most countries seem to prefer not to have explicit cost-effectiveness thresholds. Important reasons are the value given to other dimensions such as patient group characteristics (burden of disease, low initial quality of life, severity and duration of life), whether or not other treatment options are available, the innovative nature of the technology and uncertainty considerations. Our analysis suggests that the lack of clarity might be a rational response to complex political environments in the sense that the absence of explicit criteria leaves policymakers with a flexibility to handle the political pressure that arises in connection with reimbursement decisions. In order to develop our knowledge on pharmaceutical pricing in bilateral markets such factors should be included in future works.[36]

[35] The press release on the Nordic procurement deal to secure lower medicine prices is available at http://www.regjeringen.no/n0/dep/hod/id421.

[36] A somewhat different avenue of future research would be to study the timing of firm's decisions to launch new innovative drugs into various markets.

Our conclusions may also have relevance beyond pharmaceutical markets since negotiations appear as an important institution in bilateral monopoly markets. For both parties, the objectives of negotiations are to influence the outcomes (contract terms) in the direction of own interests. One strategy to achieve this, prior to negotiations, is to take part in positioning games. Such cases are likely when a government negotiates with firms that exclusively supply products such as armaments, transport services or other goods and services for which voters have an explicit interest in the negotiated outcome (e.g. prices, funding, locations, quality and employment).

Empirical research on bilateral monopoly situations should focus on the conditions affecting political benefits and costs, as well as characteristics of the firm and the purchaser, in order to further clarify the connection between pricing and ongoing positioning and negotiation games. Given pharmaceuticals, hypotheses that could be tested is the role of the type of political technology ("add fuel to the fire" or "take the wind out of the rivals') and the perceived effects that lobbying and campaigning (voters' sensitivity) have on the order of moves, lobbying spendings, and negotiated prices. However, as often is the case for lobbying studies, in contrast to for example studies on campaign contributions, significant data constraints prevail making econometric testing challenging. In the case of pharmaceuticals the negotiated prices are typically confidential and lobbying costs are difficult to observe since stakeholders are not required to disclose such information. In addition, lobbying investments take many forms such as support (financial and in-kind) to consumer groups (patient associations), the use of external consulting services and support from industry associations in grabbing the attention of the public. An interesting observation is that purchasers (public agencies) seem to have increased their capacity in the fields of public affairs, public relations and communication. However, the separation of such campaigning investments that belong to a particular case (negotiation) appears to be challenging. In addition, the case specific character of negotiations in connection with a particular innovative drug makes sample size a problem.[37] Given this, a more promising avenue for future research on pharmaceutical markets might be the use of case studies that combines quantitative and qualitative methodologies. Interviews with various stakeholders (such as consumer groups, pharmaceutical firms, pharmaceutical industry associations, healthcare decision makers and opinion leaders among health care workers), records and media articles may in principle provide valuable insights into the strategic considerations made.[38] By referring to a specific case concerning price negotiations for the medicine Edaravone, Nyland and Pettersen (2018) describe and discuss the roles played by the Norwegian purchaser organization, a pharmaceutical firm and the media.[39,40] For this particular case they describe a positioning game prior to the negotiations, although not observing essential data, that is analogous to the assumption made for the model analyzed here.

7. Conclusion

In exchange situations, such as negotiations, the parties engage in mutually beneficial trades since having a common interest to cooperate, however, they also have conflicting interests over the terms of trade. In addition, the stakeholders need not be limited to those actually participating in the negotiations. For example if one of the parties is a governmental representative, voters become stakeholders. This means, for heterogeneous voter preferences, that a positioning game might take place prior to the negotiations to influence actual outcomes. In this paper we propose a model that focuses on negotiations and the strategic interactions between pharmaceuticals and purchaser organizations where voters are stakeholders. The model is concerned with the outcome of bilateral price negotiations between a firm, that enters a market with a new patented drug, and a purchaser organization (e.g. a centralized government-controlled payer or group purchasing groups). The model yields insights about pharmaceutical pricing and generates hypotheses about factors that determine prices.

First, we introduce a political cost function that depends on the difference in the number of voters being supporters and non-supporters of a particular agreement. The voters are concerned with treatment effects and the opportunity costs of the drug in question and are influenced by arguments (lobbying and campaigning) presented to them by the negotiating parties. Second, we identify factors that impact the negotiated price in a Nash bargaining game. The price, being a function of the influential activities (campaigning and lobbying), becomes the average of the firm's unit costs of production and the purchaser's valuation of the net utility gain per patient from replacing the existing treatment with the new medicine. The price increases with the unit drug cost of the existing treatment, with the purchaser's valuation, relative to the existing one, of the new treatment, and the price of the old drug, while it decreases with the marginal cost of public funding and the bargaining power of the purchaser. When the patient group size becomes higher, the price can both increase and decrease. Third, we analyze the impact political environments might have on the negotiated prices. The investments into lobbying and campaigning depend on factors such as the investment costs of the two activities, voters' sensitivity to such activities, and strategic interrelationships between the activities. Based on this conceptual model, we have seen that likely positioning games are those where one of the two negotiating parties acts as leader while the rival acts as follower. Such games produce values of lobbying and campaigning that are modest compared to other games considered.

[37] However, in other areas where the negotiated outcomes and the influential activities are more readily observable than in the case of price bargaining for new medicines, it could be easier to observe essential information and apply statistical methodologies to analyze political cost functions of the type presented in our study.

[38] Two examples of drugs that have received massive media attention in Norway the last few years are Ipilmumab and Spinraza. According to the archives of Retriever, Scandinavias largest agency for media monitoring and analysis, these two drugs have been mentioned more than 3000 times in Norwegian media articles the last few years (https://www.retriever.no/product/medieovervakning-og-medieanalyse).

[39] See Nyland and Pettersen (2018), page 16–17.

[40] Edaravone represents a new possible treatment for Amyotrophic lateral sclerosis (ALS).

Declaration of competing interest

We declare no conflict of interest when working on the paper!

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