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Economics: The Open-Access, Open-Assessment E-Journal

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Suggested Citation: Wittmann, Nadine (2014) : Regulating gasoline retail markets: The case of Germany, Economics: The Open-Access, Open-Assessment E-Journal, ISSN 1864-6042, Kiel Institute for the World Economy (IfW), Kiel, Vol. 8, Iss. 2014-33, pp. 1-33, https://doi.org/10.5018/economics-ejournal.ja.2014-33

This Version is available at:
https://hdl.handle.net/10419/102722

Economics
The Open-Access, Open-Assessment E-Journal

Vol. 8, 2014-33 | October 09, 2014 | http://dx.doi.org/10.5018/economics-ejournal.ja.2014-33

Regulating Gasoline Retail Markets: The Case of Germany

Nadine Wittmann

Abstract

In 2011, price peaks in retail gasoline prices caused public outrage and attracted the attention of German regulatory agencies. After having examined the market, competition authorities concluded that tacit collusion existed but could not easily be prosecuted under given competition law. In several other countries, various types of regulatory schemes are implemented to tackle tacit collusive behavior, e.g., there are price ceilings established in Luxembourg or per day limits of price increases given in Austria. However, research has found that none of them has led to satisfactory results. Hence, the following paper proposes a different regulatory approach, i.e., the implementation of corrective taxes. Results show that a specially tailored tax on price successfully manages to render collusion an unprofitable business by collecting marginal profits and that the inherent vice of the gasoline retail market, i.e., the transparency that enables tacit—and therefore non-prosecutable—collusion, could be turned into a regulatory virtue as it becomes a powerful means to help successfully tackle imperfect competition and to bring about a more efficient market outcome.

JEL Q48 D42 D43

Keywords Gasoline retail market; regulation; market structure and antitrust; collusion

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Citation Nadine Wittmann (2014). Regulating Gasoline Retail Markets: The Case of Germany. *Economics: The Open-Access, Open-Assessment E-Journal*, 8 (2014-33): 1—33. http://dx.doi.org/10.5018/economics-ejournal.ja.2014-33

Received March 31, 2014 **Published as Economics Discussion Paper** April 10, 2014
Revised September 21, 2014 **Accepted** September 25, 2014 **Published** October 9, 2014

1 Introduction

In today's globalized economy, mobility is a crucial aspect of most people's everyday lives on both a professional and personal level. Many people still rely on cars to satisfy their demand for transportation.[1] Although the number of cars that run either partially (i.e. hybrid technologies) or totally on alternative energy sources is increasing steadily, the vast majority still relies entirely on fossil fuel based technologies.[2] Hence, the retail market for gasoline is a very important economic sector to most industrialized nations and any irregularities or turbulences draw a lot of attention from the general public, policy makers, and researchers alike (Haucap and Mueller 2012). European nations in general and Germany in particular is certainly no exception to that. E.g., with well above 500 cars per 1000 people Germany is among the world's top 12 nations in terms of car ownership.[3] Also, the German gasoline retail market experienced significant price peaks in 2011, which triggered in-depth investigations by German regulatory authorities (Bundeskartellamt 2011). Possible measures and regulatory actions to be taken are still under consideration (Bundeskartellamt 2013) which makes the German gasoline retail market an extremely interesting showcase for the analysis presented in this paper. Regarding the characteristics of the market in general, there is a vast strand of literature dealing with numerous aspects of the retail gasoline market.

A lot of publications examine the characteristics of the demand side, such as elasticity of demand (Dahl 2012, Brons et al. 2008), using various methods and looking at various countries, e.g. North America (Lau et al. 2012, Park and Zhao 2010, Nicol 2003), South America (Hofstetter and Tovar 2008), China (Lin and Zeng 2013), the Middle East (Ben Sita et al. 2012), or Europe (Pock 2010). Overall, the common denominator is that demand for gasoline is inelastic (Haucap and Mueller 2012). So far, there exist a total of well over 240 empirical gasoline demand studies that examine over 70 countries (Dahl 2012). With respect to diesel, there are another 60 studies dealing with over 55 countries. Dahl (2012) examined whether income and own-price elasticity differ across nations. While her data analysis showed that differences among countries exist, it nonetheless

[1] http://www.huffingtonpost.ca/2011/08/23/car-population_n_934291.html

[2] http://data.worldbank.org/indicator/IS.VEH.PCAR.P3/countries/1W?display=default

[3] http://www.electricdrive.org/index.php?ht=d/sp/i/27132/pid/27132

rendered important results as certain pattern emerged that allowed for estimating elasticity values for over a hundred nations. Moreover, Dahl also derives policy implications regarding the implementation of environmental and fuel mix policy measures in the retail gasoline market. Dahl's findings underpin those of Pock (2010) who also found that changes in diesel car usage do affect demand in the gasoline retail market, and therefore also influence the own-price and income elasticity levels of the latter. Dahl (2012) also found that price elasticity increased with prices of both gasoline and diesel fuel. A paper by Nicol (2003) examines the elasticity of demand with respect to Canada and the United States. Naturally, one has to differentiate between different types of income elasticity, while the most common ones analyzed are own-price and income elasticity (Nicol 2003). Moreover, introducing the time aspect into the model set, Noel's results show a significant difference between short and long run elasticity. In general, most empirical studies agree on a short (long) run own-price elasticity of around –0.26 (–0.86) regarding in the gasoline retail market (Nicol 2003). While the empirical model of Nicol (2003) does not contradict these results, it nonetheless finds significant proof of the fact that the exact level of both own-price and income elasticity of households differs across both household types and countries. These findings are certainly in line with standard economic theory which states that heterogeneous agent models render different results than a standard homogeneous agent models (Kirman 2006). Moreover, another important aspect that was identified by Pock (2010) with respect to estimating gasoline demand in Europe is that of an increase in diesel car usage. With respect to empirical data analysis such trends have to be taken into account in order to render non-confounded results. Pock's analysis shows that the surge in diesel cars across Europe led to an overestimation of both income and own-price elasticity. With respect to the US retail market for gasoline, Park and Zhao (2010) focus on an empirical data analysis of post 2000 data. In their model setup price elasticity depends on the time horizon, budget constraints, as well as the economic characteristics of the good in question, i.e. whether it is necessary to economic subsistence or a luxury product, and whether substitutes are easily at hand (Park and Zhao 2010). Within their model set, time is not a relevant variable. This stems from the fact that their data is fixed by month and that substitution possibilities are hard to come by in the short run. Overall, Park and Zhao (2010) find that welfare could be increased by a shift from income to gasoline taxation and that deadweight loss for the most part

depends on own-price elasticity. Lin and Zen (2013) analyze elasticity of demand in the Chinese gasoline market. Aside from calculating estimates for own-price and income elasticity whose ranges also comprise the estimates given by Nicol (2003) they also calculate the so called vehicle miles traveled elasticity (Lin and Zen 2013) which ranges somewhere between –0.882 and –0.579. In China, fuel taxes have been increased in 2009 and now also include agents that were previously exempted from the tax scheme, such as airlines and the army (Lin and Zen 2013). In their model setup, they find that demand seems slightly more elastic with respect to gasoline demand for transportation than other purposes. With respect to income elasticity of gasoline demand, Ben Sita, Marrouch and Abosedra (2012) analyze Lebanon data. They find that both government revenues and environmental standards do not benefit from a flat excise tax. Their model expresses gasoline demand as a function of structural changes that affect consumption, price and income. In doing so, they find that long run elasticity levels are higher than identified otherwise and conclude that structural changes have a significant effect on the demand for gasoline as they appear to affect people's economic behavior substantially (Ben Sita, Marrouch, Abosedra 2012). On the whole, it can be said that the general consensus across publication is that demand for gasoline is rather inelastic (Havranek et al. 2012, Haucap and Mueller 2012).

With respect to empirical findings regarding then general workings of gasoline retail markets, the following findings are of great interest. Polemis and Panagiotis (2013) examine how gasoline price fluctuate in the EU and whether price changes are asymmetric, i.e. prices are more likely to, e.g., increase than decrease. In the course of their analysis they find that for most EU countries, the gasoline market is still dominated by a small number of large and international corporations that explicit a very high level of vertical integration (Polemis and Panagiotis 2013). Their analysis focuses on 11 EU countries, i.e. "Austria, Belgium, Finland, Greece, France, Germany, Ireland, Italy, Netherlands, Portugal and Spain" (Polemis and Panagiotis 2013, p. 426). It is assumed that the existence of asymmetric price volatility is a result of tacit collusion being prevalent within the gasoline retail market (Borenstein et al. 1997). In the course of their analysis, Polemis and Panagiotis find that asymmetric price changes are especially prevalent within the wholesale market in which positive retail price increases are passed on to consumer prices virtually instantly while price remain fairly sticky in the face of

a decrease in wholesale prices. According to their analysis, policy measures which foster competition within the wholesale segment of the gasoline retail market would also pose a remedy regarding asymmetric price volatility. Garcia (2013) also researched price asymmetries in the market for gasoline using a Meta regression analysis. Aside from EU markets, his analysis also incorporates, among others, the North American hemisphere as well as Australia. Nonetheless, his findings are in line with those of Polemis and Panagiotis (2013) who also identify that the asymmetries occur mostly and most prominently with respect to the retail market segment. Moreover, he also identifies the lack of competition as the primary source of the problem. The Meta analysis conducted by Brons et al. (2008) also examines the price elasticity of gasoline demand along with other important elasticities such as mileage per car. Their analysis shows that the latter is inelastic and values are in line with those identified by others such as Nicol (2003). They also identify differences in elasticity levels between countries which stem from structural differences such as infrastructure and availability of car substitutes such as public transportation. The paper by Lau et al. (2012) focuses on the Canadian Research market and looks at how price regulation affects the retail market for gasoline. Their analysis shows that price regulation leads to a significant reduction in price volatility within the market which is also a good indicator on whether regulating price manages to successfully, i.e. negatively, affect tacit collusion within the market.

Hence, with respect to the supply side of the retail market for gasoline, the general consensus is that the gasoline retail market is likely to suffer from a lack of competition and an oligopolistic market structure and non-prosecutable tacit collusion (Garcia 2013, Haucap and Mueller 2012, Andreoli-Versbach 2011, Bundeskartellamt 2011). Therefore, several countries have taken different regulatory measures in order to fight this economically undesirable status quo. However, it appears as though none of these measures have proven successful (Berninghaus et al. 2012, Haucap and Mueller 2012), i.e. neither have markets become significantly more competitive and less collusive nor has asymmetric price volatility been abolished (Polemis and Panagiotis 2013, Bettendorf et al. 2003). Hence, it seems as though, so far, regulation authorities do not have any feasible instrument available, to adequately address this problematic state of affair.

However, the model presented in the following section might be an option which could help to do away with the problem in question. The paper is structured

as follows: Section 2 presents the formal structure of the proposed regulatory scheme and Section 3 contains a numerical example. Section 4 takes a critical look at the proposed regulatory scheme and findings presented in Section 2 using additional literary sources. Section 5 contains some concluding remarks.

2 The Model

As has been shown in the previous section, seminal research identifies the following set of crucial characteristics inherent to the gasoline retail market: Inelastic demand, imperfect competition and tacit collusion. However, before the formal analysis conducted in this section can commence, three important aspects have to be introduced. Firstly, it is important to note that the core of the proposed regulatory tax scheme presented in the following section draws from findings by M.A. Adelman (1978). In his paper on the constraints on the world oil monopoly price he proposes that oil importing nations could successfully tackle the OPEC cartel by implementing a tax rate proportional to price. Whenever prices rise, the tax rate is adapted accordingly and the cartel is thereby deprived of the desired rise in revenue, which otherwise would have taken place due to a sufficiently inelastic demand function. In addition, a recent paper, Vetter (2013a) generates valuable findings which proof that variable tax rate schemes on sales prices can indeed increase welfare in markets that exhibit certain types of imperfect competition. As is to be seen shortly, the results of the following sections serve as additional verification of Vetter's results. Secondly, the design of the proposed regulatory scheme adheres to the findings of Buchanan (1969) who has shown the importance of market structure in designing optimal regulation. The results of a recent paper by Kverndokk and Rosendahl (2011) also validate the importance of Buchanan's findings with respect to the oil market and transport sector in general. In particular, Kverndokk and Rosendahl found strong evidence that, in the presence of market power, effects on the oil market resulting from regulating the transport sector differ significantly from those under perfect competition. Thirdly, it is important to keep in mind what the regulatory scheme is supposed to accomplish. The proposed scheme is not meant to generate government income, i.e. a predictable stream of revenue to the government as discussed in Madowitz and Novan (2013). Also, it is not meant as a measure to internalize the negative effects of fossil fuel consump-

tion, e.g. the energy tax, as in Fisher et al. (1996). Rather, it is meant as a measure to successfully correct and prevent market distortions that stem from the exertion of market power as in Adelman (1978).

2.1 Demand

The inverse demand function, denoted with *D: p(x)*, is assumed to take the common downward-sloping form regarding the connection between price *p* and quantity demanded *x* (Vetter 2013a), i.e.

$$D: p(x), \quad \partial p(x) \big/ \partial x < 0 \tag{1}$$

with $p(x), x \geq 0,$ and is also assumed to stem from a strictly monotonically decreasing demand function, *x(p)*, with $\partial x(p) \big/ \partial p < 0,$ which has also been used by Schendel and Balestra (1969) in their paper on price wars and rational behavior in gasoline markets.

However, in order to better illustrate the outcomes and analysis to come, a set of two exemplary demand functions, $D_i,$ with $i \in \{I, II\},$ is introduced, which differ in terms of their elasticity to further illustrate the importance of the latter with respect to market outcomes

$$\begin{aligned} D_I &: p_I = a - bx_I \\ D_{II} &: p_{II} = a - \frac{1}{s} x_{II}^2 \end{aligned} \tag{2}$$

with $a, b, s > 0$ and $x_I, x_{II}, p_I, p_{II} \geq 0.$ Hence, in addition to portraying the standard linear demand curve, there is a second one that holds more elasticity within the upper price range and at the same time more inelasticity within the lower price range than a standard linear demand curve and thereby better manages to emulate some of the empirical findings on gasoline retail markets (Dahl 2012).

In addition, to further facilitate comparability of market outcomes, the two representative demand functions do not only share the same reservation price at a eurocent/l (ct/l) but also the same maximum quantity demanded in case of a price equal to zero, i.e. $p_i = 0,$ that is denoted with x^{sat} liters per period—e.g. per

week—which means that the two are connected mathematically through the following identity $b \equiv \frac{x^{sat}}{s}$. In general, the former assumption is meant to illustrate a situation in which there is a point at that, although price is zero, demand does not increase any more, as, intuitively speaking, a consumer has only so much distance to travel to work and only so much spare time to make road trips and so forth. Hence, other exogenous variables would have to change first that could then cause the demand curve to shift outward. Price elasticity of demand, i.e. $E = \frac{\partial x_i}{\partial p}\frac{p}{x_i(p)}$, with $i \in \{I, II\}$, is given by

$$E_{D_I} = -\frac{p}{a-p}, \quad E_{D_{II}} = -\frac{p}{2(a-p)}. \tag{3}$$

Within the entire price range $p \in [0, a)$ ct/l, D_{II} is more inelastic than D_I. The unitary elastic point is reached at $\frac{a}{2}$ ct/l for D_I and $\frac{2a}{3}$ ct/l for D_{II}.

On the whole, demand within retail gasoline markets has proven to be rather inelastic (Haucap and Mueller 2012, Schendel and Balestra 1969). However, it is certainly not perfectly inelastic along the entire range of the demand function. Rather, elasticity increases as the price rises (e.g. Adelman 1978) which is also in line with the findings of Dahl (2012) that have been presented in Section 1. Intuitively speaking, when gasoline prices are low, consumers' behavior, e.g. patterns of car usage, will not change significantly when prices fluctuate marginally. Once a significantly higher price level is reached, however, demand becomes increasingly more elastic with respect to price changes, because now people might more often choose to go by foot or take the bike instead of their car, as the opportunity cost of taking the car, just to get to the bakery around the corner, have become considerably higher. And, at the very end, i.e. a price approaching the reservation price, consumers start to switch almost entirely to using public transportation or to a car that runs on a different type of fuel. A graphical illustration along with a numerical example is presented in Section 3.

2.2 Supply

Relevant cost structures and tax rates consist of unit cost of input *(c)* which contains per unit wholesale price as well as costs of transportation (Bundeskartellamt 2011). Naturally, looking at different countries, different types of taxes can be found to be present in retail gasoline markets. However, in order to be consistent with the focus of this paper on German market settings, standard *VAT* (t^U), which stands for value-added tax, along with a fixed energy tax (t^E) are taken into account in this model setup, i.e.

$$\begin{aligned} & c = \text{constant},\ c > 0 \\ & t^E = \text{constant},\ t^E > 0 \\ & t^U = \tau p_i = \tau p(\mathrm{x}_i), \text{ where } i = \{I, II\} \text{ and } 0 \leq \tau < 1. \\ & \Rightarrow MC(\mathrm{x}_i) = c + t^E + t^U = c + t^E + \tau p(x_i) \end{aligned} \tag{4}$$

2.3 Results without Regulation against Collusive Behavior

Without collusion, companies arrive at a standard Bertrand oligopoly outcome with zero profits, given the homogenous nature of the product in question (Haucap and Müller 2012). Naturally, this standard result implicitly implies some simplifying assumptions, e.g. that there are homogenous cost structures and no economically relevant capacity restrictions prevalent. If, however, companies decide to act as one collusive cartel in order to achieve positive profits, they have to ensure that supervision and observation of compliance with collusive agreements—e.g. prices—are feasible. Also, sufficient means of sanctions and punishment must be readily available to maintain a successful collusive agreement. According to German competition authorities, these preconditions are all met by the German gasoline markets in general (Bundeskartellamt 2011). In particular, findings show that the supply side of the German gasoline retail market is comprised of an oligopoly that consists of five major companies—Aral, Esso, Jet, Shell, Total—and a negligible competitive fringe (Bundeskartellamt 2011). Generally speaking, given that collusive agreements are successfully reached and given that companies manage to act as a non-defective cartel, a monopoly-type market outcome emerges. Hence, cartel's profits π are maximized, i.e.

$$\max_{x_i} \pi(x_i) = (1-\tau)\, p(x_i) \cdot x_i - (c + t^E) x_i, \tag{5}$$

which results in the standard profit maximizing condition that marginal revenue *(MR)* equals marginal cost *(MC)*, i.e.

$$p(x_i) + \left(\partial p(x_i) \Big/ \partial x_i \right) \cdot x_i = \frac{c + t^E}{1-\tau}. \tag{6}$$

Regarding the two representative demand functions, marginal revenue equals

$$MR_I = a - 2bx_I, \quad MR_{II} = a - \frac{3}{s} x_{II}^2 \tag{7}$$

which then has to equal marginal cost *(MC)* as in (4). Hence, as standard theory predicts, a cartel's market price rises above marginal cost and quantity supplied declines as shown by (6), (8) and (9) together with (10) to (13) in Table 1.

These findings are also implemented in the course of a numerical example presented in Section 3. The results of the latter are then presented in Table 3, and illustrated by Figure 5, and Figure 6.

Table 1: Equilibrium Results of Bertrand Oligopoly and Collusion

Equilibrium Results	Sce-nario	Non-collusive Bertrand oligopoly	Collusive Cartel
Market price (p^B vs p^{cartel})	D_I ,D_{II}	(8) $\frac{c + t^E}{(1-\tau)}$ <	$D_I : \frac{a + c + t^E}{(2-\tau)}, D_{II} : \frac{2a + c + t^E}{(3-\tau)}$. (9)
Quantity supplied (x^B vs x^{cartel})	D_I	(10) $\frac{(1-\tau)a - c - t^E}{(1-\tau)b}$ >	$\frac{(1-\tau)a - c - t^E}{(2-\tau)b}$. (11)
	D_{II}	(12) $\sqrt{s \frac{(1-\tau)a - c - t^E}{(1-\tau)}}$ >	$\sqrt{s \frac{(1-\tau)a - c - t^E}{(3-\tau)}}$ (13)

2.4 Regulating Collusive Behavior

As has already been mentioned in Section 1, none of the present regulatory instruments, e.g. the Austrian rule, the Australian Fuel-Watch-Concept or Luxembourg's price ceilings, seems to deal effectively with the prominent collusive behavior prevalent in retail gasoline markets (Haucap and Mueller 2012; Bundeskartellamt 2011). Hence, it appears as though these instruments promise little success to German regulatory agencies. Therefore, one might ask oneself whether there is an alternative regulatory policy measure readily at hand. Its implementation should successfully manage to drive the collusive cartel into the Bertrand oligopoly outcome, thereby being a remedy to prevalent market distortion and increasing consumer welfare. As the following analysis shows, this can be successfully done by implementing a regulatory tax scheme that, by design, changes from regressive to progressive at the point where marginal cost equals price and thereby takes into account the propositions and findings of both Adelman (1978) and Buchanan (1969). Thereby, a successful regulatory scheme (t^{cartel}) manages to do away with the negative effects associated with collusive behavior. In case of the retail gasoline market such a regulatory scheme can be characterized as follows:

Proposition 1. An optimal regulatory tax scheme (t^{cartel}) collects cartel's profits entirely, i.e. $\pi^{cartel} \equiv 0,$ whenever prices are above marginal cost and thereby causes collusive behavior to become completely unprofitable.

Proof.

Rearranging (6) and substituting for $p(x_i)$ in (5) renders marginal cartel profits of $\left[-(1-\tau)\frac{\partial p}{\partial x_i}x_i\right] \geq 0,$ as well as total cartel profits of

$$\pi^{cartel}(x_i) = -(1-\tau)\frac{\partial p(x_i)}{\partial x_i}x_i^2 \geq 0, \forall x_i \geq 0. \tag{14}$$

Hence, if

$$t^{cartel} \equiv t(x_i) \equiv \left| p(x_i) - MC(x_i) \right|, \tag{15}$$

applying (15) with respect to (5) renders

$$\pi(\tau, c, t^E, t^{cartel}, \mathrm{x}) \equiv 0 \tag{16}$$

$\forall x \geq 0$, as profits are collected entirely by the tax on collusion, i.e. $t^{cartel} = \frac{\pi^{cartel}}{x^{cartel}}$.

End of proof.

Thereby, given the design of the proposed regulatory tax scheme, skimming cartel's profits holds along the entire range of possible price levels, which is also shown in Figure 1 which illustrates the case of D_I, in which cartels profits in the absence of regulation as in (14) are equal to

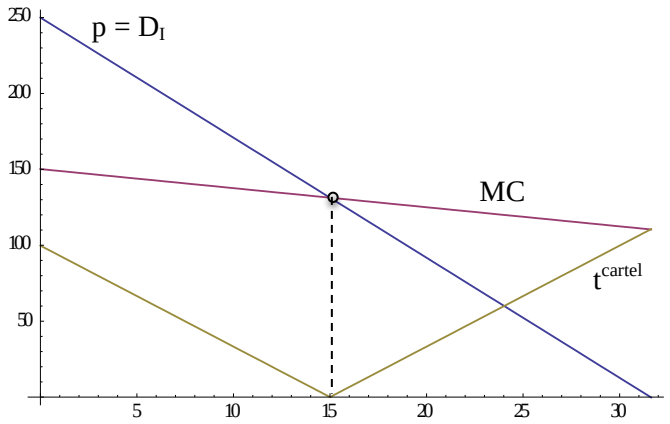
$$\pi^{cartel}(\tau, a, b, c, t^E) = (1-\tau)\frac{\left((1-\tau)a - c - t^E\right)^2}{(2-\tau)^2 b}$$

and the optimal ad valorem tax rate defined by (15) equals therefore

$$t^{cartel} \equiv \left|(1-\tau)\frac{\left((1-\tau)a - c - t^E\right)}{(2-\tau)}\right| \geq 0.$$

Hence, once t^{cartel} is implemented, companies' expected profits from collusion are now equal to or even less than those in case of the non-collusive Bertrand oligopoly as, even if costs associated with tacit collusion are very small but nonetheless non-negative, e.g. the expected cost of prosecution by competition

Figure 1: Exemplary Scenario D_I Including Regulatory Tax t^{cartel}



authorities or the cost of observing other gas stations, the non-collusive Bertrand oligopoly becomes the profit maximizing equilibrium outcome.

Moreover, what also proofs quite interesting about this specifically tailored tax scheme is that, as a result, the optimal tax level is equal to the minimum tax rate which is equal to zero, i.e. $t_{Min}^{cartel} = 0,$ as it is located at the zero profits Bertrand oligopoly outcome at which price equals marginal cost.

Lemma 1. The proposed regulatory tax scheme also reduces the cartel's options for sanctioning defectors through predatory pricing, which refers to setting prices below marginal costs, i.e. $p^{pred} < \frac{c + t^E}{1-\tau},$ *as such measures become even more costly.*

As has already been extensively proven by economic research, any cartel needs an effective sanctioning mechanism to ensure compliance and to discourage defection (e.g. Adelman 1978). As we are faced with price instead of Cournot competition, defection from collusive agreement means that defectors set a price below the cartel's profit maximizing monopoly price and above marginal cost price, e.g. in case of Scenario D_I, i.e.

$$\frac{a + c + t^E}{(2-\tau)} > p^{def} \geq \frac{c + t^E}{(1-\tau)}. \tag{17}$$

Thereby, defecting companies intend to increase their share of supply (Schendel and Barista 1969) and, hence, their share of profits from collusion. Given the high transparency of the gasoline retail market, however, such a behavior will not remain unnoticed by the other cartel members; e.g. in Germany every gas station, on average, monitors approximately 3.83 other gas stations (Bundeskartellamt 2011). Deterring sanctions could very well take the form of temporary predatory, i.e. below marginal cost, pricing, i.e. $p^{pred} < \frac{c + t^E}{1-\tau}.$ However, the proposed regulatory tax scheme also serves to curtail cartels sanctioning power as it doubles the cartel's cost, denoted by C^{pred}, of such punitive actions as (15) results in

$$C^{pred} = \left| p^{pred} - MC(x^{pred}) \right| + t^{cartel} = 2 \left| p^{pred} - MC(x^{pred}) \right|. \quad (18)$$

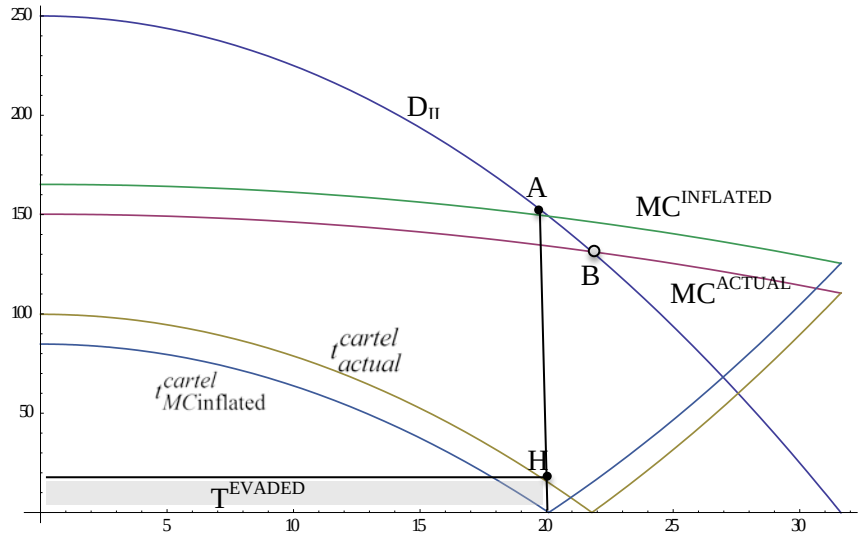
Lemma 2. The proposed regulatory tax scheme strengthens the position of the competitive fringe, as it renders related measures of collusive behavior easier to prosecute as they now turn into an act of tax evasion.

Without the proposed regulatory scheme and in case of tacit collusion, cartel members generate positive profits by charging monopoly price levels as shown by (14). Therefore, one could ask themselves why companies of the competitive fringe do not intervene by putting competitive pressure on cartel members through setting a more competitive price, e.g. as shown by (17). However, aside from the fact that the gasoline retail market bears substantial costs of entry (Haucap and Mueller 2012) additional hints can be found in the fuel sector inquiry report of German competition authorities (Bundeskartellamt 2011). It states that influential gasoline retail market suppliers are directly associated with the major wholesale market players of the gasoline market. As a result, "free" gas stations which are not associated with wholesale gas suppliers are commonly charged a significantly higher wholesale gas price, i.e. $c^{free} > c$, which implies that $\Delta C = c^{free} - c > 0$. Competition authorities are aware of these actions but this practice cannot be easily prevented (Bundeskartellamt 2011). Hence, if c^{free} is chosen sufficiently high, the profit maximizing cartel price level is equal to the "free" gas stations' marginal cost price, e.g. with respect to scenario D_I this results in $\Delta C \equiv \frac{(1-\tau)a - c - t^E}{(\frac{b}{\tau} + 1 - \tau)}$. Through the proposed regulatory tax t^{cartel}, however, collusive behavior becomes unprofitable as shown by (16) and tacit collusion itself is thereby shattered which causes protectionist wholesale pricing to become less called for.

However, what is an even more important and valid argument, in economic terms, is that charging inflated wholesale prices now becomes an act of tax fraud that can be easily prosecuted under standard tax law, e.g. in Germany under §370

AO.[4] How does that come about? Through charging inflated wholesale prices, wholesale gas suppliers cause free gas stations to set the wrong tax rate with respect to any set of retail price and retail quantity supplied. Hence, the actions of the latter result in an act of tax evasion which is, in contrast to the economic aspect of this strategic behavior (Bundeskartellamt 2011), a prosecutable tax offence (see Footnote 4). Figure 2 illustrates the point made: With wholesale gasoline suppliers charging actual costs, c, the market equilibrium is characterized by point B in Figure 2 and a resulting actual regulatory tax rate of zero. Billing $c^{free} > c$, however, leads to inflated marginal costs and results in a different gasoline retail market equilibrium which is represented by point A in Figure 2. The shaded rectangle represents the tax volume evaded and its height equals the per unit tax rate evaded in point A.

Figure 2: Tax Evasion Caused By Inflating Marginal Cost



[4] http://www.gesetze-im-internet.de/ao_1977/__370.html (German version) or http://www.gesetze-im-internet.de/englisch_ao/englisch_ao.html#p2106 (English version).

Table 2: Tax Evasion Caused By Inflating Marginal Cost

Equilibrium Results	Scenario	Charging c (**Figure 2**: Point B)	Charging $c^{free} > c$ (**Figure 2:** Point A and H)
Market price (p^c *vs.* p^{free})	D_I, D_{II}	(19) $\frac{c+t^E}{(1-\tau)} <$	$\frac{c+t^E}{(1-\tau)}+\frac{\Delta C}{(1-\tau)}$ (20)
Quantity supplied (x^c *vs.* x^{free})	D_I	(21) $\frac{(1-\tau)a-c-t^E}{(1-\tau)b} >$	$\frac{(1-\tau)a-c-t^E}{(1-\tau)b}-\frac{\Delta C}{(1-\tau)b}$ (22)
	D_{II}	(23) $\sqrt{s\frac{(1-\tau)a-c-t^E}{(1-\tau)}} >$	$\sqrt{s\frac{(1-\tau)a-c-t^E}{(1-\tau)}-s\frac{\Delta C}{(1-\tau)}}$ (24)
Tax rate paid	$D_I = D_{II}$	0 (25)	0 [5] (26)
Tax rate due	$D_I = D_{II}$		ΔC [6] (27)
Evaded tax volume	$D_I = D_{II}$		$\Delta C \times x^{free}$ (28)

Table 2 presents the results of the analysis with respect to scenario D_I in a concise manner. Equations (19) and (20) illustrate that inflating marginal cost leads to higher prices which results in lower quantities demanded as shown by (21) to (24). The level of tax evasion is given by (28). Due to the transparency inherent to both the gasoline wholesale and retail market segment such a tax evasion can be both easily detected and prosecuted. Hence, the expected payoff Π^{Exp} from charging inflated wholesale prices becomes negative, i.e.

$$\Pi^{Exp} = c^{free} x^{free} - \chi(c^{free} x^{free} + f^{fine}) < 0 \qquad (29)$$

---

5 Solving $t^{cartel} = |P - MC|$ leads to $t^{cartel} = (1-\tau)\frac{c+t^E+\Delta C}{(1-\tau)} - c - t^E + \Delta C \equiv 0.$

6 Inserting x^{free}, from (T2.IV), into $t^{cartel} = (1-\tau) \times p(x^{free}) - c - t^E$ renders $t^{cartel} = (1-\tau) \times (a - b \times \frac{(1-\tau) \times a - c - t^E - \Delta C}{b(1-\tau)}) - c - t^E \Rightarrow t^{cartel} \equiv \Delta C.$

with $\chi \to 1$ including a non-negative fine for committing tax fraud, i.e. $f^{fine} > 0$. Thereby, competition is fostered while collusive actions and profit skimming are successfully confounded in all, i.e. both retail and wholesale sectors of the gasoline market.

Lastly, regarding the feasibility and applicability of the approach, it can also be stated, that the proposed regulatory tax scheme appears quite applicable, as commonly used gas station software[7] [8] typically combines all aspects of business management, back office and point of sale issues and also allows for a flexible

[7] Relevant websites on gas station software in German:

http://www.infordata-oase.de/produkte/winoase/sondermodule-winoase.html

http://www.ratio-elektronik.de/de/kassensysteme.php

http://www.bungalski.de/prospekt.pdf

http://www.mum-edv-service.de/index.php/produkte/tankstellen-raststaetten-software

http://www.xsitesoftware.ca/site/home

http://download.cnet.com/Gas-Station-Software/3000-2067_4-176906.html

http://www.ratio-elektronik.de/de/kassensysteme.php

http://www.bungalski.de/prospekt.pdf

http://www.mum-edv-service.de/index.php/produkte/tankstellen-raststaetten-software

[8] Relevant Websites on gas station software in English:

http://www.xsitesoftware.ca/site/home

http://download.cnet.com/Gas-Station-Software/3000-2067_4-176906.html

Quote: "Store purchases, fuel sales, fuel purchases, price adjustments or shortage, paid-outs, assets, complete employee, customer, and vendor management. Inventory tracking by department, item, and category. Flexible taxing system which allows you to tax items differently. Keep track of each of your fuel pumps and tanks, by storing information about their location, model, and capacity. Optionally associate a pump and a tank with each fuel grade, for keeping track of fuel inventory, and better tracking of which tank and/or pump produces the most sales. The Agnitech gas station software is intended to be used as a back-office software to keep track of historical data of everything from store sales and purchases, fuel sales and purchases, payments, receivables, daily assets, etc. […] It tracks all activity that takes place at the gas station, from tracking fuel sales by category, fuel purchases, store sales and purchases, tracking store sales by department and by countable products. It also tracks all payments made to vendors and other payees, it tracks the daily assets by shift and by day. It allows you to instantly generate reports that show you what you have and what you should have. It also generates fuel reconciliation reports, historical reports of everything that happened during any period of time, and much much more." (Source: http://download.cnet.com/Gas-Station-Software/3000-2067_4-176906.html Access Date: September 2014).

taxing system (see Footnote 8). Hence, the proposed regulatory tax scheme is equally simple to implement as the well-known and well-functioning *VAT* scheme as the information problem is passed onto the economic agent that actually holds all the necessary information, i.e. the suppliers of the gasoline retail market. This results from the fact that, through standard management and back office software or basic profit margin spread-sheets, gasoline retailers generally have perfect information (see Footnotes 7 and 8) on their unit cost structure and price setting and the absolute value of subtracting the two simply renders t^{cartel}. At most, it could mean that some new lines of code need to be added to the already existing software system or the profit margin spreadsheet used. Relevant data sets could then be sent over periodically to regulation authorities and be evaluated software-based as well. Hence, regulation authorities can isolate and focus on prosecuting irregularities such as positive tax rates, falsely calculated tax rates or inflated wholesale prices which result in tax evasion while gasoline retailer, for the most part, only need to make sure that their software or spreadsheet works correctly and to decide whether they want to engage in unit cost pricing or collect taxes for the government instead of cartel profits.

On the whole, the reason why tacit collusion can be upheld so easily within the gasoline retail market is that market agents' behavior in general and market prices in particular are highly transparent and readily observable at almost negligible cost (Haucap und Mueller 2012, Bundeskartellamt 2011). In addition, not only retail market structures but also data on wholesale prices and suppliers cost structures are accessible to regulation authorities (Bundeskartellamt 2011 and 2013). Through the proposed regulatory tax scheme, this inherent vice of the gasoline retail market, i.e. the transparency that enables tacit—and therefore non-prosecutable - collusion, is turned into a regulatory virtue as it becomes a powerful means to successfully tackle imperfect competition. This is also in line with findings of Vetter (2013a), who identifies information deficits as one of the most crucial issues when it comes to the practicability of variable tax rate schemes, such as a digressive tax rate.

3 Numerical Example

The analysis now proceeds by presenting further results and discussion based on a numerical example. These findings provide additional grounds that validate the results and discussion of the previous sections. Overall, they illustrate particularly well how market outcomes depend on the elasticity of demand with respect price but also that the proposed tax scheme functions successfully either way. Naturally, numerical results with respect to optimal prices and quantities presented in this section depend on the exemplary numbers chosen. However, as has been shown by (16) the proposed tax scheme renders the desired results even in the general model setup of (1), (4) and (5), thereby the main findings with respect to the desired effect of the proposed tax scheme do not suffer from a loss of generality.

3.1 Demand

Representative demand functions are chosen in accordance with (2). Reservation price is assumed at 2.50€/l, i.e. 250ct/l[9] and x^{sat} is set around 31 liters per period, e.g. per week,[10] i.e.

$$D_I = 250 - 7.91x_I, \quad D_{II} = -1/4x_{II}^2 + 250. \tag{30}$$

Price elasticity of demand, as in (3), can be expressed as

$$E_{D_I} = -\frac{p}{250-p}, \quad E_{D_{II}} = -\frac{p}{2(250-p)} \text{ with } p \in [0,250). \tag{31}$$

---

[9] Taking the Green parties 1998 proposal of 5 D-Mark per liter of gasoline as a vivid and well known example which, to-date, whips up significant outrage among German car owners.

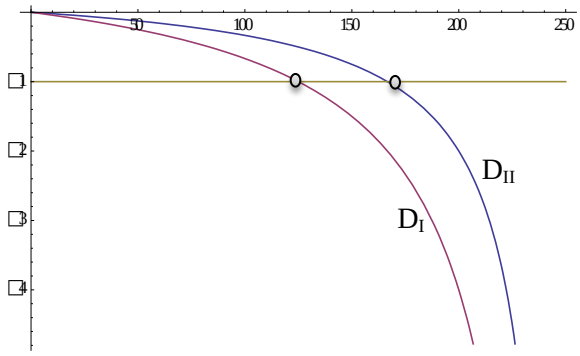
http://www.spiegel.de/auto/aktuell/kraftstoffpreis-warum-benzin-viel-zu-billig-ist-a-553489.html

[10] Given an average weekly amount of kilometers driven by German car owners of around $\frac{14000km\ p.a.}{52\ weeks\ p.a.} \approx \frac{270km}{week}$

(http://de.statista.com/statistik/daten/studie/2579/umfrage/durchschnittlich-pro-jahr-mit-kfz-gefahrene-kilometer/) and given an average fuel consumption of 8.5l/100*km* per car (http://www.upi-institut.de/iaa.htm) renders an average demand of around 23 *l/week*. Therefore, assuming a maximum quantity demanded of 31 *l/week* appears well justified.

Hence, within the entire price range between zero and 250ct/l of gasoline, D_{II} is more inelastic than D_I. The unitary elastic point is reached at 125ct/l for D_I and 166.67ct/l for D_{II} which is illustrated by Figure 3.

Figure 3: Price Elasticity of Demand



3.2 Supply

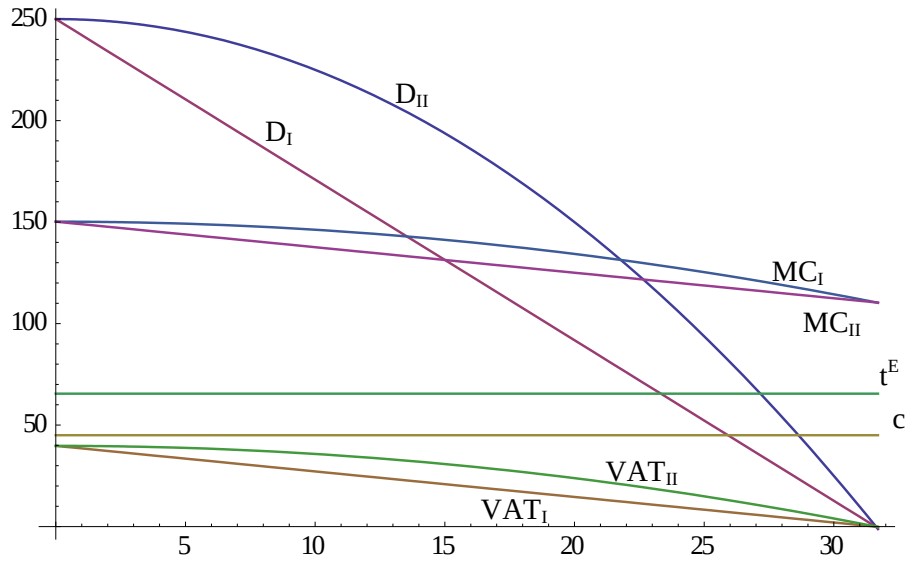
Relevant cost structures and tax rates are chosen according to (4) combined with real live numbers, presented by German competition authorities in their final sector analysis report (Bundeskartellamt 2011) unit cost of input equals

$$\begin{aligned} & c = 45, t^E = 65.45, t^U = \tau p_i = 0.16\, p(x_i), \quad \forall i = \{I, II\}. \\ & \Rightarrow MC = 110.45 + 0.16\, p(x_i) \end{aligned} \tag{32}$$

The cost and demand structure of this numerical model are shown in Figure 4.

Both representative demand functions, D_I and D_{II}, are sketched along with resulting marginal cost curves, MC_I and MC_{II}. The latter include unit cost of input *(c)* as well as energy tax (t^E) and *VAT* in case of both scenarios. Section 3.3 and 3.4 are based on the settings illustrated in Figure 4, given demand and supply structures as characterized by (30) and (32).

Figure 4: Demand and Cost Structures



3.3 Results without Regulation against Collusive Behavior

As has already been elaborated upon in more detail in Section 2, in the absence of collusion a standard Bertrand oligopoly outcome with zero companies' profits emerges. If, however, a collusive cartel is established successfully, profits become positive and are maximized according to the standard profit maximizing condition that marginal revenue *(MR)*

$$MR_I = 250 - 15.82x_I, \quad MR_{II} = 250 - \frac{3x_{II}^2}{4} \tag{33}$$

equals marginal cost *(MC)* as shown by (32). Table 3 presents a comprehensive overview over the results of the four different scenarios presented so far, i.e. scenarios D_I and D_{II} given either non-collusive or collusive market outcome.

In case of a non-collusive Bertrand oligopoly, both D_I and D_{II} render the same market price but, naturally, the more inelastic demand in case of D_{II} results in a higher quantity demanded.

Table 3: Equilibrium Results of Bertrand Oligopoly and Collusion

Equilibrium Results	Non-collusive Bertrand oligopoly	Collusive Cartel facing D_I	Collusive Cartel facing D_{II}
Quantities and Price: *(Q*,P*) [Q** in liters, *P** in *eurocent/liter]*	Scenario D_I: (15.0, 131.3) Scenario D_{II}: (21.79, 131.3)	(6.85,195.82)	(11.85, 214.89)
Suppliers' Profits	$\Pi^* = 0$	$\Pi^* = 371.49$	$\Pi^* = 832.77$
Consumers' Rent	$CS_{DI} = 890.18$ $CS_{DII} = 1724.52$	$CS_{DI} = 627.31$	$CS_{DII} = 277.38$
Tax revenue	$T_I^E = 981.75$, $T_I^U = 313.22$ $T_{II}^E = 1426.16$, $T_{II}^U = 454.87$	$T_I^E = 448.33$ $T_I^U = 213.28$	$T_{II}^E = 775.58$ $T_{II}^U = 404.89$
Aggregate Welfare	Scenario D_I: 2185.15 Scenario D_{II}: 3605.55	D_I: 1660.41	D_{II}: 2290,62
Welfare Loss	–	**–24%**	**–34.5%**

Once collusion is successfully accomplished, prices rise and quantity is reduced in both cases. Again, both effects are relatively more severe in case of the more inelastic scenario D_{II}. Moreover, it is extremely interesting to see how prominent the effects of the difference in demand functions come up in these numbers. Although both reservation price and maximum quantity demanded are completely identical for both D_I and D_{II}, the difference in inelasticity of demand D_I and D_{II} has a significant effect on price levels and rents, which is in line with standard microeconomic theory. In the non-collusive Bertrand oligopoly, quantity demanded as well as consumer rents are significantly higher in case of a more inelastic demand function, i.e. D_{II}. However, once a collusive cartel is established, supplier's profits rise tremendously—at the expense of consumer rents and tax revenue. This effect is especially prominent in case of inelastic demand where consumer rents decrease by over 83% and tax revenue decreases by 45% (energy tax)/ 11% (*VAT*). These findings are in line with those of Park and Zhao (2010) as

has been mentioned in the introduction. Hence, this example clearly shows that a successful regulation of such a retail gasoline cartel would entail a substantial welfare gain to society as a whole. Figure 5 and Figure 6 are meant to further illustrate the setups and results presented in Table 3.

Figure 5: Demand D_I and Resulting Marginal Revenue and Marginal Cost

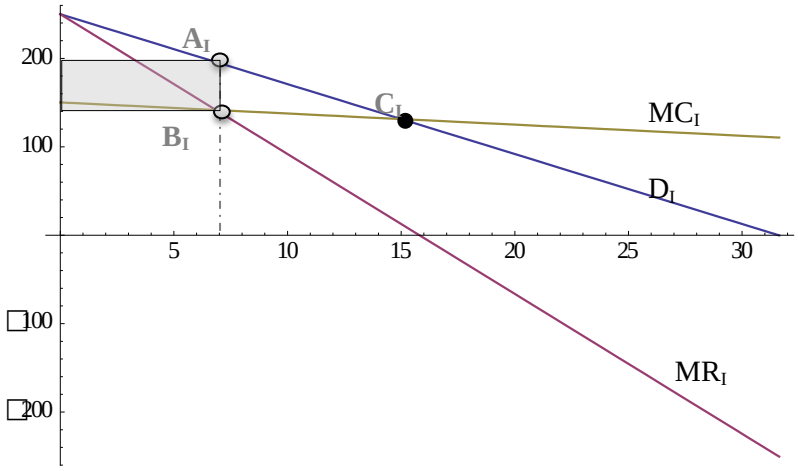
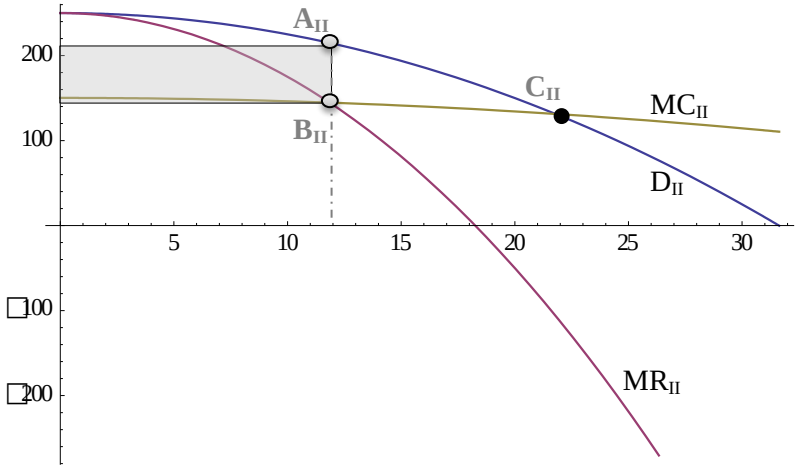


Figure 6: Demand D_{II} and Resulting Marginal Revenue and Marginal Cost



Points C_I and C_{II} represent equilibrium results in case of a non-collusive Bertrand oligopoly. Points A_I and A_{II} represent equilibrium market outcomes in case of a collusive cartel. Cartel's profits are sketched by the rectangular shape. Welfare losses of collusion are easily identified as the area between the lines connecting points A_I, B_I, and C_I in Figure 5 and A_{II}, B_{II}, and C_{II} in Figure 6.

3.4 Regulating Collusive Behavior

Now, the proposed regulatory policy scheme that has previously been introduced in Section 2.4 is applied to the numerical setup of Section 3.3. As has been elaborated upon before, its implementation is meant to drive the collusive cartel into the Bertrand oligopoly outcome represented by both (9), (11), and (13) of Table 1 and column two of Table 3. The optimal tax rate set according to (15) in combination with the information given by (30) and (32). Hence, the following equations render the functions which determine the appropriate tax rate in each of the two representative demand scenarios:

$$
\begin{aligned}
&t_I^{cartel} = \left|((1-0.159)\,p_I - 45 - 65.45)\right|, \\
&t_{II}^{cartel} = \left|((1-0.159)\,p_{II} - 45 - 65.45)\right| \\
&\Rightarrow \\
&t_I^{cartel} = \left|((1-0.159)(250-7.91x_I) - 45 - 65.45)\right|, \\
&t_{II}^{cartel} = \left|((1-0.159)(-1/4x_{II}^2 + 250) - 45 - 65.45)\right| \\
&\forall x_I, x_{II} \in \{0, 31.63\}.
\end{aligned}
\tag{34}
$$

Figure 7 illustrates the respective functions which may serve to facilitate the understanding of the results presented in Table 4 and Table 5.

Figure 7 depicts demand and marginal cost structures as well as optimal tax rates of both scenarios D_I and D_{II}. Point A_I (A_{II}) represents the equilibrium market outcome in case of demand scenario D_I (D_{II}). The former characterizes both the Bertrand oligopoly result, as given by column two in Table 3**,** as well as the case of the collusive cartel, regulated by the tax rate given by (34).

Figure 7: Demand D_I, Resulting Marginal Revenue and Marginal Cost and Tax Rate t^{cartel}

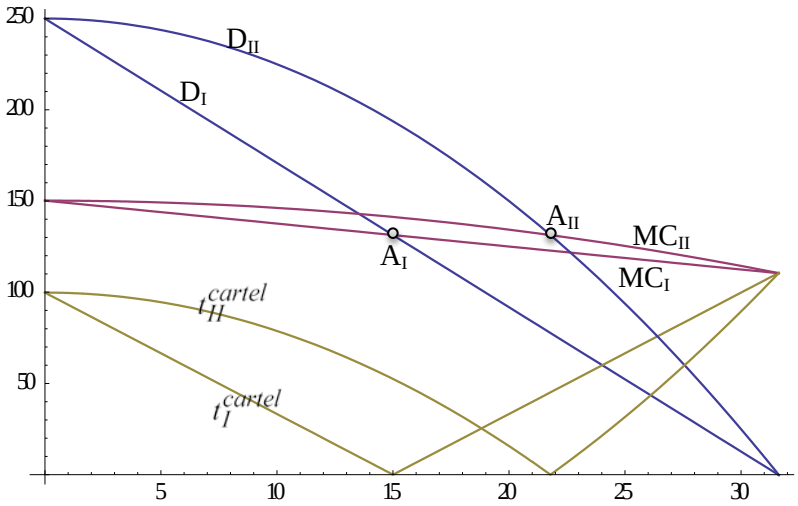


Table 4: Equilibrium Results Including Regulatory Tax Rate t^{cartel}

Equilibrium Results	Non-collusive Bertrand oligopoly Collusive Cartel facing D_I	Collusive Cartel facing D_{II}
Quantities and Price: (Q^*,P^*)	Scenario D_I: (15.0, 131.3)	Scenario D_{II}: (21.79, 131.3)
Suppliers' Profits	$\Pi^*= 0$	
Consumers' Rent	CS_{DI} = 890.18	CS_{DII}= 1724.52
Tax revenue	T_I^E = 981.75, T_I^U = 313.22, T_I^{cartel} = 0	T_{II}^E =1426.16, T_{II}^U =454.87, T_{II}^{cartel} = 0
Aggregate Welfare	Scenario D_I: 2185.15	Scenario D_{II}:3605.55
Welfare Loss	**Δ 0%**	

Thereby, as has also been illustrated in Section 2.4, Figure 7 in combination with Table 4 portrays how collusive behavior becomes unprofitable and its negative effects on society's welfare are successfully avoided. Table 5 presents the results regarding the scenario of charging inflated wholesale gasoline price c^{free} compared to charging the actual cost c.

Table 5: Equilibrium Results Including Regulatory Tax Rate t^{cartel}

Equilibrium Results	Charging $c = 45$	Charging $c^{free} = 55$
Market price (p^c vs. p^{free})	Scenario D_I: 131.3 Scenario D_{II}: 131.3	Scenario D_I: 143.22 Scenario D_{II}: 143.22
Quantity supplied (x^c vs. x^{free})	Scenario D_I: 15.0 Scenario D_{II}: 21.79	Scenario D_I: 13.5 Scenario D_{II}: 20.67
Tax rate paid	0	0
Tax rate due		$\Delta C = 10$
Evaded tax volume		Scenario D_I: 135 Scenario D_{II}: 206.7

4 Results and Discussion

The analysis of the previous section greatly draws from the propositions and findings of Adelman (1978) when it comes to choosing the proposed policy measure. Some might argue that this is a very confined view. However, even Danielsen (1979) does not question the concept of successfully skimming a cartel's profits through implementing an ad valorem regulatory tax scheme (Adelman 1979) in the course of his critical comment on Adelman's paper. He mainly questions whether all nations in demand of OPEC supply could uniformly consent to implementing such a tax policy. However, this problem certainly does not arise in case of the gasoline retail market as the regulatory policy proposed in Section 2 deals with a cartel comprised of companies instead of sovereign nations such as OPEC. Moreover, the work of Delipalla (1992) also provides additional grounds in favor of implementing an ad valorem tax policy to do away with market distortions, given certain market conditions. In her paper Delipalla shows that, under imperfect competition, an ad valorem tax scheme renders optimal

results in terms of improving social and consumer welfare. Naturally, there are also market conditions under which findings can be exactly the opposite, as Vetter (2013b) proves in his paper on endogenous competition in a Bertrand-Edgeworth duopoly. Nonetheless, in his paper on taxing a monopoly (Vetter 2013a), Vetter's finding directly support the findings made in the previous sections, as in his model, a variable tax rate also serves to improve welfare, both in a monopoly as well as in certain types of oligopoly settings. However, the question remains whether there are other policy measures at hand that would render a better regulatory performance than the one proposed in the previous sections. While Haucap and Mueller (2012) as well as Berninghaus et al. (2012) find that none of the other currently available regulatory measures, as mentioned in Section 2, renders satisfactory results, Dewenter and Heimershoff (2012) draw a less radical conclusion when it comes to the Austrian rule. This means that their empirical analysis indicates that limiting the number of per day price increases might indeed hamper collusive behavior. However, neither is this result a unanimous finding of all the seminal literary sources in question, nor do these findings directly oppose the findings presented in Section 2. In addition, one might now ask oneself whether current European competition law, i.e. 101TFEU and 102TFEU, or national competition law, such as §20GWB (3) in case of Germany, might not suffice and, hence, render any further regulations as proposed in Section 2 obsolete. However, both Luxembourg and Austria are EU member states and have, at the same time implemented regulatory measures to fight collusive behavior in their national gasoline retail market (Haucap and Mueller 2012). This might serve as a valid indicator on how vanishingly low the chances of successfully prosecuting collusive behavior within the gasoline retail market under these given competition laws really is. The legal setting is identical and, hence, no better for any other EU member state, such as Germany and its competition authorities. Therefore, the need for implementing a regulatory policy scheme such as the alternative presented in this paper cannot be refuted.

Another aspect might lie in the question whether the existence of price wars as discussed by Slade (1992) or Schendel and Baslistrada (1969) or the appearance of price cycles such as described by Maskin and Tirole (1988), Noel (2007), or Wang (2009) might pose a problem when implementing the proposed regulatory tax policy. While the former phenomenon has already been discussed in *Lemma 1* of Section 2.4, the latter issue is primarily based on the fact that demand for gasoline

is not just relatively inelastic (Haucap and Mueller 2012) but that, due to its particular characteristics, its elasticity actually fluctuates. Intuitively speaking, these fluctuations can be, e.g., either time-induced or location-induced. For instance, if you own a gasoline fueled vehicle and use it in your everyday life, time-induced fluctuation might stem from holiday season or adherence to common work schedules and location-induced fluctuation might result from the lack of exit possibilities on a highway you are driving on. Hence, if all suppliers are able to anticipate when and/or where a large number of their customers are in fairly desperate demand of the good in question and cannot postpone that demand due to exogenously given time restrictions, prices and profits can be increased through a time- or location-specific price increase. If companies successfully engage in coordinating their pricing strategies within these cycles a collusive cartel emerges (Wang 2009). The question of how such tacit collusion can be successfully tackled remains highly debated upon (Posner 2001 in Wang 2009, Turner 1962 in Wang 2009). However, upon having taken a look at the analysis presented in the previous section of this paper, it seems as though, regarding the debate on whether and how to successfully tackle tacit collusion, a new alternative has been brought to the table. In short, the latter statement is based on the following reasoning: In accordance with the analysis presented by Adelman (1978), the proposed variable tax scheme renders tacit collusion an unprofitable business. In addition, it puts an additional cost on predatory pricing. Moreover, cartel members cannot shift profits to the wholesale market by inflating marginal costs as that would result in knowingly aiding and abetting tax evasion. However, as long as companies do not inflate wholesale prices, they can charge any retail market price p they deem apt but they not only have to transfer resulting VAT but also regulatory tax t^{cartel}. Hence, companies remain free of choice, while the underlying regulatory framework is designed as such that, in equilibrium, the Bertrand oligopoly outcome is reached at an optimal regulatory tax rate level of $t^{cartel} = 0.$

5 Conclusion and Policy Implications

As the analysis in this paper has shown, a successful regulation of the retail gasoline market is not only vital to avoid unnecessary economic welfare losses to

society but it also appears feasible. According to seminal research, virtually all of the various regulatory instruments currently in place, such as the Austrian rule, the Fuel-Watch-Concept in Australia, or price ceilings in Luxembourg, have not led to satisfactory results (Berninghaus et al. 2012, Haucap and Mueller 2012). Hence, it has been the goal of the analysis presented in this paper to identify a policy measure that proposes a both valid and promising regulatory alternative. This has been successfully achieved in Section 2 as the proposed tax scheme has proven to render inefficiently high market prices unprofitable and, in addition, to increase costs of cartels' punitive reactions to defection as well as to strengthen the position of the competitive fringe. However, there are always at least two sides to every story. Hence, Section 4 critically evaluates the regulatory policy instrument proposed in Section 2 of this paper. However, the main idea and findings of the proposed regulatory scheme appear to have successfully withstood the test. The former can be summarized as follows: The main idea was to identify an alternative policy measure that squeezes Cartel's profits, increases consumer welfare and fosters competition within the market. As shown by the analysis presented in this paper, all of these targets can be successfully accomplished by the proposed policy scheme. It does so by taking a different approach based on the theory of M.A. Adelman (1978) while, at the same time, taking into account Buchanan's (1969) findings on the effect of imperfect competition on optimal tax rates. Results show that the proposed regulatory tax scheme successfully manages to render collusion an unprofitable endeavor. In addition, selling gasoline to companies of the competitive fringe at wholesale prices above marginal cost could now even be prosecuted under well-established laws of tax evasion. So far, such a behavior, although common and well-known to regulation authorities, cannot be reasonably prosecuted under competition law,[11] although it substantially hampers competition within the gasoline retail market (Dewenter and Heimeshoff 2012, Bundeskartellamt 2011). Moreover, sanctioning defective cartel members or harming the competitive fringe through predatory, i.e. below marginal cost pricing, becomes additionally costly under the proposed tax scheme. Last but not least, the

[11] As, despite of 101TFEU, 102TFEU, or §20GWB (3), prosecution under these competition laws appears tedious in case of both gasoline wholesale and retail price setting behavior, although, in case of wholesale prices that hamper competition, initial steps have been taken by German competition authorities in early 2012. So far, however, there has, been no conviction.

proposed tax scheme appears applicable as gasoline stations' cost structures and gasoline retail prices are well documented and monitored via standard gasoline stations' computer-based management software solutions (see Footnotes 7 and 8) and thereby, on demand, also highly transparent to regulation authorities (Haucap and Mueller 2012, Bundeskartellamt 2011 and 2013). As a result, the imminent vice of the gasoline retail market, i.e. the transparency that enables tacit—and therefore non-prosecutable—collusion, turns into a regulatory virtue as it becomes a powerful means to successfully tackle imperfect competition and to bring about an efficient market outcome.

Acknowledgements I would like to express my gratitude to Ralf Dewenter, to Michael Hesch, as well as to the two anonymous referees of Economics, the Open-Access, Open-Assessment E-Journal, as their constructive comments greatly improved the scope and structure of the analysis presented in this paper.

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