

Wein, Thomas

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by  
Thomas Wein

University of Lüneburg  
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# **Microeconomic Consequences of Exemptions from Value Added Taxation – The Case of Deutsche Post**

Thomas Wein\*

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\*Prof. Dr. Thomas Wein  
Leuphana University Lueneburg  
Institute of Economics  
PO Box 2440

D-21314 Lueneburg  
Germany  
++4131/6772302 (phone)  
++4131/6772026 (fax)  
[wein@leuphana.de](mailto:wein@leuphana.de)  
<http://www.leuphana.de/institute/ivwl/abteilungen/wirtschaftspolitik/startseite.html>

## Abstract

The exemption for Value Added Taxation (VAT) can be used to pursue distributive objectives. Goods like food, housing, medicine, or infrastructure services (water, telecommunication, postal) are very often partially or totally exempted from VAT. The exemption of infrastructure services had been frequently combined with market entry restrictions. Both instruments should assure the fulfilling of the universal service obligation (USO). VAT-exemption leads to two problems, at least: (i) the expectable financial gain, which can be achieved by the exempted firm, is unpredictable, and (ii) the welfare consequences depend on the prevailing type of market structure (competition, monopoly with or without price discrimination, or dominant firm). The VAT-exemption for German postal services can be seen as an outstanding case study to show the typical consequences. Because of empirical references for intensive use of price discrimination by Deutsche Post AG and strong arguments of Deutsche Post AG as a dominant firm welfare could be increased by abolishing VAT-exemption without abandoning USO.

## Zusammenfassung

Vielfach werden sektorale Mehrwertsteuerbefreiungen mit der Verfolgung verteilungspolitischer Ziele begründet. Gerade für Güter wie Nahrungsmittel, Wohnen, Gesundheits- oder Infrastrukturdienstleistungen (Wasserversorgung, Telekommunikation, Postdienste) gilt/galt ein reduzierter Mehrwertsteuersatz oder die Mehrwertbesteuerung entfiel/fällt vollständig. Die steuerliche Begünstigung von Infrastrukturgütern wird/wurde häufig mit Marktzutrittsbeschränkungen kombiniert. Beide Instrumente zusammen sollen verteilungspolitische Ziele im Raum, sogenannte Universaldienstverpflichtungen, erfüllen. Mehrwertsteuerbefreiungen führen einerseits dazu, dass der finanzielle Vorteil des Befreiten kaum vorhersehbar ist, und andererseits die Wohlfahrtswirkungen der Befreiung von den geltenden Marktstrukturen (Wettbewerb, Monopol, Markt mit dominanter Firma) abhängen. Die in Deutschland reformierte, aber immer noch bestehende Befreiung der Deutschen Post AG ist ein hervorragendes Beispiel, um die typischen Konsequenzen einer solchen Form der Verteilungspolitik zu beschreiben. Da die Deutsche Post AG erhebliche Möglichkeiten zur monopolistischen Preisdifferenzierung besitzt und einiges dafür spricht, dass sie sich als dominante Firma verhalten kann, würde die Wohlfahrt bei Wegfall der Mehrwertsteuerbefreiung ansteigen, ohne die Finanzierungsgrundlage für die Universaldienstverpflichtung zu beeinträchtigen.

JEL-classification: L51, L87, K23

## **1 The Problem**

Universal service obligation (USO) usually means that all customers – low and high cost - will be served in a special market without discrimination which should be implemented by some/one firm(s) in the market. USOs are quite common in markets which were formerly dominated by public utilities (energy, postal services, public transportation, telecommunication, etc.). Market opening would cause unfair competition, if USO is not eliminated: The former monopolist has to bear additional costs which must not be burdened by the competitors. “Pay or play regulation” can be an alternative to fulfil USO without distorting competition: Suppliers which are providing services for high cost customers (play) are rewarded by reduced financial duties (pay). Reduced financial burden can be reached by an exemption for value added taxation (VAT). Not to be revenue-taxed allows to reduce prices or to finance additional costs. The objective of this paper is whether such kind of pay or play regulation could be a better alternative than franchise bidding. Franchise bidding means that state issues an invitation to tender about fulfilling USO and accept the tender with the lowest financial subsidy. This general question will be discussed for postal services in Germany, which are VAT-exempted if the USO is fulfilled.

Germany is one of the few countries in the European Union which has legally opened his market for postal services until now (see Monopoly Commission 2009, marginal notes 4-5). Since the beginning of 2008 private competitors are allowed to serve postal services without any restrictions. Before the year 2008 the incumbent, German Mail Public Limited Company (DPAG), was legally protected against competition in the case of offering letters below 50 g (“Exklusivlizenz”, exclusive licence). This legally protected monopoly status was disclaimed politically as a necessary financial compensation given to DPAG to fulfil the German USO. Additionally, the DPAG was exempted from Value-Added-Taxation (VAT) to finance the German USO. After different federal governments and political parties had made several proposals for a reform of VAT (Bundesregierung 2008, and F.D.P. 2009), the exemption from Value-Added-Taxation (VAT) was legally extended to all firms which partially or completely provide German USO at the end of June 2010. Thus, DPAG or competitors are currently not obligated to charge VAT, if they provide several universal service items (letters, parcel up two kg, or else) to all German households in a non-discriminating way.

No VAT-exemption for USO-firms could have several implications which should be evaluated. First, the typical VAT-system allows to deduct VAT paid for non-labor inputs. This deduction can be seen as additional revenues, which lessens the burden of VAT for firms. The more a firm uses higher shares of labor inputs, the more important the VAT-burden is. Second, the consequences of VAT depend on the type of customers: If customers are obliged to charge VAT, they are able to deduct VAT paid to USO-firms. These customers are only interested in net prices. VAT-exempted USOs incur a competitive disadvantage. Third, VAT-indebted USO firms could react by diminishing its net prices, especially for VAT-excepted customers. This strategy depends on the possibilities for firms to discriminate between excepted and indebted customers. Fourth, the competitive situation in the customer markets influences the consequences of the taxing system: For example, if the competitors of the dominant USO-firm behave as fringe firms, they decide about the price level. VAT-indebted fringe firms face higher costs. Thus, the price for all firms increases. All four aspects should be recognized simultaneously.

This paper is organized as follows. Chapter 2 will explain the German USO, including the VAT-exemption until June 2010 and the new legal situation, which is valid since July 1<sup>st</sup> 2010. Based on the model of Choné et al. (2000), the principles of VAT will be shown in section 3. Using standard microeconomic tools and assuming different market structures we are going to explain the consequences of VAT and VAT-exemption (chapter 4). Section 5 empirically describes the market structure of German postal services. Depending on the prevailing market structure we are able to derive expected consequences of no VAT-exemption. Chapter 6 contains some conclusions.

## **2 USO for postal services in Germany**

Paragraph 11 of German Postal Law (PostG) codifies that postal services, which are indispensable, should be supplied nationwide with a specific quality and affordable tariffs. The German legal ordinance for postal services and USO (PULDV) explicates, that letters up to two kg, parcel up to 20 kg, newspaper/journals, registered mails, cash on deliver items, and express items are included by the USO. The incumbent DPAG has to provide a nationwide network of branch offices. Letters should reach recipients one day after delivery in eighty percent of cases, and two days after delivery in 95 percent of cases. The DPAG has put out

several negotiated agreements additionally, for example concerning the network of letterboxes.

If the USO is not assured within a competitive environment, especially the incumbent DPAG declares that he is not able to fulfil this obligation, PostG shows two alternatives approaches (§§ 11-17):

- Supplier which has significant market power could be committed to provide the universal service by the regulation authorities. Given that case the supplier is entitled to receive back the long run incremental costs of efficient provision.
- The regulation authority puts out the universal service to the suppliers which charge the lowest costs.

The expenses for universal services will be proportionally refinanced to turnovers (universal tax) if the supplier reaches more than € 500 000 revenues per year. Both approaches are in force since the beginning of 2008.

Until now the DPAG has not used the possibility declaring to give up USO. The DPAG argues to be exempted from VAT in “exchange” for USO. According to § 4, 11 b UStG (Value Added Tax Law) turnovers created by DPAG and directly connected to the postal services were not taxed by VAT until June 2010. National stamps were also free from VAT (§ 4, Nr. 8i UStG). Hence, the DPAG did not charge VAT for all turnovers which were associated with USO. But two exceptions were given:

- Parcels which were posted by business units and were not delivered to public desks were taxed by DPAG.
- Directed catalogues did not belong to USO, but DPAG did not levy VAT if catalogues have a weight less than 1 kg.

For all turnovers which are not taxed by DPAG the incumbent DPAG is not able to realize deduction of input taxes. Thus, the value added taxes of non-labour inputs, which are used to fulfil USO, must be born by the incumbent. The DPAG suffers a cost disadvantage. Because the competitors were not exempted, they had to charge value added tax. If the customers of the competitors were able to deduct input taxes the disadvantage “VAT” turns back for the competitors: They can compete with a lower net price for postal services which are part of USO. In case of the impossibility to deduct input taxes the incumbent DPAG has an advantage with lower tariffs for universal postal services. This advantage must be relevant for private households, administrations, churches, and VAT-exempted sectors (bank,

insurance, charities, hospitals, medicals, and educational institutions). But if we look on local postal service markets, the services of competitors are very often used by VAT-exempted firms. This paradox can be probably explained by other cost factors (labour) which beat down their tariffs.

Since July 1<sup>st</sup> 2010 § 4, 11 b UStG (Value Added Tax Law), which exempts postal services from VA-Taxation, has been valid for firms providing universal services all over the country. Following a decision of the European Supreme Court, VA-Taxation will also be cancelled, if parts of universal services are supplied. Thus, in case of a nationwide provision competitors are exempted, if they convey letters up to two kg, parcel up to 10 kg, addressed books, catalogs, newspapers/journals until two kg, registered mails, and consignment of valuables. Parcels between ten and 20 kg, addressed books, catalogs, newspapers/journals more than two kg, express items and cash on deliver items are taxed by the complete VAT-rate. These items still are part of USO but are no longer VAT-exempted. Independent of conveyed items VAT-exemption is no longer given, if the postal service provider concludes individual contracts or supply with different quality conditions or lower tariffs by using general terms and conditions.

### **3 Universal Service Obligation and the Objective of VAT-exemption**

In the past, public utilities very often had the obligation to supply their services to all customers at affordable tariffs (universal service obligation; USO). Charging common prices although the costs were different between the consumers (cross subsidization) allows to finance USO. In case of abolishing market entry barriers competitors would supply low cost consumers with low prices (cream skimming). Public utilities would suffer losses and have to leave the market. Choné et al. (2000) assume a market with one network good. A competitor is able to enter this market. Both firms can serve two customers which are located in different regions. Customers, who consume  $Z^{\text{HC}}$  live far away, therefore they cause high network connection costs. Low connection costs are associated with  $Z^{\text{LC}}$ , customers with  $Z^{\text{LC}}$  are located close to the network.

Figure 1 shows both markets in the case of perfect competition (see also appendix 1). Thus, the marginal costs of the firms are represented by the (upward running) supply curves,  $S^{\text{HC}}$

and  $S^{LC}$ ,  $D^{LC}$  and  $D^{HC}$  illustrate typical demand curves, assumed to be identical for simplicity. Under such conditions the equilibrium points A and B are relevant with the corresponding prices ( $P^*$  and  $P^{HC}$ ) and quantities ( $Z_A^*$ ,  $Z_B^{HC}$ ). Choné et al. (2000) distinguish between two conditions for USO: Ubiquity “U” (all customers must be served) and ubiquity combined with non-discrimination “UND” (all customers must be served by tariffs). Condition “UND” can be explained by figure 1: All high cost customers must be served at the price of  $P^*$ . But  $P^*$  is too low to cover cost of  $Z_B^{HC}$ . Hence, the USO can be assured by

- forbidding any competitors to supply  $Z^{LC}$  (restricted entry regulation),
- opening both markets and organizing franchise bidding for  $Z_B^{HC}$ . To secure supply of  $Z_B^{HC}$  an auction must be organized which asks for the (lowest) subsidy  $P^*HEA$ ,
- establishing pay or play regulation. The market for  $Z^{LC}$  is not subjected concerning the supply. If a competitor serves the market  $Z^{HC}$  by charging price  $P^*$  it will be relieved to pay, for example to pay value added taxes.

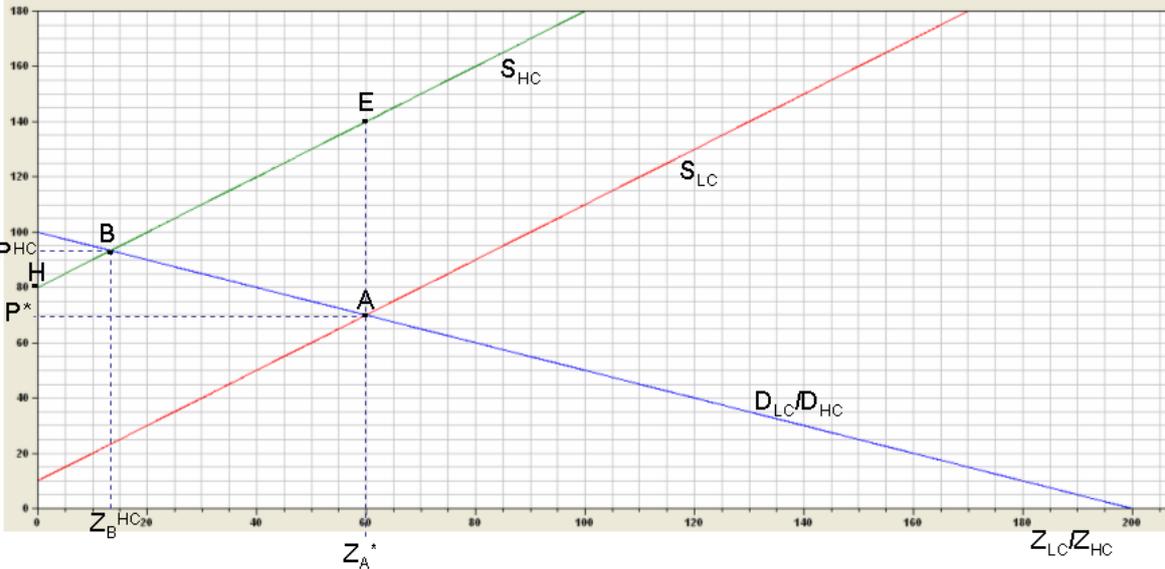


Figure 1: USO and Perfect Competition

**4 Microeconomics of Value Added Taxation**

**4.1 Perfect Competition**

Figure 2 shows a general framework to explain VAT. The first stage represents the upstream market which delivers intermediate goods for the downstream market 1. The downstream market produces for private consumers or for another downstream market 2. We assume that

the typical European VAT subtraction method is used by fiscal authorities (for example Metclaf 1995): Firms are only taxed by their value added measured by the difference of the value of sold and purchased goods. In economic terms, the subtraction method leads to a taxation of the market based revenues minus the expenses for all non-labor inputs. Downstream firms are allowed to deduct capital expenditures. Downstream firms are sometimes exempted from VAT, but private customers are always non-rated.

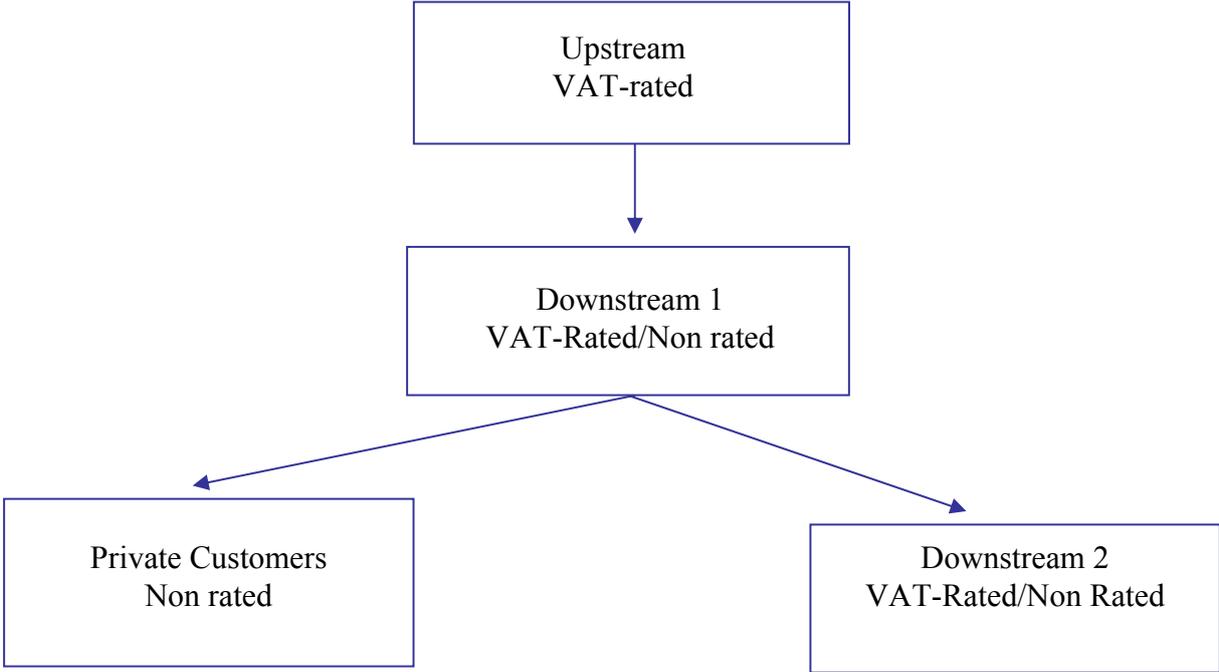


Figure 2 General Framework for VAT

In the first step, Figure 3 shows the situation in which upstream (U) and downstream (D) firms are rated with the ad valorem tax rate  $t$  (see also appendix 2). Assuming the existence of a tax rate  $t$ , demand curve is given with  $D^U(1-t^U)$  in figure 3. Because of assuming perfect competition the supply curves  $S^U$  represents the aggregate marginal costs. Points A and B indicate the upstream market equilibrium with gross price  $P_G^U$  and net price  $P_N^U$ . Paid value added taxes are  $Z_B^U \cdot t^U$ . Downstream firms use intermediate goods  $Z^U$  for producing final goods  $Z^D$ . The rated downstream firms are able to deduct paid value added taxes. Thus, they can calculate with the net price  $P_N^U$  which internally represents constant marginal costs  $MC^U$ . This marginal cost must be added to the supply curve  $S^D$ . Because of ad valorem taxation in the downstream market the new equilibrium point is G with gross price  $P_G^D$  and net price  $P_N^D$ . Value added taxes, which are generated because of the existing downstream market, equate rectangle  $Z_G^D \cdot t^D$ .

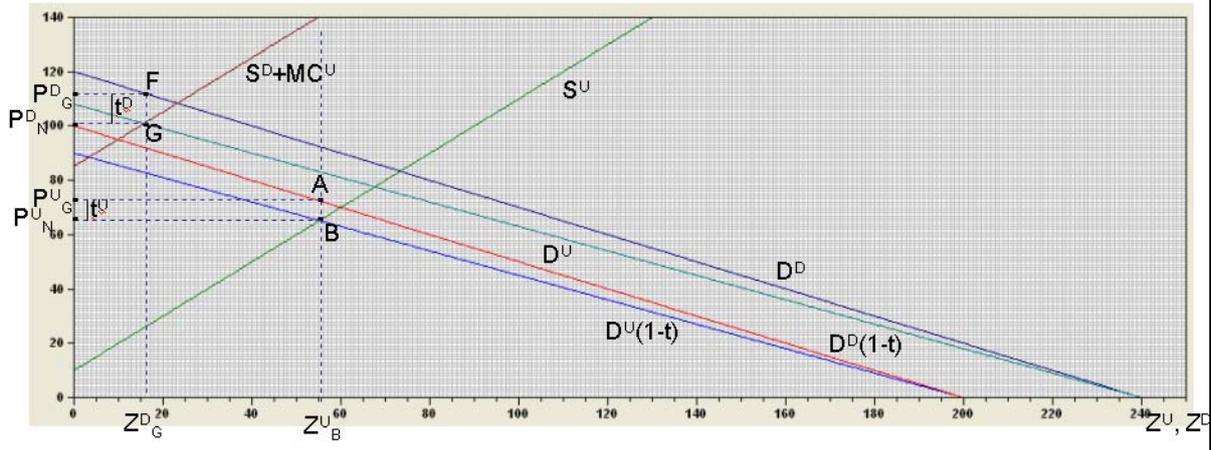


Figure 3: Upstream and downstream VAT – Perfect Competition

In the second step, if downstream firms are not rated they have to calculate with the gross price  $P^U_G$ , which equals  $MC^U$  plus  $t^U$  (see figure 4 and also appendix 3). The market equilibrium is given by G, which leads to the uniform price C and the quantity  $Z^D_G$ . Comparing both situations it becomes obvious that non-rating firms decrease prices and increase quantities in the area of downstream. Profits, which can be simplified measured by producer surplus, increase from triangle  $P^D_N L J$  to triangle CGM. The state incurs a loss of paid VAT at downstream stage  $t^D \cdot Z^D_H$  and gains paid taxes at upstream by the rectangle RSTU. Thus, a very low increase of downstream profits causes high tax revenue reduction. The consumer gains consumer surplus by the area  $P^D_G H G C$ . Assuming that instead of VAT exemption a franchise bidding auction leads to the same profit increase for USO fulfilling downstream firm, the rectangle  $P^D_G H K N$  (+6.34 by any quantity of  $Z^D_H$ ) can be calculated as additional welfare (more tax revenues, omitted consumer surplus), ignoring the tax burden caused by levying taxes to finance subsidy. Summing up, it can be said that pay or play regulation by VAT-exemption seems to be a very inefficient solution. Furthermore, it is difficult to anticipate the additional profits for regulators.

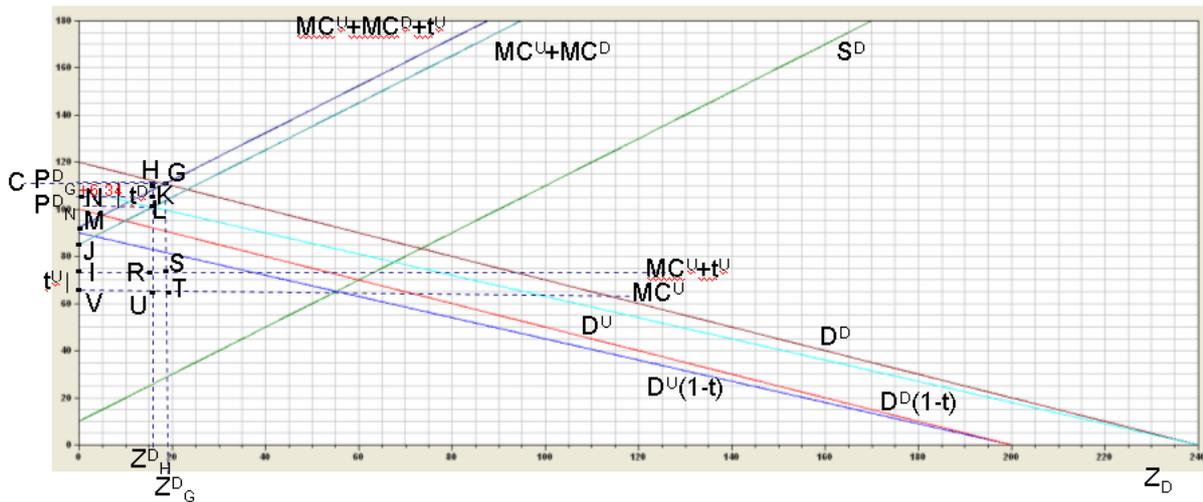


Figure 4: Financial benefits of VAT-exemption – Perfect Competition

## 4.2 Monopoly

It is possible that a monopoly is given in the downstream market. Assuming that ad valorem taxation is implemented, the demand curve must be written as  $D^D(1-t^D)$  (see figure 5). To behave as a monopolistic downstream firm leads to the corresponding marginal revenue curve  $MR^D(1-t^D)$  (see also appendix 4).

A rated downstream firm is able to deduct paid value added taxes from the upstream value added step. Thus, downstream firms are only burdened with upstream and downstream marginal costs ( $MC^U+MC^D$ ). Equalizing marginal revenues with these marginal costs determines equilibrium point H, which is connected to gross price  $P_G^D$ , net price  $P_N^D$ , and quantity  $Z_H^D$ . Value added tax revenues are given by  $P_G^D K A P_N^D + I R U Q$ . Profits can be calculated by  $P_N^D A H T = (P_N^D - M) Z_H^D + M H T$ . Consumer surplus would be presented by  $F K P_G^D$ .

A non rated downstream firm cannot deduct paid value added taxes. Consequently, the relevant marginal costs are  $MC^U+MC^D+t^U$ . In case of VAT-exemption the “original” demand curve  $D^D$  is given, followed by marginal revenue curve  $MR^D$ . The objective of profit maximisation leads to intersection point B, which is connected to price  $P^G$  and quantity  $Z_B^D$ . Value added tax revenues can only be expected on upstream stage by  $I S J Q$ . Profits are equal to triangle  $P^G G E$ . Thus, consumer surplus will be measured by  $F G P^G$ .

The welfare consequences which have to be expected in case of changing from the case “with exemption” to the case “without exemption” are higher tax revenues, lower profits, and

decreasing consumer surplus. Assuming a situation like in figure 5 the aggregated welfare consequences are negative, but low. Dividing this negative value by  $Z_H^D$  leads to  $VWKP_G^D$  (-0.2 per rata  $Z_H^D$ ). In other words, in case of the existence of monopoly the abolishing of VAT-exemption causes a welfare loss. This could be interpreted as a typical second best result: Two aberrations from perfect competition (“VAT-exemption and monopoly”) are better than one (“monopoly”). In reality, most infrastructure monopolists are not allowed to charge monopoly prices. Price cap regulations are rather very often implemented. Probably, as more as this regulation creates results as under perfect competition, the second best result as mentioned above disappears.

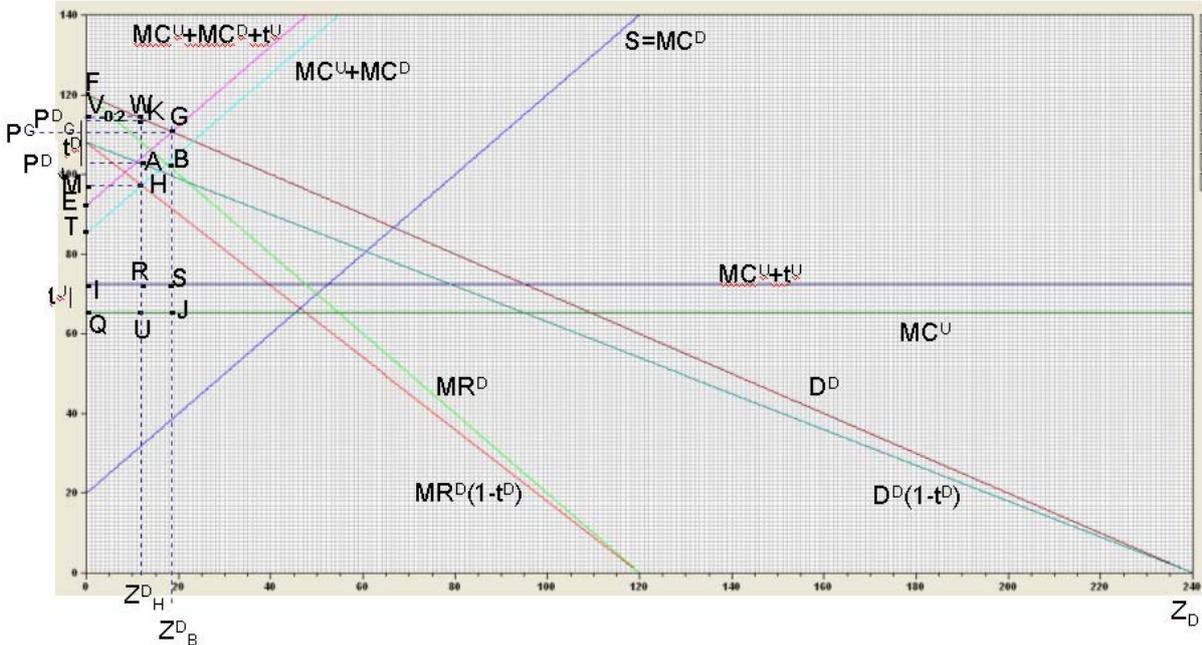


Figure 5: VAT and Monopoly

**4.3 Price Discrimination**

The consequences of VAT also depend on the question to what extent suppliers have monopoly power and are able to discriminate consumers. Looking on figure 6 we can see that two groups buy products  $Z_1^D$  and  $Z_2^D$ , respectively. Their demand curves are given with  $D_1^D$  and  $D_2^D$ .

Figure 6 shows the situation, where VAT-exemption is given on the downstream market (see also appendix 5). Aggregating the two demand curves horizontally leads to the dashed line  $D^D$  as demand curve. Thus, the dashed line  $MR^D$  represents the aggregated marginal revenue curve. Because of VAT-exemption downstream suppliers have to bear the value added taxes

of the upstream market ( $t_U$ ). Additionally, they are confronted with their own marginal costs ( $MC^D$ ) and the net price of upstream ( $MC^U$ ). Equalizing the marginal revenue curve with all this costs leads to point H and the shadow price K. Profit maximizing in downstream market 1 means to put the shadow price K on a level with marginal revenue ( $MR^D_1$ ). Thus, point  $H_1$  is optimal which leads to the associated price  $P^E$  and quantity  $Z_D^E$ . Maximizing profit for market 2 in the same way,  $H_2$ , L,  $P^L$  and  $Z_D^L$  are given. The VAT-exempted firm is able to extract by  $P^E$  EGA in market 1 and  $P^L$  LMA in market 2. The value added tax revenues which are caused by these two submarkets are restricted by the tax revenues on upstream market:  $ORSZ_D^E$  and  $ORTZ_D^L$ .

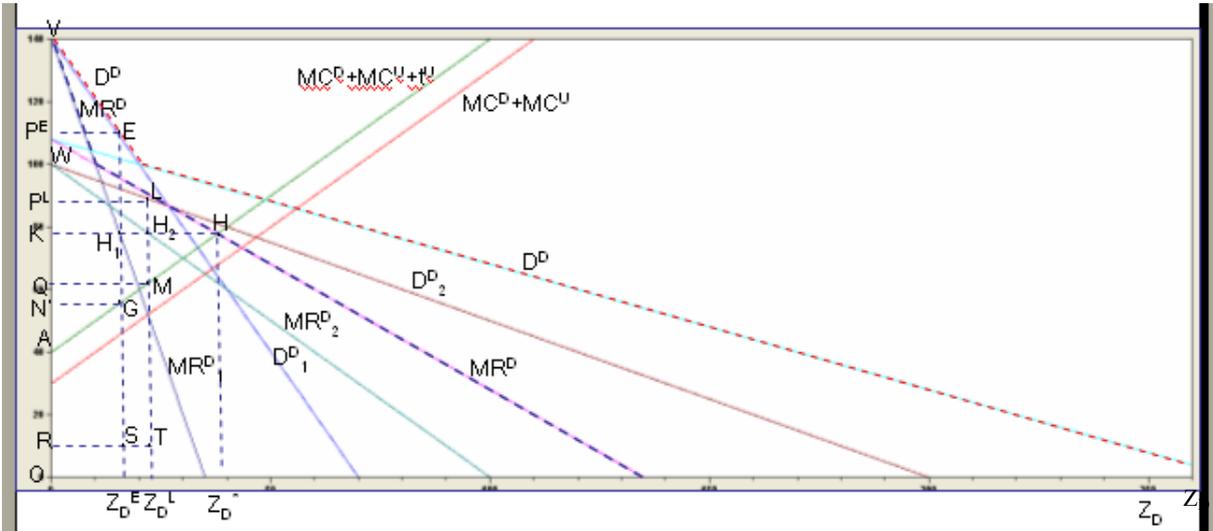


Figure 6: Price Discrimination and VAT-exemption

If both markets will be taxed by ad valorem tax  $t^D_1$  and  $t^D_2$  the derived demand curves are given by  $D^D_1(1-t^D)$  and  $D^D_2(1-t^D)$  (see figure 7 and also appendix 6). Using its monopoly power the downstream firm calculates with their marginal revenue curves  $MR^D_1(1-t^D)$  and  $MR^D_2(1-t^D)$ . In order to maximize monopoly profits both marginal revenue curves must be horizontally aggregated to  $MR^D$  and then be equated with the sum of constant marginal costs for upstream and increasing marginal costs for downstream. Point H which leads to shadow price Q indicates profit maximizing condition. Assuming that price discrimination is possible the intersection points of the marginal revenue curves with both marginal costs lead to the optimal points  $H_1$  and  $H_2$ . Thus, optimal gross price are  $P_G^D_1$  and  $P_G^D_2$ , net prices  $P_N^D_1$  and  $P_N^D_2$ , and tax rates  $t^D_1$  and  $t^D_2$ . The new monopoly profits are  $P_N^D_1 FNI$  and  $P_N^D_2 LMI$ . Tax revenues are equal to  $t^D_1 * Z_D^E$  and  $t^D_2 * Z_D^L$  (downstream), and  $ORSZ_D^E$  and  $ORTZ_D^L$  (upstream).

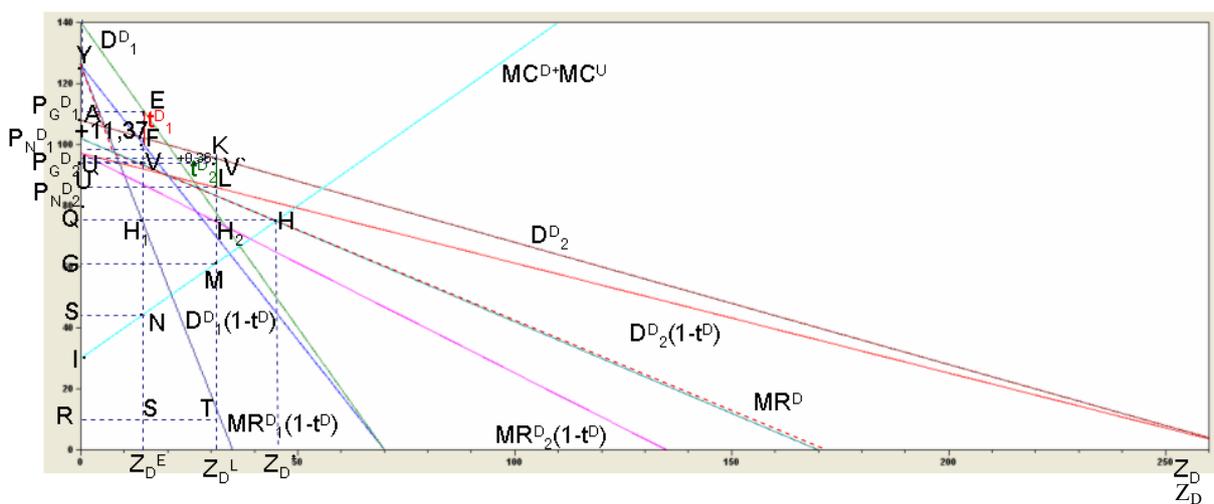


Figure 7: Price discrimination and No-VAT-exemption

By abolishing the VAT-exemption three different welfare effects are relevant. First, the profits in market 1 increase, whereas they decrease in market 2. Tax revenues will increase in both markets. Consumer surplus which are relevant for market 1 would be lower, in market 2 increasing surplus can be expected. Out weighting all three effects in both markets lead to positive welfare consequences by  $UVEP_G D_1$  (+11.37 per rata  $Z_D^E$ ) by  $U'V'KP_G D_2$  (+0,36 per rata  $Z_D^L$ ) in figure 7 (see also appendix 6).

#### 4.4 The dominant-firm model

The dominant-firm-model is based on two central assumptions (see Carlton/Perloff 2000, 107-118). On the one hand, the dominant firm is able to select prices like a monopolist. On the other hand, the dominant firm is faced with small firms which are price-takers (fringe firms). Fringe firms can reach significant market shares all together. The dominant firm equalizes marginal revenue with marginal costs taking into account the quantity supplied by the fringe firms. The more market entries expected by the dominant firm, the lower the monopoly power of the dominant firm. The market power of dominant firm may be caused by lower costs or differentiated products. Better management, patents, learning curve advantages, realized economies of scale in the past, or benefits created by the state (tax or toll advantages, previous market entry restrictions) can be important for lower costs of the dominant firm. Product differentiation means that the dominant firm produces goods at higher quality, whereas fringe firms serve market niches.

Figure 8 represents the basic model and introduces the role of VAT.  $MC_f^D$ ,  $AC_f^D$ , and  $S_f^D$  show the market conditions which are given for fringe firms. One typical fringe firm  $f$  operates according to marginal cost curve  $MC_f^D$  and to average cost curve  $AC_f^D$ . We assume that only three identical firms are active in the market. Aggregating horizontally the marginal cost curves leads to supply curve  $S_f^D$  of fringe firms.  $D^D$  represents the market demand curve. The shape of long run average cost curve ( $LAC_d^D$ ) and marginal cost curve ( $MRC_d^D$ ) indicates unlimited economies of scale at downstream stage. These cost conditions are relevant for dominant firm.  $D^D$  represents the market demand curve. If the market price is higher than or equal to  $P^1$ , the whole downstream market will be served by the fringe firms. In case of a price lower than  $P^2$  no fringe firm is willing to serve the downstream market. If prices between  $P^1$  and  $P^2$  are charged, fringe firms supply according to  $S_f^D$ . Thus, the demand curve which is relevant for the dominant firm is given by  $D_d^D$  (dashed line).  $D_d(1-t^D)$  is equal to the derived demand curve if downstream market will be taxed with  $t^D$ . Calculating marginal revenue from derived demand curve and whole market demand curve the kinked marginal revenue curve  $MR_d^D(1+t^D)$  can be drawn (also dashed line). Equalizing marginal revenue with long run marginal curve leads to point H. Thus, the gross price  $P_G^D$ , the net price  $P_N^D$  and the optimal quantity  $Z^{D*}$  can be derived. The profit of the dominant downstream firm is equal to  $P_N^D SGB$ . As far for the fringe firm, its profit is given by  $P_G^D LMP_N^D$ . Because we have assumed that three identical fringe firms exist, the sum of fringe profit is equal to three times of  $P_G^D LMP_N^D$ . Taxes revenues are created on downstream market, by  $t^D \cdot Z^{D*}$ , and, if we are looking “back” to the downstream market by  $t^U \cdot Z^{D*}$ .

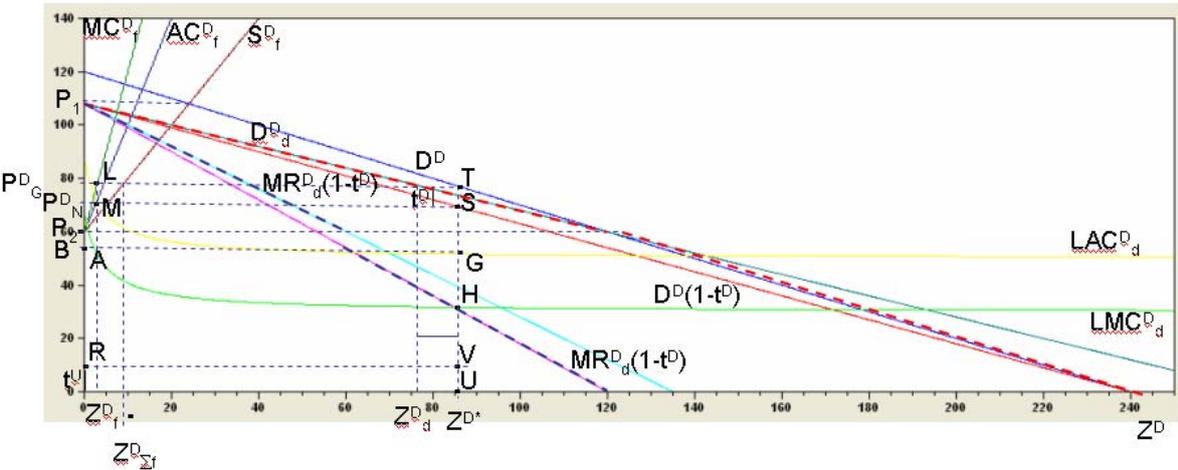


Figure 8: Dominant firm and VAT

Figure 9 represents the situation with VAT-exemption. Fringe firms are value added taxed as before, hence no change for marginal costs, average costs and their supply curve are given.

The dominant firm should be VAT-exempted. Therefore, on the one hand the derived demand curve  $D^D_d$  and the marginal revenue curve  $MR^D_d$  are given. On the other hand, because of the VAT-exemption, the upstream VAT  $t^U$  cannot be deducted. Consequently, higher marginal and average costs are inevitable. Equalizing marginal revenues with marginal costs leads to point H, profits of dominant firm by  $P^T TCA$ , profit of fringe firms  $3 \cdot (P^T LMF)$ , and tax revenues corresponding to upstream market  $t^U \cdot Z^{D^*}$  (ignoring lower additional VAT paid by fringe firms because of lower quantities in downstream markets.)

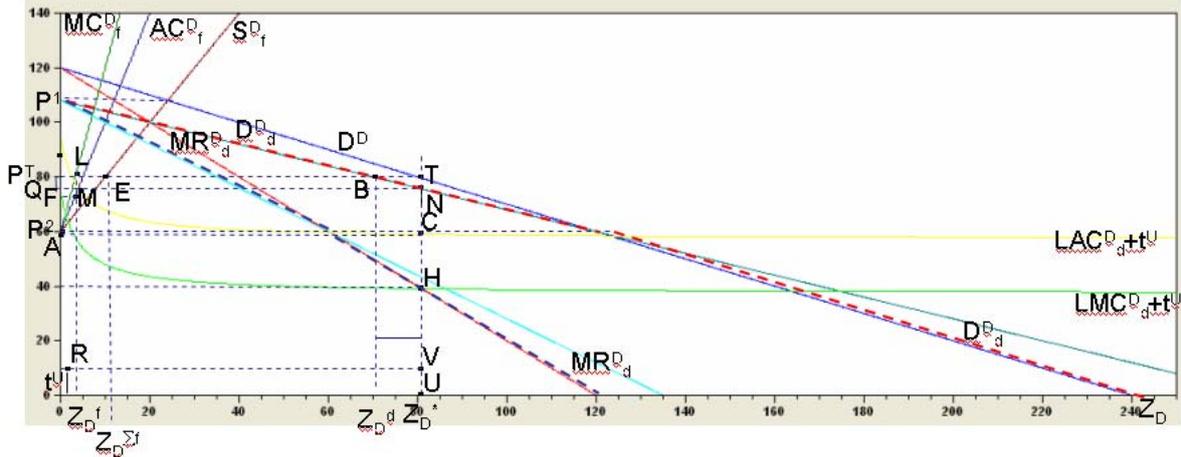


Figure 9: Dominant firm and VAT-exemption

If we compare both regimes abolishing of VAT-exemption creates lower profits for dominant firm and fringe firms, lower taxes revenues, but a little bit more consumer surplus because of lower price. In all, the society gains welfare. If we calculate this welfare effect referred to the market quantity in case of VAT, the welfare gain  $P^T TNQ (+4.13 \text{ per rata } Z^{D^*})$  would be possible.

**4.5 Market structure and VAT**

The consequences of abolishing VAT-exemption depends on the prevailing market structure (see table 1). Columns 2-4 show directions of influence in case of typical market structures. The values of column 5 are based on the assumption of special functions. Hence, the positive or negative welfare consequences are examples and cannot be generalized. In case of perfect competition lower (net) prices are decreasing the profits of suppliers, higher gross prices destroy consumer surplus, but more tax revenues will be generated. Accepting the used demand and supply conditions the enormous tax revenue increases are enough to compensate

the losses of profits and consumer surplus: the welfare effects are extremely positive. If we assume monopoly conditions, the private stakeholders worsen their positions, the state gains by additional tax revenues. Summing up by using specific functions, the welfare effects are negative, but very low. Price discrimination depends on the relevant market. The inelastic market 1 bears the same consequences as monopoly. In case of the elastic market 2 consumer and tax side will be improved, the welfare effect is positive. If we assume a dominant firm, this firm will be disadvantaged by lower profits, also fringe firms. Consumers will have benefits, and tax revenues will be higher. Assuming specific functions welfare effects are positive, but low. Summing up, abolishing VAT-exemptions of course leads to “profits” for the state because of higher tax revenues. Firm profits and consumer surplus can be influenced positive or negative depending of prevailing market condition. Without the case of monopoly we find positive welfare effects, but they could be very low.

Table 1: From VAT-exemption to No-VAT-exemption

		Profits (2)	Consumer surplus (3)	Tax revenues (4)	Welfare consequences (5)
Perfect competition		Decrease	decrease	increase	++
Monopoly		Decrease	decrease	increase	(-)
Price discrimination	Market 1	Decrease	decrease	increase	+
	Market 2	Increase	Increase	increase	+
Dominant firm	Dominant	Decrease	decrease	increase	(+)
	Fringe	Decrease			

**5 The market structure of Postal Services in Germany**

In 2009 the whole postal market created revenues of 25.4 billion €, which must be splitted between the unregulated KEP submarket (messenger, parcel and express delivery; “Kurier-, Express- und Paketdienste”; 16 billion €) and the regulated letter market (9.4 € billions) (see Bundesnetzagentur 2010, p. 139).

Looking on the KEP market in 2008, a total of 41 percent of the revenues were generated by delivery of parcels, 37% by express, and little bit more than one fifth by messenger services

(see Bundesnetzagentur 2010, p. 139). On the supply side we have several nationwide active suppliers, which are able to provide high quantities (DHL, DPD, FedEx, GLS, Hermes Logistics, TNT Express, and UPS) and small, specialized and regional restricted firms additionally, which are very often engaged in express and messenger services only (see Monopoly commission 2009, marginal note 38). Table 2 shows the market shares of competitors and DPAG since the opening of the letter market in 1999.

Table 2: Market shares in German market for letters

Year	Market shares (%)	
	Competitors	DPAG
1999	1.3	98.7
2000	1.7	98.3
2001	2.4	97.6
2002	3.0	97.0
2003	3.9	96.1
2004	5.3	94.7
2005	7.6	92.4
2006	10.7	89.3
2007	11.3	88.7
2008	10.7	89.3
2009	11,8	88.2

Sources: Bundesnetzagentur 2009, p. 27, and Bundesnetzagentur 2010, p. 142.

If the letter market will be analyzed in detail, competitors have reached a market share of 11.6 % for individual letters (2008, measured by revenues), but only 2.1 % for bulk mail (see Bundesnetzagentur 2009, p. 29-30). Concerning affidavits of service by mail (“Postzustellungsurkunden”), the regulation authority estimates competitors’ market share of a quarter in 2008 (see Bundesnetzagentur 2009, p. 34). Until the end of 2008 the regulation authority chartered 2 500 market entry licenses, a little bit more than thousand had given up their licence (1047; see Bundesnetzagentur 2009, p. 35). Not more than 750 license owners could be seen as active in the market (see Bundesnetzagentur 2009, p. 142). The licenses can be applied for one region, one federal state or nationwide; nearly 30 percent applied for region, a little bit lower for federal state level and more than 43 percent nationwide (see Bundesnetzagentur 2009, p. 36). It can be assumed by certainty that a lot of firms do not use

their approved region. Ignoring the dominant firm DPAG, the letter market can be described by a great number of small firms. In 2008 about 200 firms received revenues until 10 000 €, 127 until 100.000 €, 121 until 500 000 €, 49 until 1 million €, 109 until 10 million €, 15 until 50 million €, and 4 more than 50 million €. In Germany, the regulation authority, Federal Network Agency (BNetzA), publishes revenues and the amount of postal items on annual base. Dividing revenues by postal items leads to average prices (see Table 3). During nearly all years since deregulation the DPAG was charging lower average prices than their competitors. Only in 2003 the inverse relationship is given. But Table 3 does not differentiate between postal services submarkets.

Table 3: Average Prices in €

	DPAG	Competitors
1999	0.65	0.70
2000	0.62	0.69
2001	0.62	0.64
2002	0.61	0.65
2003	0.59	0.63
2004	0.59	0.58
2005	0.58	0.66
2006	0.57	0.69
2007	0.56	0.69
2008	0.54	0.71

Using table 4 submarkets could be identified for 2008. Columns three and four show the tariffs of the competitors, left median prices and right unweighted average prices. Column two presents the official tariffs which are charged by DPAG. But if business customers are able to sort delivered items or convey huge scales they receive rebates. Hence, business customers very often pay lower tariffs than reported in column 2.

Table 4: Prices for Postal Services in € (2008)

Letters	<i>DPAG</i>	<i>Competitors</i>	
	Official price	Median price	Unweighted average price
up to 20 g	0.55	0.42	0.41
up to 50 g	0.90	0.66	0.60
up to 100g	1.45	0.97	0.96
up to 500g	1.45	0.99	0.97
up to 1000g	2.20	1.54	1.50
more than 1000g	3.90	2.50	2.68

Comparing 2008 and 2007, the regulation authority found out that the competitors increase the percentage of using the infrastructure of DPAG (sorting centres, delivery network). Hence, it seems plausible that German market converge to the British in which there is nearly no competition on the delivery stage, but more by using infrastructure of Royal Mail. After the German Parliament had passed the new VAT-Law the incumbent DPAG announced its price reaction (see FAZ 2010). Generally, it would like to adjust her rebates to stay competitive. Granting twelve percent rebates for letters, information items and heavy parcels to major customers (conveying big quantities or prepared items) leads to stable gross prices. VAT-rated major customers receive lower net prices, because it is legally forbidden to discriminate between business customers. Addressed information items and newspapers/journals will not receive additional rebates, because non VAT-rated customers usually send these products. Moreover, the new rebates are in favour of competitors, if they are using the postal network of DPAG by consolidation. Major customers who have passed individual contracts do not receive rebates automatically. Dependent on her competitive position, DPAG is able to adjust gross tariffs as consequence of the elimination of VAT-exemption.

The different market activities have important consequences for the profitability of the firms. The DPAG reaches for letters a profit-turnover margin of 15.7 % (12.9 %) in 2008 (2007), but for the whole trust -1.0 % (5.0) (see Monopolycommisson 2009, marginal note 49). The regulation authority investigated 426 active licence owners with more than 10 000 € in 2007

and found that 41 % were working profitable, but nearly the same number made losses (39 %).

The institutional setting and the empirical facts indicate that the German postal service market could be described by the model of dominant firm. Private customers and small business customers which convey little postal items (low costs shares or low possibilities to prepare post items) effectively have no alternative to DPAG. If business customers are able to prepare postal items for local markets, they could choose between DPAG and private competitors, sometimes one supplier in a local area, other times several competitive firms. Other business customers convey nationwide postal services, the distribution channel “postal networks” are decisive for their market strategies. Examples are mail order companies or publishing houses. They are able to prepare postal items by sorting for regions and to deliver items to sorting centres. Such business customers are able to negotiate contracts individually or to claim customer specific rebates. Hence, we partially have strong competition, but the DPAG very often possesses a monopoly position. In contrary to the model of dominant firm, we are not able to identify uniform prices, which could indicate that different submarkets exist. Assuming that market for postal services in Germany can be adequately described by the theory of dominant firm, we are able to forecast positive welfare consequences in case of abolishing VAT-consequences. Positive welfare consequences mean that we are able to compensate DPAG for fulfilling USO and have further advantages by increasing consumer surplus and tax revenues.

## **6 Conclusions**

Universal service obligations are very often dictated for infrastructure services. VAT-exemptions are one instrument to finance such obligations. Such kind of “pay or play regulation” can be an alternative to fulfil USO without preventing competition. Following the German regulation tradition the DPAG was VAT-exempted until June 2010. After this date competitors could also be exempted, if they are able to fulfil USO. The microeconomic analysis shows that the abolishing of VAT exemption raises tax revenues independent of the assumed market structures. The profits and consumer surplus very often go down, but in some cases are increasing. Assuming special demand and cost functions welfare can normally be improved by complete value added taxation without reducing the “payments” for USO.

Only in the case of monopoly welfare would be lower by value added taxation. The empirical evidence indicates that the DPAD can behave as a dominant firm and/or is able to price discriminate. Thus, a full abolishing of all postal services VAT-exemptions has positive welfare consequences without jeopardizing the financial background for USO in this market. Moreover, the new tax law goes into the wrong direction. Generally spoken, franchise bidding must be preferred against VAT-exemption, a special version of pay or play regulation.

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**Appendix 1:** Calculations concerning figure 1

$$D^{LC} = 100 - 0,5Z_{LC}.$$

$$D^{HC} = 100 - 0,5Z_{HC}.$$

$$S^{LC} = 10 + Z_{LC}.$$

$$S^{HC} = 80 + Z_{HC}.$$

Equilibrium in point A:

$$100 - 0,5Z_{LC} = 10 + Z_{LC}.$$

$$Z_A^* = 60.$$

$$P^* = 70.$$

Equilibrium in point B:

$$100 - 0,5Z_{HC} = 80 + Z_{HC}.$$

$$Z_A^{**} = 13,33.$$

$$P^{**} = 93,33.$$

Subsidy requirements:

$$(80 - 70) \cdot 60 + 0,5(140 - 80) = 600 + 900 = 1500.$$

**Appendix 2:** Calculations concerning figure 3

$$D^U = 100 - 0,5Z^U.$$

$$t = 0,1.$$

$$D^U(1 - t^U) = (100 - 0,5Z^U)(1 - 0,1) = 90 - 0,45Z^U.$$

$$S^U = 10 + Z^U.$$

Equilibrium in point B:

$$90 - 0,45Z^U = 10 + Z^U.$$

$$Z_B^U = 55,17.$$

$$P_N^U = 90 - 0,45(55,17) = 65,17.$$

$$P_G^U = 100 - 0,5(55,17) = 72,415.$$

$$t^U = 7,245.$$

$$D^D = 120 - 0,5Z^D.$$

$$t = 0,1.$$

$$D^D(1-t^D)=(120-0.5Z^D)(1-0.1)=108-0.45Z^D.$$

$$S^D=65.17+20+Z^D.$$

Equilibrium in point G:

$$108-0.45Z^D=65.17+20+Z^D.$$

$$Z^D_G=15.74.$$

$$P^D_N=108-0.45(15.74)=100.917.$$

$$P^D_G=120-0.5(15.74)=112.13.$$

$$t^D=112.13-100.917=11.213.$$

Tax revenues in the downstream market:

$$t^D \cdot Z^D_G = 11.213 \cdot 15.74 = 176.50.$$

**Appendix 3:** Calculations concerning figure 4

$$P^U_G = MC^U + t^U = 65.17 + 7.245 = 72.415.$$

Equilibrium in point G:

$$72.415 + 20Z^D = 120 - 0.5Z^D.$$

$$Z^D_G = 18.39.$$

$$C(Z^D_G) = 120 - 0.5 \cdot 18.39 = 110.805.$$

Value added tax revenues without exemption:

$$t^D \cdot Z^D_G + t^U \cdot Z^D_H = 7.245 \cdot 15.74 + 11.213 \cdot 15.74 = 176.50 + 114.0363 = 290.54.$$

Value added tax revenues with exemption:

$$t^U \cdot Z^D_G = 7.245 \cdot 18.39 = 133.24.$$

Increasing tax revenues in case of abolishing VAT-exemption:

$$290.54 - 133.24 = 157.3.$$

Profits in case of non-exemption:

$$P^D_{NLJ} = 0.5(100.917 - 85.17)15.74 = 123.92.$$

Profits in case of exemption:

$$CGM = 0.5(110.805 - 92.415)18.39 = 169.10.$$

Decreasing profits in case of non-exemption:

$$123.92 - 169.10 = -36.18.$$

Omitted consumer surplus:

$$-((P^D_G - C)Z^D_H + HGL) = -((112.13 - 110.805)15.74 + 0.5(112.13 - 110.805)(18.39 - 15.74)) = - (17.065 + 4.2135) = -21.28.$$

Welfare effects of non-VAT-exemption:

$$157.3-36.18-21.28=98.84.$$

Divided by  $Z^D_H$ :

$$98.84/15.74=6.34.$$

**Appendix 4:** Calculations concerning figure 5

$$D^D=120-0.5Z^D.$$

$$t=0.1$$

*Without exemption:*

$$D^D(1-t^D)=108-0.45Z^D.$$

$$MR^D(1-t^D)=108-0.9Z^D.$$

$$MC^U+MC^D=65.17+20+Z^D=85.17+Z^D$$

Equilibrium in point H:

$$108-0.9Z^D=85.17+Z^D.$$

$$Z^D_H=12.01.$$

$$P^D_N(Z^D_H)=108-0.45(12.01)=102.60.$$

$$P^D_G(Z^D_H)=120-0.5(12.01)=114.$$

$$t^D=114-102.6=11.4$$

Value added tax revenues:

$$t^D Z^D_H+Z^D_H \cdot t^U=11.4 \cdot 12.01+7.245 \cdot 11.4=136.91+82.59=219.5$$

$$C=MR^D(1-t^D)(Z^D_H)=108-0.9(12.01)=97.19$$

Profits:

$$P^D_{NAHT}=(P^D_N-C)Z^D_H+CHT=$$

$$5.41 \cdot 12.01+0.5(97.19-85.17)12.01=64.97+0.5 \cdot 11.84 \cdot 12.01=64.97+71.10=136.07.$$

Consumer surplus:

$$FKP^D_G=0.5(120-114)12.01=3 \cdot 12.01=36.03.$$

*With exemption:*

$$MC^U+MC^D+t^U=65.17+20+Z^D+7.245=92.115+Z^D$$

Equilibrium in point G:

$$92.115+Z^D=120-0.5Z^D.$$

$$Z^D_G=18.59.$$

$$D^D(Z^D_G)=120-0.5(18.59)=110.71.$$

Value added tax revenues:

$$t^U \cdot Z^D_G=7.245 \cdot 18.59=134.68.$$

Profits:

$$P^G_{GE}=0.5(110.71-92.115)18.59=0.5 \cdot 18.59 \cdot 18.59=172.80.$$

Consumer surplus:

$$FGP^G=0.5(120-110.705)18.59=0.5 \cdot 9.295 \cdot 18.59=86.4.$$

Welfare consequences from “with exemption” to “without exemption”:

$\Delta$ tax revenues +  $\Delta$ profits +  $\Delta$ consumer surplus=

$$(219.5-134.68)+(136.07-172.80)+(36.03-86.4)=84.92-36.73-50.37=-2.18.$$

Divided by  $Z^D_H$ :

$$-2.18/12.01=-0.2=P^D_{GKVW}.$$

**Appendix 5:** Calculations concerning figure 6

Market 1:

$$D^D_1=P=140-2Z^D_1.$$

$$Z^D_1=-0.5P+70.$$

$$MR^D_1=P=140-4Z^D_1.$$

$$Z^D_1=-0.25P+35.$$

Market 2:

$$D^D_2=P=100-0.5Z^D_2.$$

$$Z^D_2=-2P+200.$$

$$MR^D_2=P=100-Z^D_2.$$

$$Z^D_2=-P+100.$$

Aggregate curves

$$D^D=D^D_1+D^D_2=$$

$$Z^D_1+Z^D_2=Z^D=-0.5P+70-2P+200=-2.5P+270.$$

$$Z^D=-2.5P+270.$$

$$D^D=P=108-0.4Z^D.$$

In detail:  $D^D=$

$$P=108-0,4Z_D \text{ if } Z_D \geq 16, \text{ else } P=140-2Z_D^D_1.$$

$$MR^D=MR^D_1+MR^D_2=$$

$$Z^D_1+Z^D_2=Z_D=-0.25P+35-P+100.$$

$$Z_D=-1.25P+135.$$

$$MR^D=P=108-0.8Z_D.$$

In detail:  $D^D=$

$$P=108-0,8Z_D \text{ if } Z_D \geq 8, \text{ else } P= P=140-4Z^D_1.$$

$$t^U=10.$$

$$MC^D+MC^U=30+Z_D.$$

*With exemption*

$$MR^D=MC^D+MC^U+t^U$$

$$108-0+8Z_D=10+30+Z_D$$

$$Z_D=37,8.$$

$$(MC^D+MC^U+t^U)(Z_D)=P=40+37.8=77.8$$

*Market 1*

Quantity

$$77.8=140-4Z_D.$$

$$Z_D=15.5.$$

Price  $P^E$ :

$$=140-2(15.5)=140-31=109.$$

Tax revenues in upstream:

$$t^U \cdot Z_D=10 \cdot 15.5=150.$$

Profits:

$$(N=(MC^D+MC^U+t^U)+Z_D=40+15.5=55.5.)$$

$$P^E EGA=(P^E-N) \cdot Z_D+NGA=(109-55.5) \cdot 15.5+0.5(55.5-40) \cdot 15.5=829.25+120.51=949.76$$

Consumer Surplus:

$$VEP^E=0.5(140-109)15.5=240.25.$$

*Market 2*

Quantity

$$77.8=100-Z_D.$$

$$Z_D=22.2.$$

Price  $P^L$ :

$$=100-0.5(22.2)=88.9.$$

Tax revenues in upstream:

$$t^U \cdot Z_D=10 \cdot 22.2=222.$$

Profits:

$$(Q=(MC^D+MC^U+t^U)+Z_D=40+22.5=62.5.)$$

$$P^L LMA=(P^L-Q) \cdot Z_D+QMA=(88.9-62.2) \cdot 22.2+0.5(62.2-40) \cdot 22.2=592.74+246.42=839.16$$

Consumer Surplus:

$$WHK=0.5(100-88.9)22.2=123.21.$$

### **Appendix 6:** Calculations concerning figure 7

With taxation

$$t=0.1$$

Market 1:

$$D_1^D(1-t)=P=(140-2Z_1^D)(1-0.1)=126-1.8Z_1^D.$$

$$MR_1^D(1-t)=P=126-3.6Z_1^D.$$

$$Z_1^D=-5/18P+35.$$

Market 2:

$$D_2^D(1-t)=P=(108-0.4Z_2^D)(1-0.1)=97.2-0.36Z_2^D.$$

$$MR_2^D(1-t)=P=97.2-0.72Z_2^D.$$

$$Z_2^D=-25/18P+135.$$

Aggregate curves

$$MR^D=MR_1^D+MR_2^D=$$

$$Z_1^D+Z_2^D=Z_D=-5/18P+35-25/18P+135=170-120/72P.$$

$$P=-6/10Z_D+102.$$

In detail:  $MR^D=$

$$P=126-3.6Z^D \text{ if } Z_D \leq 8, \text{ else } P=102-6/10Z^D.$$

Equilibrium:  $MR^D=MC^D+MC^U$

$$102-6/10Z^D=30+Z^D.$$

$$Z^D=45.$$

$$Q=30+45=75.$$

### *Market 1*

Equilibrium  $H_1$ :

$$75=126-3.6Z^D_1.$$

$$Z^D_1=14.17.$$

$$P_N^D_1=126-1.8(14.17)=100.494.$$

$$P_G^D_1=140-2(14.17)=111.66.$$

$$t^D_1=P_G^D_1-P_N^D_1=111.66-100.494=11.166.$$

Tax revenues:

$$t^D_1 Z^D_1+t^U Z^D_1=11.166 \cdot 14.17+10 \cdot 14.17=158.222+141.7=299.922$$

Profits:

$$(S=30+14.17=44.17)$$

$$P_N^D_1 FNS+SNI=(100.494-44.17)14.17+0.5(44.17-30)14.17=798.111+100.4=898.511.$$

Consumer surplus

$$UEP_{GD_1}:=0.5(140-111.66)14.17=215.38.$$

### *Market 2*

Equilibrium  $H_2$ :

$$75=97.2-0.72Z^D_2.$$

$$Z^D_2=30.833.$$

$$P_N^D_2=97.2-0.36(30.833)=86.1.$$

$$P_G^D_2=108-0.4(30.833)=95.668.$$

$$t^D_2=P_G^D_2-P_N^D_2=95.668-86.1=9.57.$$

Tax revenues:

$$t^D_2 Z^D_2+t^U Z^D_2=9.57 \cdot 30.833+10 \cdot 30.833=295.07+308.33=603.40$$

Profits:

$$(G=30+30.833=60.833)$$

$$P_N^D_2 LMG+GMI=(86.1-60.833)30.833+0.5(60.833-30)30.833=779.05+475.34=1254.40.$$

Consumer surplus

$$AKP_{GD_2}:=0.5(108-95.668)30.833=190.12$$

		Market 1	Market 2
Profits	with exemption	949.76	839.16
	without exemption	898.511	1254.40
	$\Delta$	51.25	-415.24
Tax revenues	with exemption	150	222
	without exemption	299.922	650.763
	$\Delta$	+149.92	+428.76
Consumer surplus	with exemption	240.25	123.21
	without exemption	215.38	190.12
	$\Delta$	-24.87	+66.91
Aggregate effects		176.3	80.43
	by quantity without	176.3/15.5=+11.37	80.43/22.2=+0.36
Change from “with exemption” to “without exemption”		+256,73	

**Appendix 7:** Calculations concerning figure 8

With taxation=without exemption

$$t^U = 72.115 - 65.17 = 6.945.$$

$$D^D = 120 - 0.5Z^D.$$

$$t = 0.1.$$

$$D^D(1-t^U) = (120 - 0.5Z^D)0.9 = 108 - 0.45Z^D.$$

$$MC_f^D = P = 60 + 6Z^D.$$

$$Z_{f1}^D = P/6 - 10.$$

$$Z_f^D = Z_{f1}^D + Z_{f2}^D + Z_{f3}^D = P/6 - 10 + (P/6 - 10) + (P/6 - 10) = P/2 - 30$$

$$S_f^D = P = 60 + 2Z_f^D.$$

Calculating  $P^1$ :

$$S_f^D = D^D.$$

$$60 + 2Z^D = 120 - 0.5Z^D.$$

$$Z^D = 24.$$

$$P^1 = 120 - 0.5Z^D = 120 - 0.5(24) = 108.$$

Calculating  $P^2$ :

$$60 = D^D.$$

$$60=120-0.5Z^D.$$

$$Z^D=120.$$

$$P^1=120-0.5Z^D=120-0.5(24)=108.$$

Deriving  $D^D_d$ :

$$\frac{\Delta Y}{\Delta x} = \frac{60-108}{120-0} = -\frac{48}{120} = -0.4.$$

$$D^D_d=108-0.4Z^D, \text{ if } P \geq 60, \text{ else } 120-0.5Z^D.$$

Calculating  $MR^D_d$ :

$$MR^D_d=108-0.8Z^D, \text{ if } P \geq 60, \text{ else } 108-0.9Z^D.$$

Cost structures of dominant firm:

$$LMC^D=150/(Z^D+4)+30.$$

$$LDC^D=150/(Z^D+4)+50.$$

Calculating optimal point H:

$$LMC^D=MR^D_d$$

$$150/(Z^D+4)+30=108-0.9Z^D.$$

$$Z^{D*}=84.79.$$

$$P^D_N=D^D(1-t^D)(Z^{D*})=108-0.45 \cdot 84.79=69.85.$$

$$P^D_G=D^D(Z^{D*})=120-0.5 \cdot 84.79=77.61.$$

$$P^D_G - P^D_N = t^D = 77.61 - 69.85 = 7.76.$$

Tax revenues:

$$\text{Downstream} = t^D \cdot Z^{D*} = 7.76 \cdot 84.79 = 657.97.$$

$$\text{Upstream by downstream} = t^U \cdot Z^{D*} = 7.245 \cdot 84.79 = 614.30$$

$$\text{Total} = 657.97 + 614.30 = 1272.27$$

Profits Downstream:

$$LAC^D_d(Z^{D*}) = 150/84.79 + 50 = 51.77$$

$$\text{Profit } (P^D_N - LAC^D_d) \cdot Z^{D*} = (69.85 - 51.77) \cdot (84.79) = 1533$$

Profits fringe firms:

Quantity of firm f = Point L =

$$77.61 = 60 + 6Z^D_f.$$

$$Z^D_f = 2.935.$$

$$AC^D_f(Z^D_f) = 60 + 4 \cdot 2.935 = 71.74.$$

$$\text{Profit } \pi_f = (P^D_G - AC^D_f(Z^D_f)) Z^D_f = (77.61 - 71.74) 2.935 = 17.2.$$

In case of 3 firms =  $17.2 \cdot 3 = 51.6$ .

Sum of profits:  $1533+51.6=1584.6$ .

Consumer surplus:

$$0.5(120-P_G^D)Z^{D*}=0.5(120-77.61)84.79=1797.12.$$

### **Appendix 8:** Calculations concerning figure 9

Without taxation

Optimal point H

$$\begin{aligned} LMC^D_d+t^U &= MR^D_d \\ 150/(Z^D+4)+37.245 &= 120-Z^D. \\ Z^D &= 81. \end{aligned}$$

Tax revenues, created in upstream:

$$\begin{aligned} t^U \cdot Z^D &= 7.76 \cdot 81 = 628.56. \\ D^P(Z^D) &= P^T = 120 - 0.5(81) = 79.5. \end{aligned}$$

Profit of dominant firm:

$$\begin{aligned} LAC^D_d(Z^D) &= 150/(81+4)+37.245+20=59. \\ \Pi &= Z^D(P^T - LAC^D_d(Z^D)) = 81(79.5-59) = 1660.5. \end{aligned}$$

Profit of fringe firm (VAT-fringe firm will calculate with net prices because of the possibility of deduction)

$$\begin{aligned} 79.5 &= 60 + 6Z^D_f. \\ Z^D_f &= 3.25. \\ AC^D_f &= 60 + 4(3.25) = 73. \\ \pi_f &= (79.5 - 73)(3.25) = 21.125. \end{aligned}$$

In case of 3 fringe firms:

$$3(21.125) = 63.4.$$

Sum of profits:  $1660.5+63.4=1720.9$

Consumer surplus:

$$0.5(120-P^T)Z^D = 0.5(120-79.5)81 = 1640.25.$$

Change from “with exemption” to “without exemption”

Profits	with exemption	1720.9
	without exemption	1584.6
	$\Delta$	-136.3
Tax revenues	with exemption	628.56
	without exemption	1272.27
	$\Delta$	+643.71
Consumer surplus	with exemption	1640,25
	without exemption	1797.12
	$\Delta$	-156.87
Aggregate effects: $\Delta$ without exemption		350.54
	by quantity	$350.54/84.79=4.13$

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Leuphana Universität Lüneburg  
Institut für Volkswirtschaftslehre  
Postfach 2440  
D-21314 Lüneburg  
Tel.: ++49 4131 677 2321  
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