Comparison of price caps and tariffs to counter a foreign monopoly

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Abstract

This paper compares import tariffs and import price caps as policy measures to regulate a foreign monopolist. We show that for any positive import tariff there exists a set of price caps each of which Pareto-dominates the given tariff. This result is particularly important in the case of nontransferable utilities, as in the illustrated example of the EU-Russia gas market.

Keywords: monopoly regulation, price cap, tariff, European Union, Russia, energy policy
JEL: D42, F12, F13,

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1. Introduction

In a domestic market where a foreign monopolist operates, free trade results in higher prices and lower quantities supplied than in a competitive market (e.g., Tirole, 1988, Chapter 1). In order to reduce the monopolist's market power and increase domestic welfare, various regulatory measures are discussed including import tariffs or subsidies (Katrak, 1977; Svedberg, 1979; Tower, 1983), import price caps (Magat, 1976; De Meza, 1979; Kowalczyk, 1994), consumption taxes or subsidies (Katrak, 1977; Hillman and Templeman, 1985), quotas and quality controls (Krishna, 1987; Kowalczyk, 1994).

In this paper, we compare import tariffs and import price caps to regulate a foreign monopolist, using the current example of the EU-Russia gas market. It is shown that for every tariff there exists a set of price caps that yields higher domestic welfare and higher foreign monopoly profits. In other words, each of these price caps Pareto-dominates the tariff. This is particularly important in the case of nontransferable utilities, as in EU-Russia relations.

Optimal tariffs (taxes) in monopoly markets were first studied by Graaf (1949) and Johnson (1951). In the linear model, i.e., with a linear demand function and constant marginal cost, an import tariff can make the demand side better off than under free trade (Katrak, 1977; Svedberg, 1979). Although an import tariff generally raises the consumer price and lowers the quantity traded, total domestic welfare is higher than under free trade when the tariff revenue collected is added to the consumer surplus. If the assumption of linear demand curve is relaxed, the optimal import tariff can be zero or negative, i.e., an import subsidy is the optimal policy (De Meza, 1979; Jones and Takemori, 1989). Here, a subsidy may be optimal for both specific and ad valorem tariff (Brander and Spencer, 1984). This result also holds when income effects are taken into account (Jones, 1987).

As for the comparison of tariffs with other instruments, a price cap slightly above the monopolist's marginal cost is the best policy from a domestic welfare perspective. (De Meza, 1979). In a bilateral monopoly market, each side prefers its optimal price cap to its optimal (non-negative) tariff (Tower, 1983). According to Kowalczyk (1994), the optimal price cap welfare-dominates the optimal tariff, i.e., the sum of the welfare of the demand side and the monopolist is higher than that of the optimal tariff. Moreover, when marginal cost is constant or decreasing, a minimum import obligation is equivalent to a corresponding price cap.

Although the price cap is considered a better policy measure, it is less beneficial in practice. According to De Meza (1979) and Pomfret et al. (1992, Chapter 3), calculating the optimal price ceiling requires no more information than calculating the optimal consumption tax, but enforcing a price cap on a foreign monopolist is more difficult than imposing an import tariff. Nevertheless, the price cap has come under the spotlight in a recent and politically charged case, as detailed in the next section.

2. Political background

The current background to the analysis is the EU-Russia gas market, which has come into focus as a result of Russia's military invasion of Ukraine. This market was monopolistic before

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gas supplies were interrupted – first by the Russian embargo and then by the sabotage of the pipelines. Since the prices paid under existing supply contracts are generally linked to spot prices on EU gas markets, Russia can increase its profits in a manner similar to a monopolist by limiting quantities and raising prices, which it has successfully demonstrated since mid-2021. After the military invasion, Russia reduced or cut supplies consecutively to different EU countries. The corresponding market reaction caused gas prices to reach fifteen times the long-term average at times. The average TTF gas price was 20 EUR/MWh from 2010–2019, while it increased to over 300 EUR/MWh in August 2022.

During Russian gas supplies to the EU before their interruption and in view of their resumption, the introduction of tariffs and an import price cap on Russian gas exports are being discussed. Because the EU was the only significant foreign buyer of Russian gas from the West Siberian gas fields, it has the power to impose a tariff or even a price cap on Russian gas. While some scholars and policymakers point to tariffs as a preferred instrument (e.g., Gros, 2022; Hausmann et al., 2022), others recommend an import price cap (e.g., European Council, 2022). On 19 December 2022, the EU nations consented to a price cap for Russian gas.

3. Model and results

3.1. Basic Model

Consider the following market equilibrium model (e.g., Tirole, 1988): Let $x(p)$ be the demand function, $x(0) < \infty$, with the derivative $x'(p) < 0$ and the inverse function $p(x)$. With the cost function $C(x)$ of supply x, the marginal cost $C'(x)$ does not decrease, i.e., $C''(x) \geq 0$. The producer and consumer surplus are denoted by π_s and π_d, respectively.

Under perfect competition, the competitive price p^*, the competitive supplied quantity x^*, the producer surplus π_s^*, and the consumer surplus π_d^* are

$$\begin{aligned} &p^* = C'(x^*), \quad x^* = x(C'(x^*)), \\ &\pi_s^* = p^* x^* - C(x^*), \quad \pi_d^* = \int_0^{x^*} p(y)dy - p^* x^*. \end{aligned} \tag{1}$$

In the monopoly market the monopolist maximizes its profit (surplus)

$$\pi_s(p) = px(p) - C(x(p)) \tag{2}$$

with respect to p, resulting in the monopoly price condition

$$p^M = C'(x(p^M)) + \frac{x(p^M)}{-x'(p^M)},$$

where $p^M > p^*$ and $x^M (= x(p^M)) < x^*$. It is assumed that $x(p)$ and $C(x)$ are such that p^M is the unique maximizer of $\pi_s(p)$ and $\pi_s'(p) > 0$ for $0 \leq p < p^M$, which is satisfied, for example, in the case of a linear or concave demand function. The producer and consumer surplus are

$$\begin{aligned} \pi_s^M &= p^M x^M - C(x^M), \\ \pi_d^M &= \int_0^{x^M} p(y)dy - p^M x^M. \end{aligned}$$

3.2. Import Tariff

Consider the introduction of an import tariff that ties the consumer price p^T to the producer price p_s^T, where the tariff revenue collected is added to the consumer surplus. Let the import tariff rate t considered in the following analysis be the effective tariff rate, defined as the fraction of the actual tariff rate that causes a change in demand for the commodity relative to the monopoly case, taking into account subsidies to consumers and associated income and substitution effects. Three cases can be distinguished. First, if all tariff revenues are used to subsidize the price of this commodity, the market outcome does not change compared to the monopoly without tariff. Therefore, the effective tariff rate is zero. Second, only part of the tariff revenue is used to subsidize the price of the commodity. In the case of an actual tariff rate t_0 and a subsidy rate z, $z < t$, the effective tariff rate is $t = t_0 - z$. Third, all or part of tariff revenues are used to subsidize consumers in general, i.e., the subsidies can also be used for other goods. Due to the substitution effect, demand for the commodity is lower than demand without a tariff, but higher than demand with the same tariff rate without the consumer subsidy. Thus, the effective tariff rate is positive, but lower than the actual tariff rate (e.g., Varian, 2014).

Designing a tariff that maximizes total domestic welfare requires at least two instruments – tariffs and subsidies – for optimal policy (Paulsen and Adams, 1987). In the context considered here, however, we focus on a single tariff instrument. According to Skeath and Trandel (1994), this should be an ad valorem tariff rather than a specific tariff, because in a monopoly environment the former dominates the latter in terms of consumer surplus and tariff revenue. Given an ad valorem tariff $t > 0$, the monopolist maximizes its profit

$$\pi_s(p_s) = p_s x((1+t)p_s) - C(x((1+t)p_s)),$$

where $x((1+t)p_s) \equiv x(p)$ with $p = (1+t)p_s$. The maximization leads to the producer price condition

$$p_s^T = C'(x((1+t)p_s^T)) + \frac{x((1+t)p_s^T)}{-(1+t)x'((1+t)p_s^T)}.$$

The corresponding consumer price $p^T = (1+t)p_s^T$ can be represented as

$$p^T = (1+t)C'(x(p^T)) + \frac{x(p^T)}{-x'(p^T)}.$$

By substituting p^T into the first order condition for maximizing monopoly profit (2), it can be shown that $p^T > p^M$ and thus $x^T = x(p^T) < x^M$. Under special conditions of the monopolist's profit function (2), the optimal tariff may be negative, i.e., a subsidy (Brander and Spencer, 1984). Since we do not consider this relevant for the context considered here, we focus on the case of a positive optimal tariff, which includes the linear

model.[1] In this case,

$$\begin{aligned} &p_s^T < p^M < p^T, \\ &\pi_s^T = p_s^T x^T - C(x^T) < \pi_s^M, \\ &\pi_d^T = \int_0^{x^T} p(y)dy - p_s^T x^T > \pi_d^M. \end{aligned} \tag{3}$$

Compared to the monopoly case, the delivery quantities are smaller and the domestic price is higher. However, when revenue from the optimal tariff is added to domestic welfare, the demand side is made better off by the introduction of a tariff (Graaff, 1949; Johnson, 1951). The relationships (3) also hold for a specific tariff τ added to the selling price, i.e., $p^T = p_s^T + \tau$ (Brander and Spencer, 1984).

3.3. Import price cap

We now assume that the demand side is able to impose an import price cap p^C with $p^* \leq p^C < p^M$. Since the maximum price the monopolist receives is set by the price cap and does not depend on the quantity supplied, the monopolist has an incentive to supply as much as possible as long as the price is above its marginal cost.

Both tariffs and price caps can increase domestic welfare and decrease the welfare of the foreign monopolist compared to the monopoly case. The analysis is limited to the case of positive tariffs for which (3) holds, i.e.,demand-side welfare gains are larger with a well-chosen price cap. The difference is that a tariff leads to lower quantities and higher domestic prices, while a price cap leads to higher quantities and lower prices. Comparing the two instruments, the following statement holds.

Proposition 3.1. *In a monopoly market, for every import tariff that satisfies $p_s^T < p^M < p^T$, there exists a set of import prices caps $\mathcal{M} = (\underline{p}^C, \bar{p}^C) \in \mathbb{R}^+$ each of which Pareto-dominates the tariff, i.e., $\forall p^C \in \mathcal{M} : \pi_s^C > \pi_s^T$ and $\pi_d^C > \pi_d^T$.*

Proof. First, set $p^C = p_s^T$. Then $x^C = x(p_s^T) > x(p^T) = x^T$. Welfares are

$$\begin{aligned} \pi_s^C &= p^C x^C - C(x^C) = \pi_s^T + p_s^T(x^C - x^T) - \int_{x^T}^{x^C} C'(y)dy \\ &> \pi_s^T + (x^C - x^T)(p_s^T - C'(x^C)) \geq \pi_s^T, \end{aligned} \tag{4}$$

where $C'(x^C) \leq C'(x^*) = p^* \leq p_s^T$, and

$$\begin{aligned} \pi_d^C &= \int_0^{x^C} p(y)dy - p^C x^C \\ &= \pi_d^T + \int_{x^T}^{x^C} p(y)dy - p^C x^C + p_s^T x^T > \pi_d^T, \end{aligned} \tag{5}$$

since for all $y \in [x^T, x^C]$, $p(y) \geq p(x^C) = p^C = p_s^T$.

Now assume that there exists a price cap $\tilde{p}^C$, $\tilde{p}^C < p_s^T$, that satisfies

$$\tilde{\pi}_s^C = \pi_s^T \;\Leftrightarrow\; \tilde{p}^C x(\tilde{p}^C) - C(x(\tilde{p}^C)) = p_s^T x^T - C(x^T).$$

If $\tilde{p}^C \geq p^*$, $\underline{p}^C = \tilde{p}^C$: Because $\underline{x}^C = x(\underline{p}^C) > x(p_s^T) = x^C > x^T$, it holds that

$$\begin{aligned} \underline{\pi}_d^C &= \int_0^{\underline{x}^C} p(y)dy - \underline{p}^C \underline{x}^C \\ &= \pi_d^C + \int_{x^C}^{\underline{x}^C} p(y)dy - \underline{p}^C \underline{x}^C + p^C x^C > \pi_d^C. \end{aligned}$$

If $\tilde{p}^C < p^*$, $\underline{p}^C = p^*$: $\underline{x}^C = x^*$ in (1), thus, $\underline{\pi}_d^C = \pi_d^* > \pi_d^C$. Then, for all p^C with $\underline{p}^C < p^C < p_s^T$, it holds that $x^C > x^T$, $\pi_s^C > \pi_s^T$, and $\pi_d^C > \pi_d^T$.

Finally, assume that there exists a price cap $\bar{p}^C$, $p_s^T < \bar{p}^C < p^M$ that satisfies

$$\bar{\pi}_d^C = \pi_d^T \;\Leftrightarrow\; \int_0^{x(\bar{p}^C)} p(y)dy - \bar{p}^C x(\bar{p}^C) = \int_0^{x^T} p(y)dy - p_s^T x^T.$$

Because $\bar{p}^C < p^M$, $x(\bar{p}^C) > x(p^M) > x^T$, it holds that

$$\begin{aligned} \bar{\pi}_s^C &= \bar{p}^C x(\bar{p}^C) - C(x(\bar{p}^C)) \\ &> \pi_s^T + \bar{p}^C(x(\bar{p}^C) - x^T) - C(x(\bar{p}^C)) + C(x^T) > \pi_s^T. \end{aligned}$$

Thus, for all p^C with $p_s^T < p^C \leq \bar{p}^C$, it holds that $x^C > x^T$, $\pi_s^C > \pi_s^T$, and $\pi_d^C > \pi_d^T$.

Since $x'(p) < 0$, $p'(x) < 0$, and $\pi_s'(p) > 0$, there exists a unique $\underline{p}^C$, a unique $\tilde{p}^C$ and a unique $\bar{p}^C$ with the above properties, completing the proof. □

Note, for each $p^C \in \mathcal{M}$ it holds that $x^C > x^M > x^T$. The converse of the proposition is not true. More precisely, for any price cap $p^C \in [p^*, p^M] \supset \mathcal{M}$, there is no tariff where $\pi_s^C \leq \pi_s^T$ and $\pi_d^C \leq \pi_d^T$, i.e., that better serves both the demand and the supply side.

3.4. Extensions

Proposition 3.1 is also of strategic importance. Assuming that the demand side can more easily enforce a tariff against the monopolist than a price cap, the Pareto-dominance property can be used strategically to impose a price cap. By announcing the price cap, the demand side can credibly threaten the monopolist with a tariff if it does not accept the price cap. This is possible because there are tariffs that are worse than the price cap for the monopolist and better than the monopoly solution for the demand side.

[1] It is assumed that p^M is significantly higher than p^* and thus, with a reasonable tariff, p_s^T is also assumed to be higher than p^*. The optimal tariff is positive if

$$\frac{x''((1+t)p_s^T)}{-x'((1+t)p_s^T)} - \frac{-x'((1+t)p_s^T)C''(x((1+t)p_s^T))}{p_s^T - C'(x((1+t)p_s^T))} < \frac{2 - \frac{C'(x((1+t)p_s^T))}{p_s^T}}{(1+t)(p_s^T - C'(x((1+t)p_s^T)))}.$$

The optimal tariff is negative if

$$\begin{aligned} \frac{2 - \frac{C'(x((1+t)p_s^T))}{p_s^T}}{(1+t)(p_s^T - C'(x((1+t)p_s^T)))} &\leq \frac{x''((1+t)p_s^T)}{-x'((1+t)p_s^T)} - \frac{-x'((1+t)p_s^T)C''(x((1+t)p_s^T))}{p_s^T - C'(x((1+t)p_s^T))} \\ &< \frac{2}{(1+t)(p_s^T - C'(x((1+t)p_s^T)))}. \end{aligned}$$

If a price cap is also applied with the intention of harming the supply side, this could be accounted for in the model in that a lower producer surplus has per se positive effects on demand-side welfare (in addition to consumer surplus). Assuming that there is no corresponding mirroring on the supply side and that the producer surplus π_s^T under the tariff is the lowest possible level, the upper bound $\bar{p}^C$ of the Pareto-dominant set of price caps in Proposition 3.1 shifts downward, while the lower bound $\underline{p}^C$ remains unchanged.

4. Conclusion and policy implication

While both a tariff and a price cap on a foreign monopolist's product can make the demand side better off, the price cap Pareto-dominates the tariff. More specifically, for each tariff there exists a set of price caps that make both the demand side and the supply side better off.

The effects of imposing a price cap equal to the producer price under this tariff are that (i) the monopolist is better off because it sells at the same price but with higher quantity, (ii) for consumers who have already bought, the price is reduced from the producer price plus the tariff to the producer price (this exactly offsets the loss of tariff revenue), and (iii) consumers who were previously excluded by the tariff now also buy, so the demand side is better off overall.

Alternatively, the demand side can always set a price cap that provides the monopolist the same welfare as under a tariff, but makes the demand side itself better off. It is also possible to set a price cap that improves demand-side welfare and is higher than the producer price at a tariff, making the producer price more acceptable to the monopolist. The Pareto dominance property can also be used strategically by the demand side to enforce a price cap through the credible threat of a tariff.

Acknowledgments

The authors acknowledge feedback from Lion Hirth on an earlier draft of the paper. The authors appreciate all valuable comments and suggestions from the reviewers.

Funding: Ingmar Schlecht's work on this paper was sponsored by the Swiss Federal Office of Energy's "SWEET" programme as part of the PATHFNDR project. This funding source was not involved in the conduct of the research or preparation of the article.

Declaration of competing interest

The authors declare that they have no known competing finan- cial interests or personal relationships that could have appeared to influence the work reported in this paper.

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