



Institute for Strategy and Business Economics
University of Zurich

Working Paper Series
ISSN 1660-1157

Working Paper No. 84

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October 2009

RFID-based Entry into the German B2B Parcel Market and its Effect on Competitive Strategies, Prices and Market Shares: The Case of Red Parcel Post*

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Abstract

This paper analyzes the market entry of Red Parcel Post, a new player in the German Business-to-Business (B2B) parcel market. Currently there are four large service providers in the German B2B parcel market. Each of these incumbent providers operates - albeit with varying degrees of automation - with a classical multi-hub-and-spoke network. Red Parcel Post plans to enter the B2B parcel market with a completely new parcel delivery system for the delivery of B2B parcels throughout Germany based on a new transport network design, and RFID- and GPS-based operations. Such operations shall enable the entrant to offer new services to potential customers and realize lower costs and prices than the established firms. We describe the market and contrast the incumbents' and the entrant's business strategies. Moreover, we develop a model to analyze the effect of the entrant's market entry on competitive strategies, market shares, prices, costs and profits. First, we solve the game-theoretic model analytically to derive qualitative results. In a second step, we simulate market entry and competition by calibrating the model with data from the German B2B market illustrating the impact of market entry in various scenarios.

Keywords: Market entry, incumbent, competitive strategies, market shares, B2B parcel market, Cournot model, calibration

* A previous version of this article entitled "Market Entry and Competitive Strategies in the German B2B Parcel Market" was presented in May 2008 at the "16th Conference on Postal and Delivery Economics" organized by the Center for Research in Regulated Industries (CRRI). We would like to thank conference participants and especially Michael A. Crew and Paul R. Kleindorfer for helpful comments and suggestions. The conference version was subsequently published in the conference proceedings entitled "Progress in the Competitive Agenda in the Postal and Delivery Sector", edited by M. A. Crew and P. R. Kleindorfer. Publisher: Edward Elgar, Cheltenham, UK.

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1. Introduction

In this paper, we analyze the market entry of Red Parcel Post, a new player in the German Business-to-Business (B2B) parcel market. Currently there are four large service providers in the German B2B parcel market. Each of these incumbent providers operates - albeit with varying degrees of automation - with a classical multi-hub-and-spoke network. Red Parcel Post plans to enter the B2B parcel market with a completely new parcel delivery system for the delivery of B2B parcels throughout Germany based on a new transport network design, and RFID- and GPS-based operations. Instead of the classical multi-hub-and-spoke network, the network of Red Parcel will consist of only 4 hubs with no extra collection or delivery depots in the regions and instead of depots, 60 regional changeover stations are planned without warehouse or sorting devices. All parcels will be tagged with Radio Frequency Identification (RFID) tags and powerful transport optimization software (potentially GPS-based) will be used to optimize transportation and delivery of parcels to the consignees. Such operations shall enable the entrant to offer new services to potential customers and realize lower costs and prices than the established firms. Red Parcel Post intends to guarantee next day delivery (frequently a feature of express products only) and the shipment of a wide range of units (from 200 grams to more than the frequent weight limit of 31.5 kilograms). The expected price per shipment shall be approximately 10-20% less than what the incumbents can offer today. Within 4 to 5 years after market entry, Red Parcel Post expects to reach an annual sales volume of 850 million Euros, approximately 25% of DHL's current revenue in the German B2B parcel market.

In our analysis, we describe the market and contrast the incumbents' and the entrant's business strategies. Moreover, we develop a model to analyze the effect of Red Parcel's market entry on competitive strategies, market shares, prices, costs and profits. First, we solve the game-theoretic model analytically to derive qualitative results. In a second step, we simulate market entry and competition by calibrating the model with data from the German B2B market illustrating the impact of market entry in various scenarios.

Our paper differs from previous works because it takes into account a new parcel delivery system and distribution network - with inherent different cost structures than the established multi-hub-and-spoke networks. In particular, our paper differs from De Donder et al. (2002) who model the letter and Business-to-Consumer (C2C) parcel market using a Bertrand model with constant marginal costs. Their main objective is to identify optimal access charges to parcel

operators who access the letter mail network in rural areas. This paper also differs from Crew and Kleindorfer (2005) who analyze access policies and Ramsey-optimal access prices to the Postal Operator's (PO's) network. In their model, the PO has a universal service obligation in letters and parcels and enjoys a reserved area in single-piece mail only. Entrants are modelled as a competitive fringe.

Contrary to both models, our focus is not on welfare, but on business issues. In our model, the B2B market is not subject to universal service obligation (USO) or access regulations. Moreover, we explicitly model different business strategies and try to highlight the effects of entry and competition on economies of scale, prices, profits and market shares. Our model is based on the German case. Nevertheless, most results can be generalized to other markets and even other industries with similar demand and cost structures. To the best of our knowledge this is the first paper to analyze market entry and competitive strategies in the B2B parcel market.

The paper is of interest to service providers in the parcel market in general and the B2B market in particular. Recommendations can be derived for incumbent providers with respect to competitive changes they might encounter and for entrants with respect to the prerequisites for a successful market entry. Furthermore, the analysis of the products, market segments, customer requirements, and competitive situation as well as the parcel delivery systems of the established firms and the incumbent provider helps parcel customers to better understand the current development and potentially future evolution of the B2B parcel market. Moreover, the results derived from the model can support B2B parcel customers in their service provider switching decision. Finally, the paper is of interest to consultants and industry observers because it analyzes new strategies and developments in strategies and delivery systems of B2B parcel providers.

The remainder of the paper is organized as follows. In Section 2, we describe the German B2B parcel market. Section 3 presents the parcel delivery system of the incumbent operators and Red Parcel Post. In Section 4, we present our game-theoretic model and analyze the effect of the entrant's market entry on competition, prices and profits. To shed light on the effect of market entry on market shares and prospects of the incumbent operators, we present in Section 5 numerical results. Finally, Section 6 concludes our article.

2. The German B2B parcel market

To analyze the particularities of the German B2B parcel market, it is warranted to discuss developments on the parcel market and delineate the B2B market from other market segments. This will help us to better understand the market segment we try to capture in our model and make realistic assumptions for the model if needed.

2.1 Products, market segments, and customer requirements

Without exception, all studies investigating the German market for parcels indicate that the market has continuously grown over the past years and will continue to do so for the years to come (BIEK, 2007; ITA Logistics, 2005; Triangle Management Services, 2006). For example, from 2005 to 2006 the number of shipments grew from 1,952 billion to 2,043 billion accounting for an average growth rate of 4.7%, compared to an average of 3.8% between 1995 and 2006 (BIEK, 2007). Such high growth rates are at least double that of other German industrial sectors (BIEK, 2007). However, despite the difficulties to clear-cut market segments, the overall growth in the parcel market is not evenly distributed across all segments. In the next three subsections, we differentiate three important segments and examine each of them briefly.

2.2.1 Shipments from German shippers to "national" vs. "international" consignees

International and premium shipments mainly account for the high growth (Triangle Management Services, 2006). One well-known reason is the increased globalization of economic activities which result in a higher demand for international shipments. A second reason is that parcel companies which traditionally focused on the domestic market have begun to offer international products and to establish international networks. With parcel companies offering a broadened product/service portfolio and the ability to deliver parcels through high performance networks on a global scale, customers are more willing to ship international parcels. The parcel company GLS provides an example for this growth in international and express products. The company indicated that the number of national shipments in Germany has shown growth at around 2 to 3% per year, while international shipments grew at double digit rates (Triangle Management Services, 2006).

2.2.2 Standard vs. express shipments

Figure 1 shows that several parcel companies offer both, standard (deferred) and express (premium) products (ITA Logistics, 2005). In case of standard parcels, the transit time is regularly slower and not specified or scheduled. Standard products come along with a limited number of value-added services. In contrast, express products are delivered day and sometimes time-specific. Day and time specific delivery is normally guaranteed and customers may choose money-back-guarantees if service promises are not fulfilled. Value-added services include tracing-and-tracking, information or proactive feedback.

While standard parcel products account by far for the majority of shipments, profit margins are much lower than for express products. Similarly to the international segment, express shipments also grow at above average rates. On the downside for established companies, the level of competition in the express segment has increased with the entry of DPD and GLS now offering road-based express services. DPD and GLS are now aggressively seeking growth in this segment (Triangle Management Services, 2006).

Figure 1: Product Segmentation

	Service provider	Standard	Express
National	DHL	Europack	Express Paket, 9:00, 12:00
	DPD	Standard / Prepaid	G24, E10, E12
	UPS	Standard	Express Saver, Express Express Plus
	GLS	Standard	Next day Express (12:00), T10, T9, T8
	TNT		Übernacht Express, 09:00, 10:00, 12:00 Express
	GO!		Overnight (12:00)
International	DHL	Business Paket, Europack	DOX & WPX & ECX, Startday, Midday
	DPD	Standard / Prepaid	International Express
	UPS	Standard, Expedited	Express Saver, Express Express Plus
	GLS	GlobalParcel, Standard Parcel Europa	Global Express (Der Kurier)
	TNT	Economy Express	Global Express, 9:00 Express, 12:00 Express
	FedEx		International Priority, International First
	GO!		International
	Chronopost		Chrono International
Focus of this research			

Source: ITA Logistics (2005), own research

2.2.3 "Business-to-Consumer" (B2C) vs. "Business-to-Business" (B2B)

The last distinction we can make is whether the consignees are business organizations or individuals/households. The market segment for B2C parcels is larger (2004: 812 million shipments) than the B2B segment (2004: 570 million shipments). The well-known German general direct mail order firms such as QUELLE or OTTO - over decades the main shippers of parcels in Germany with an annual volume of around 400 million parcels (Klaus & Kille, 2006) - have witnessed a decline in their business. This decline goes along with a stagnation of B2C parcel shipments in Germany. As a consequence, profit margins for the established parcel carriers are low. In contrary, B2B shipments (e.g., spare parts, office supplies, restocking of retail outlets) are growing at around 4%. Here, parcel companies can differentiate and extend their service offerings, for example, offer pick-up services, delivery confirmation, or multi-parcel options.

In the following, we solely focus on the German national B2B market for standard parcels. To capture the competitive situation we first introduce the main incumbent parcel service providers (parcel operators) as well as the entrant provider Red Parcel Post, their market shares, product features offered, and business models. Subsequently, we describe the parcel delivery systems, networks and operations of the incumbent providers and Red Parcel Post.

2.2 Competitive Situation

Figures 1 and 2 indicate that there are currently four large service providers in the German B2B parcel market (ITA Logistics, 2005; Klaus & Kille, 2006). The *DHL* parcel business is part of Deutsche Post World Net, the former monopolist for letter and parcel delivery in Germany.

The liberalization of the German B2B parcel market has resulted in a decline in market share over the years. Today, DHL holds a market share of approximately 27%. *DPD* is controlled by the French national postal firm Groupe La Poste (through GeoPost, Paris, a 100% subsidiary). The firm holds a market share on the B2B parcel market of about 27%. *UPS* is a globally active integrator who also offers standard B2B parcel services in Germany, with a market share of 21%. The fourth largest player in the market is *GLS*, owned by the British national postal firm Royal Mail Group (through General Logistics Systems, Amsterdam, a 100% subsidiary). GLS holds about 14% of the German B2B parcel market.

Figure 1 summarizes the product features for standard shipments which are offered by the four

major parcel service providers in the B2B segment. Some services are regular features and included in the regular parcel price, while for others customers have to pay a surcharge (ITA Logistics, 2005). A closer examination of the product features shows that the pick-up of parcels is a regular service offered. Due to DHL's strong presence in the B2C market (where parcels are also delivered on Saturday), DHL is the only competitor offering Saturday delivery to business consignees. UPS' strong express network and IT-system enables the firm to offer a number of value added services as a regular service to standard parcel customers at no extra charge (e.g., shipping software, multi-piece option).

Figure 2: Product Features of Standard Shipments

Service provider	DHL		DPD		DPD		DPD		UPS		GLS	
Product	Europack		Standard		Standard prepaid		Standard		Standard		Standard	
Serving segments	Only contractual		Only contractual		Adhoc & contractual		Only contractual		Adhoc & contractual		Only contractual	
		Surcharge		Surcharge		Surcharge		Surcharge		Surcharge		Surcharge
Pick up												
Pick up request (Adhoc/regular)	Yes (Both)	No	Yes (Both)	No	Yes (Both)	No	Yes (Both)	No	Yes (Both)	Yes	Yes (Both)	No
Late pick up	No	No	No	No	No	No	No	No	No	No	No	No
Saturday pick up	No	No	No	No	No	No	No	No	No	No	No	No
Delivery options												
Saturday delivery	Yes	No	No	No	No	No	No	No	No	No	No	No
Money back guarantee	No	No	No	No	No	No	No	No	No	No	No	No
Delivery tries	2	No	3	No	3	No	3	No	3	No	2	No
After services												
Delivery confirmation	No	No	No	No	No	No	No	No	No	Yes	No	No
Proof of delivery (POD)	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes	No
Proactive negative alert	No	No	No	No	No	No	No	No	No	No	No	No
Value added services & others												
Track & trace	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Shipping software	No	No	Yes	No	No	No	Yes	No	Yes	No	Yes	No
Multipiece option	Yes	No	No	No	No	No	No	No	Yes	No	No	No
Volumetric weight	Yes	No	No	No	No	No	No	No	Yes	No	No	No
Personal delivery	No	No	No	No	No	No	No	No	No	No	No	No
Receiver pays	Yes	No	No	No	No	No	No	No	Yes	No	No	No
Cash on delivery (COD)	No	Yes	No	Yes	No	No	No	Yes	No	Yes	No	Yes
Insurance	incl. 500€	No	incl. 520€	No	incl. 520€	No	incl. 520€	No	incl. 510€	No	incl. 750€	No

Source: ITA Logistics (2005), own research

2.3 The entrant: Red Parcel Post

Beginning in 2005, there were indications that a new firm, named Red Parcel Post, will be established to enter the German B2B parcel market. Given the competitive situation in the B2B parcel market the entrance of a completely new player seems quite ambiguous:

- An oligopoly with four established providers
- All four established providers belong to larger logistics groups or former national postal monopolists
- Necessary high investments to set up a parcel delivery system on the green field

However, the new company's entry announcement has been taken seriously by the established

players. The key person behind Red Parcel Post is an experienced top-manager in this industry and was previously Managing Director of DPD and the parcel business of Deutsche Post World Net/DHL.

Red Parcel Post's goal is to enter and penetrate the German market with new product features and the offer of a very competitive price (Böhmer & Cremer, 2004; Brönnner, 2006). Red Parcel Post intends to guarantee next day delivery (frequently a feature of express products only) and the shipment of a wide range of units (from 200 grams to more than the frequent weight limit of 31.5 kilograms). The expected price per shipment shall be around 2 Euros -- approximately 10-20% less than what the incumbents can offer today. Within 4 to 5 years after market entry, Red Parcel Post expects to reach an annual sales volume of 850 million Euros, approximately 25% of DHL's current revenue in the German B2B parcel market.

In order to be able to offer competitive product/service features and competitive prices, Red Parcel Post plans to enter the B2B parcel market with a completely new parcel delivery system for the delivery of B2B parcels throughout Germany based on a new transport network design, and RFID- and GPS-based operations. This new transport and delivery system will lead to lower fixed costs, but possibly higher variable costs.

3. The parcel delivery system: Incumbents vs. Red Parcel Post

Each of the four incumbent parcel service providers operates with a classical multi-hub-and-spoke network with multiple sorting activities in parcel processing centers and delivery hubs. A service provider has to sort parcels in the parcel processing center where parcels collected in the source region arrive. Sorting is done according to the parcels' destination. After the line-haul between the sorting centers (or hubs), parcels are sorted again according to the delivery sequence before the delivery tours start (Rahn, 2004; Werners, Thorn, & Freiwald, 2001).

The delivery to the consignees accounts for the majority of total costs of operations, similar to mail delivery networks (Dietl, Trinkner, & Bleisch, 2005). Due to the pick-up service offered in the B2B parcel markets, collection of parcels at the shippers accounts for a larger percentage than in the mail delivery network. The handling costs at the parcel sorting centers and delivery hubs mainly consist of the cost for sorting parcels.

Starting in 1990, *DHL* initiated a large transition project and changed its parcel network from 140 sorting centers (with up to 9 handling steps) to a highly standardized parcel network of 33 standardized parcel sorting centers throughout Germany (with a maximum of 3 handling steps) and several hundred delivery bases. This project was finalized in mid 1995. It is possible that *DHL* has the least capacity problems as their 33 parcel sorting centers, especially in Eastern Germany, were built in anticipation of a higher than realized future growth. While the parcels could principally be transported between the sorting centers (or hubs) by ground service and/or using air service, truck line hauls are the norm. Since Deutsche Post World Net/*DHL* is the major national Postal operator, *DHL* can realize advantages in the delivery of parcels through approx. 30,000 joint delivery routes (letters and parcels).

DPD operates a European-wide network of depots and hubs (central transfer points). A depot organizes the collection as well as the distribution of parcels from/to the business customers. For shipments to nearby depots, line-hauls occur between depots, for shipments to more distant depots, the parcels are shipped to a hub and then further to the destination depot. The network in Germany consists of 6 hubs and over 60 depots. An alternative capacity strategy, to handle peak incoming volumes at a particular depot, is to reroute parcels to an adjacent depot. Because the network has a large number of depots this strategy can be successfully deployed with minimum additional cost implication (Triangle Management Services, 2006).

In Germany, the *UPS* parcel network consists of 5 central hubs and around 70 branches. B2B shipments account for around 80% of the business. Similar to *DPD* parcels are transported to adjacent branches or for shipments to more distant consignees via the hubs.

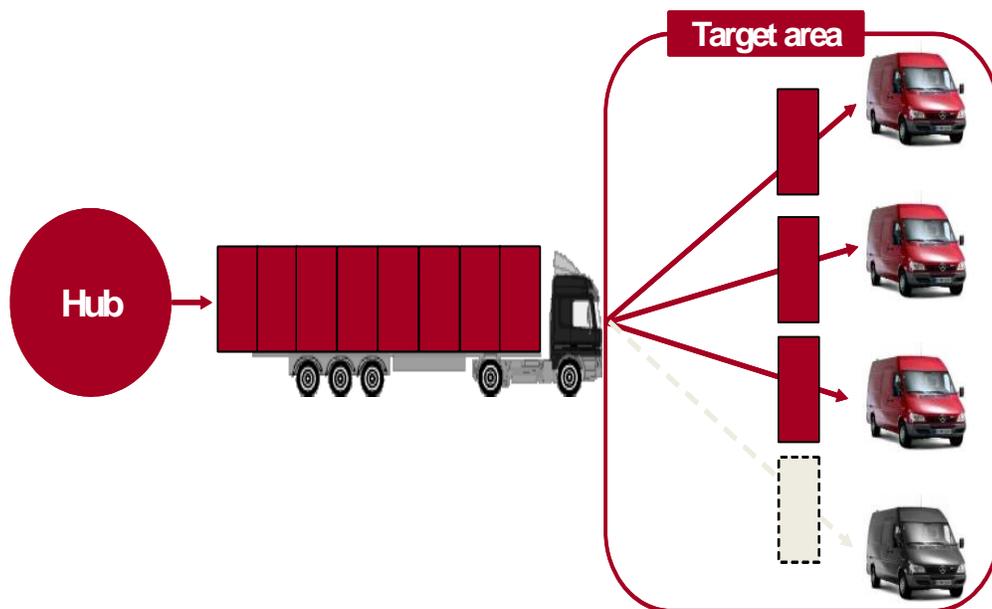
GLS operates in a similar manner as *DPD*, however, given the parcel volume, on a lower scale. *GLS'* German parcel network consists of 2 main hubs and around 90 depots.

The potential entrant, *Red Parcel Post*, announced that it would set up and operate the collection, sorting, transportation and distribution of parcels in a new way compared to the established parcel service providers. After an order has been received, the parcel is picked up and an RFID tag is placed on the parcel. During the transportation to the hub, the delivery tour is computed by the computer center and the parcel is assigned to a changeover station. At the hub this information regarding delivery tour and changeover station is transferred to the RFID tag. According to this information the parcel is placed into one of several containers which are loaded on a large line-haul truck and transported to the changeover station. At the changeover station, the containers are reloaded from the line-haul truck to smaller delivery vans (see Figure 3) and

the delivery information is transferred from the RFID tag onto the navigation system of the delivery van.

This new delivery process is described by four important changes compared to a classical multi-hub-and-spoke network. First, the entire network will consist of only 4 hubs (probably close to Magdeburg, Hannover, Dortmund and Würzburg, see Figure 4) with no extra collection or delivery depots in the regions. Instead of depots, 60 regional changeover stations are planned (without warehouse or sorting devices).

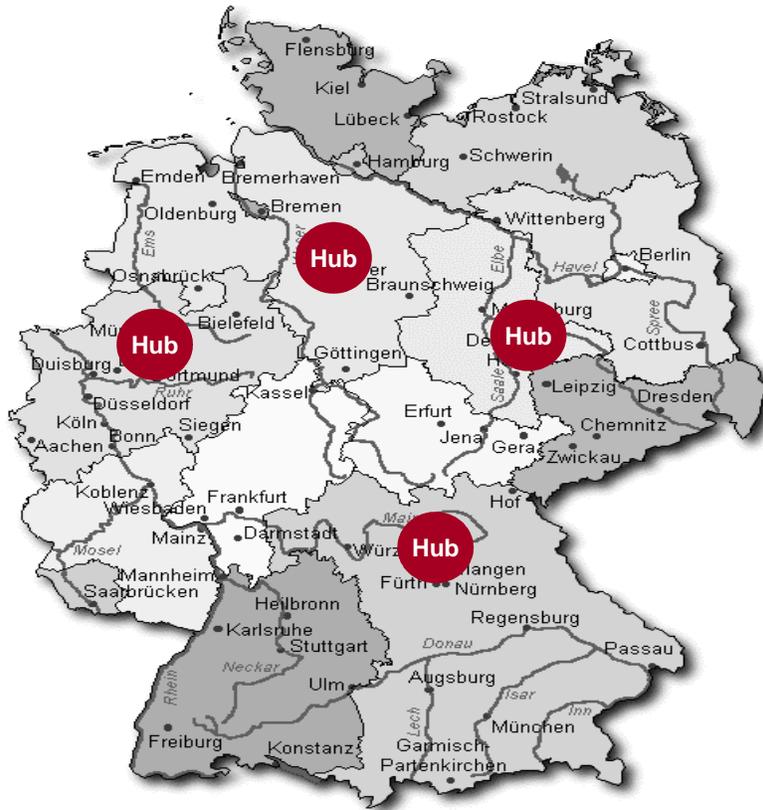
Figure 3: Delivery Processes of Red Parcel Post



Source: Bröner (2006)

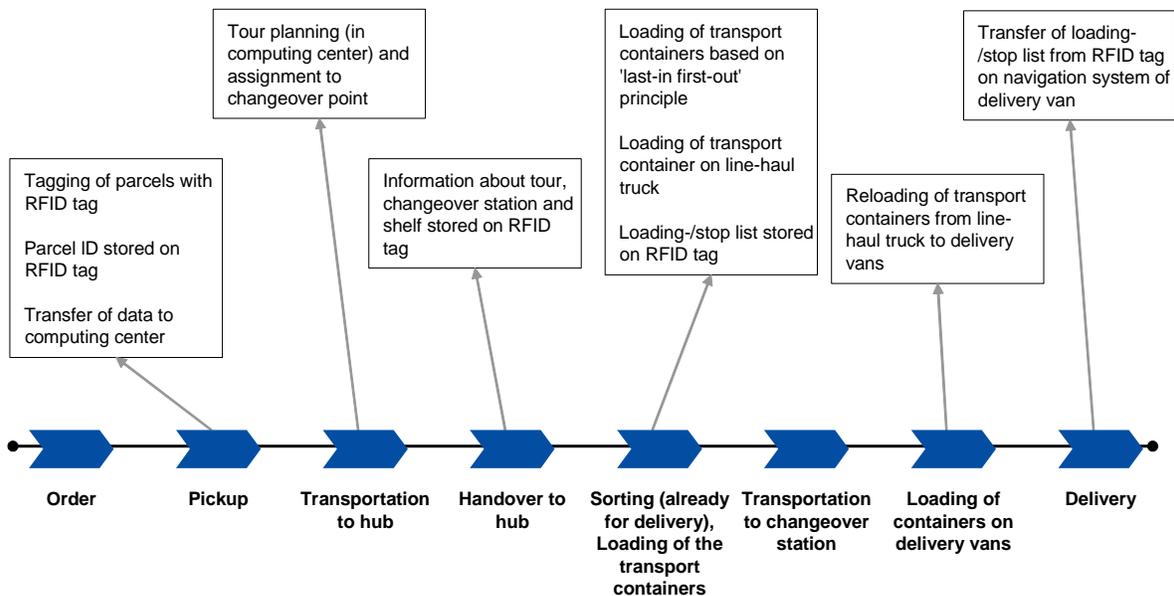
Second, the entire system is built on latest technology. All parcels will be tagged with Radio Frequency Identification (RFID) tags. This will enable Red Parcel Post to sort parcels more easily. Furthermore, a seamless tracking-and-tracing of the parcels will be possible. Third, together with the RFID technology, new transport vehicles will be used. Trucks loaded with small standardized containers will transport the pre-sorted parcels to the changeover stations where the containers are loaded on special delivery vans. This system eliminates sorting activities. Fourth, powerful transport optimization software (potentially GPS-based) will be used to optimize transportation and delivery of parcels to the consignees, which will be accomplished by around 1,000 drivers. Figure 5 provides more technical details about the production process of Red Parcel Post.

Figure 4: Hubs of Red Parcel Post



Source: Bröner (2006)

Figure 5: Parcel Delivery System



Source: Bröner (2006), own research

4. A game-theoretic model of the German B2B parcel market

In this section, we try to model the German B2B parcel market and the effect of Red Parcel Post's market entry. First, we develop a Cournot model of the current situation in the German B2B parcel market. Then we extend this model through the entry of Red Parcel Post. We solve both versions of our model analytically and numerically.

We believe that a Cournot model fits well to approximate the current situation, mainly because of the network character of B2B services. Each operator has to design a complex network of hubs, depots, routes, vans, software, etc. This network design basically determines the number of parcels that have to run through the network because such a complex collection, transportation and delivery network is hardly scalable. As soon as more than the optimal number of parcels has to be processed, service quality will decline rapidly. If demand continues to increase above a certain threshold, the network may even collapse. Too little demand, on the other hand, is economically disastrous because of the large percentage of fixed costs. Usually, the network needs a pre-specified volume of parcels to run economically. The cost structure of its network forces an operator to adjust prices in order to realize the optimal demand quantity. If demand is too small, the operator will reduce its price, if demand is too large, the operator has to increase its price.

Although each operator tries to differentiate itself from its competitors through add-on services, the B2B services of DHL, DPD, UPS and GLS are highly homogenous since each operator usually matches the services offered by its competitors. The homogeneous character of standard national B2B parcel services in Germany is also reflected by the fact that prices do hardly differ across the four largest operators.

We formalize the setup described above and present a Cournot model where n operators compete in quantities to supply a homogeneous good. The demand for the good is given by $p(Q)$ where p is the price and $Q = \sum_{i=1}^n q_i$ is the number of parcels delivered by the whole industry, q_i being operator i 's parcel proceeds. We assume a standard linear demand function given by

$$p(Q) = a - b \sum_{i=1}^n q_i$$

where a represents the market size and b is a parameter for the price sensitivity in the market. Operator i produces according to the cost function $C_i(q_i)$ given by

$$C_i(q_i) = F_i + c_i q_i$$

with fixed costs F_i and variable costs $c_i q_i$. Due to economics of scale operator i 's average costs

$$AC_i(q_i) = \frac{C_i(q_i)}{q_i} \text{ decrease in quantity, i.e., } \frac{\partial AC_i(q_i)}{\partial q_i} < 0.$$

Operator i 's profits are

$$\begin{aligned} \pi_i(Q) &= p(Q) \cdot q_i - C_i(q_i) \\ &= \left(a - \sum_{i=1}^n q_i \right) q_i - (F_i + c_i q_i) \end{aligned}$$

if it produces q_i and total industry output is Q . All operators chose their quantities simultaneously and each operator maximizes its profit given the quantities chosen by the other operators.

Operator i 's reaction function is computed as

$$R_i(Q_{-i}) = \frac{a - c_i}{2b} - \frac{\sum_{j=1, j \neq i}^n q_j}{2} \quad (1)$$

where Q_{-i} denotes the quantities chosen by the other operators. From (1) we derive that the good is a strategic substitute.

In Subsection 4.1, which serves us as the benchmark case, we consider the German B2B parcel market before the market entry of Red Parcel Post. In Subsection 4.2, we then analyze what will happen after the market entry of Red Parcel Post.

4.1 The B2B market before the entry of Red Parcel Post

In this subsection, we set $n = 4$ in order to represent the German B2B parcel market before the market entry of Red Parcel Post. As mentioned in Section 2, the post-entry market is composed out of the four large service providers DHL, DPD, UPS and GLS. We assume that these four incumbent parcel service providers have identical fixed costs since they operate with the same classical multi-hub-and-spoke network. However, variable costs are assumed to differ among the four large service providers such that the cost functions of operator $i = 1, \dots, 4$ is given by

$$C_i(q_i) = F + c_i q_i$$

Without loss of generality, we assume the following ordering of variable costs: $c_1 < c_2 < c_3 < c_4$.

By solving the system of reaction functions (1) with $n = 4$, we derive the equilibrium number of parcel proceeds by the four large service providers in the pre-entry scenario as

$$\widehat{q}_i = \frac{a - 4c_i + \sum_{j=1, j \neq i}^4 c_j}{5b}, i = 1, \dots, 4 \quad (2)$$

Comparative static yields that operator i 's equilibrium number of parcel proceeds decreases in its own variable costs and increases in variable costs of the other operators.

As a direct consequence, we derive that the operator with the lowest variable costs offers the highest number of parcel proceeds in equilibrium yielding the following ordering of parcel proceeds:

$$\widehat{q}_1 > \widehat{q}_2 > \widehat{q}_3 > \widehat{q}_4 \quad (3)$$

From (2) we deduce the equilibrium price as

$$\widehat{p} = \frac{a + \sum_{j=1}^4 c_j}{5} \quad (4)$$

and compute the equilibrium profits of the incumbent operator $i = 1, \dots, 4$ as

$$\begin{aligned} \widehat{\pi}_i &= b \cdot (\widehat{q}_i)^2 - F \\ &= b \cdot \left(\frac{a - 4c_i + \sum_{j=1, j \neq i}^4 c_j}{5b} \right)^2 - F \end{aligned}$$

Higher variable costs will decrease the equilibrium quantity chosen by operator $i = 1, \dots, 4$ and therefore increase the equilibrium price but decrease equilibrium profits. The following condition guarantees that each of the four large service providers makes non-negative equilibrium profits and therefore is active in the pre-entry market:

$$F \leq b \cdot (\widehat{q}_i)^2 = b \cdot \left(\frac{a - 4c_i + \sum_{j=1, j \neq i}^4 c_j}{5b} \right)^2, i = 1, \dots, 4 \quad (5)$$

If $F = b \cdot (\widehat{q}_4)^2$ then in equilibrium the incumbent operator 4 will break-even and the other incumbents will make positive profits.³ An increase in fixed costs F or a decrease in the number of parcel proceeds \widehat{q}_4 would force operator 4 to exit the market.

³Recall the ordering (3) of equilibrium profits.

4.2 The B2B market after the entry of Red Parcel Post

In this subsection, we analyze the German B2B market after the entry of Red Parcel Post and therefore set $n = 5$. In the post-entry market the parameters $q_i, i = 1, \dots, 4$ denote the quantities chosen by the four large service providers whereas q_5 denotes the respective quantity chosen by Red Parcel Post.⁴ As mentioned above Red Parcel Post plans to enter the market with a completely new parcel delivery system based on a new transport network design and RFID- and GPS-based operations. We account for this new technology by modelling Red Parcel Post with lower fixed costs and higher variable costs compared with the four incumbent service providers. The cost functions of operator $i = 1, \dots, 5$ is therefore given by

$$C_i(q_i) = F_i + c_i q_i$$

with $F_5 < F = F_i$ and $c_5 > c_i \quad \forall i = 1, \dots, 4$.

By solving the system of reaction functions (1) with $n = 5$, the equilibrium number of parcel proceeds by the incumbent operators denoted $q_i^*, i = 1, \dots, 4$ and q_5^* by Red Parcel Post, respectively, are given by

$$q_i^* = \frac{a - 5c_i + \sum_{j=1, j \neq i}^5 c_j}{6b}$$

Since Red Parcel Post is assumed to have higher variable costs than the four incumbents, i.e., $c_5 > c_i \quad \forall i = 1, \dots, 4$, we derive that Red Parcel Post will chose the lowest number of parcel proceeds in equilibrium.

The equilibrium price is then computed as

$$p^* = \frac{a + \sum_{j=1}^5 c_j}{6}$$

Comparison of the post-entry scenario with the pre-entry scenario leads to the following conclusion: both the equilibrium number of parcel proceeds of the incumbents $q_i^*, i = 1, \dots, 4$ and the equilibrium price p^* will decrease after the market entry of Red Parcel Post because Red Parcel Post will only enter the market when its variable costs are lower than the equilibrium

⁴Note that the subscript $i = 5$ is exclusively used for Red Parcel Post whereas the subscripts $i = 1, \dots, 4$ still characterize the four established service providers (DHL, DPD, UPS and GLS).

price, i.e. $c_5 < \widehat{p}$. This result shows that the aggregate decrease in the incumbents' number of parcel proceeds is higher than the quantity chosen by Red Parcel Post which yields a net decrease in the equilibrium price in the post-entry scenario.

We now compute the equilibrium profits of operator $i = 1, \dots, 5$ as

$$\begin{aligned}\pi_i^* &= b \cdot (q_i^*)^2 - F_i \\ &= b \cdot \left(\frac{a - 5c_i + \sum_{j=1, j \neq i}^5 c_j}{6} \right)^2 - F_i\end{aligned}$$

with $F = F_i \quad \forall i = 1, \dots, 4$.

Due to condition (5) in Section 4.1, all four incumbents were active in the pre-entry scenario. This may change, however, in the post-entry scenario: Depending on the incumbents' fixed costs it is possible that after Red Parcel Post's market entry not all incumbents will make positive equilibrium profits anymore and therefore have to exit the market. This also holds true if we assumed that the incumbents don't have equal fixed costs. However, by assuming equal fixed costs for the incumbents we predict that the incumbents with the highest variable costs will exit the market first.

By normalizing the fixed costs F such that the incumbent with the highest variable costs (in our model incumbent 4) breaks even in the pre-entry scenario, i.e., $F = b \cdot (\widehat{q}_4)^2$, we derive that the incumbent operator 4 has to exit the market first. In this case, the number of parcel proceeds and price in equilibrium are given similar to (2) and (4) in the pre-entry scenario with c_5 instead of c_4 :

$$\begin{aligned}q_i^{**} &= \frac{a - 4c_i + \sum_{j=1, j \neq i, j \neq 4}^5 c_j}{5b}, i = 1, 2, 3, 5 \\ p^{**} &= \frac{a + c_1 + c_2 + c_3 + c_5}{5}\end{aligned}$$

Since the variable costs of Red Parcel Post are assumed to be higher than the variable costs of the incumbent operator 4, i.e., $c_5 > c_4$, the equilibrium price p^{**} will be higher compared to the corresponding price \widehat{p} in the pre-entry scenario.

5. Numerical Results

The theoretical analysis performed above provides equilibrium prices and equilibrium supply formulas for the pre-entry scenario as well as for the situation after Red Parcel Post's market entry. Unfortunately, the theoretical results do not shed light on the effect of market entry on market shares, profits etc. To obtain some insight into these dimensions, we now resort to numerical simulation.

5.1 Calibration assumption and reference case

In our model, we ignore more or less smaller competitors who target niche markets. We focus on the four large incumbent operators DHL, DPD, UPS, and GLS who provide basically identical services in the German B2B market.

We start by calibrating the parameters related to the reference case before Red Parcel Post's market entry. We try to calibrate the model in a way that we observe the outcome in the German B2B parcel market in 2008. This outcome is characterized by the data presented in Section 2.1: Given 570 million shipments in 2004 and an annual growth rate of 4%, we calculate 650 million shipments as actual demand. Furthermore we know the market shares of the incumbent operators and the parcel price of 2.20 euro.

What is unknown is the price elasticity of demand. However, as mentioned by Triangle Management Services (2006) the B2B segment seems to be less price sensitive than the B2C segment. Therefore, we assume a price elasticity of 0.5.

If we insert the data of the German B2B parcel market and the assumed price elasticity to equations (1)-(3) in Section 4 we observe the cost structure presented in Table 1. Even if the absolute values of variable cost depend on the assumed price elasticity, the ordering of the variable cost is justifiable. DHL and DPD operate the largest networks. Accordingly, they have higher fixed and lower variable costs than their competitors. In addition, DHL's network is somewhat better scalable because DHL can realize economies of scope between Deutsche Post World Net's letter and parcel businesses (e.g. through common delivery routes). We model this advantage by assuming that DHL will remain in the market even if it cannot cover its fixed costs through its parcel volume. UPS operates a slightly smaller network than DHL and DPD resulting in lower fixed and slightly higher variable costs. GLS operates the smallest network of the four

large competitors. We account for GLS' network size by assuming that GLS realizes the smallest fixed and highest variable costs of all four competitors.

Table 1: Reference case

	DHL	DPD	UPS	GLS
c	1.00	1.00	1.27	1.58
q	175,500,000	175,500,000	136,500,000	91,000,000
p	2.20	2.20	2.20	2.20
Market share	27.00%	27.00%	21.00%	14.00%
TCM	210,600,000	210,600,000	127,400,000	56,622,222

Table 1 shows variable costs, quantities and market shares for each of the incumbent operators. From these we calculate the total contribution margin (TCM) at market equilibrium in the reference case. TCM is the fraction of revenues that contributes to offsetting fixed costs. In fact, the dimension of the values is not quiet conclusive, as they depend directly on our assumption of variable costs. However, we can use the percentage decrease in TCM after Red Parcel Post's market entry to assess the prospects of the incumbent service operators.

The situation after market entry of Red Parcel Post depends on two assumptions. First on the level of variable costs of Red Parcel Post, which determine the market shares of the operators. Second on the fixed costs of the incumbent operators, which determine whether one or more of the incumbent operators will exit the market. Therefore, we are going to discuss two different scenarios. In the first scenario, the four incumbent service operators remain active in the B2B market after Red Parcel Post's market entry. In the second scenario, we assume that GLS will exit the market after Red Parcel Post's market entry, as the new total contribution margin of GLS is too small to cover fixed costs. In both scenarios we consider three cases to take the effect of Red Parcel Post's variable costs on market outcome into account. In the first case, Red Parcel Post's variable costs are twice as large as the variable costs of DHL ($c_{red\ parcel} = 2.00\text{€}$). In the second case, we assume that Red Parcel Post's costs are slightly higher than the variable costs of GLS ($c_{red\ parcel} = 1.60\text{€}$) and in the third case we assume that Red Parcel Post's variable costs are between the variable costs of UPS and GLS ($c_{red\ parcel} = 1.50\text{€}$).

5.2 Scenario 1

Table 2 reports quantities, related market shares, market volume, and the equilibrium price after the entry of Red Parcel Post. Except for market volume, each of these variables depends positively on the variable costs of Red Parcel Post.

Table 2: Quantities, market shares and prices (Scenario 1)

$c_{red\ parcel}$	2.00	1.60	1.50
DHL	171,321,429 26.19%	162,964,286 24.60%	160,875,000 24.21%
DPD	171,321,429 26.19%	162,964,286 24.60%	160,875,000 24.21%
UPS	132,321,429 20.23%	123,964,286 18.71%	121,875,000 18.34%
GLS	86,821,429 13.27%	78,464,286 11.84%	76,375,000 11.49%
Red Parcel Post	25,071,429 3.83%	75,214,286 11.35%	87,750,000 13.20%
Market volume	654,178,571	662,535,714	664,625,000
Price	2.17	2.11	2.10

For each value of Red Parcel Post's variable costs, we observe decreasing market shares for the incumbent operators and a decrease in the equilibrium price, which results in a small increase in market volume. Due to the assumption of homogenous products, the absolute decrease in number of parcels delivered by the incumbent operators is the same for each operator. Consequently the percentage decrease is larger for the smaller operators UPS and GLS. For example, we observe in the second case ($c_{red\ parcel} = 1.60\text{€}$) a decrease of 7.14 % for DHL and DPD whereas the decrease of UPS (9.18%) and GLS (13.78%) is markedly larger. These results are in line with our theoretical findings in section 4.

To assess the prospects for the incumbent service operators it is important to look at the development of the TCM after the market entry of Red Parcel Post.

We summarize the change in TCM in Table 3 for each of the assumed values of Red Parcel Post's variable costs. The two important findings are the following: First, we observe larger decreases in TCM for lower values of Red Parcel Post's variable costs. This is because lower variable costs of Red Parcel Post cause a lower price and larger decreases in the number of parcels delivered by the incumbent service operators. Second, even though the absolute decrease

in TCM is larger for the big incumbent operators, the largest percentage decrease is observable for the smallest incumbent operator GLS. The reason for this result is the higher percentage decrease in number of parcels delivered by GLS.

Table 3: Total Contribution Margin and percentage changes (Comparing pre-entry to Scenario 1 equilibrium outcomes)

$c_{red\ parcel}$	2.00	1.60	1.50
DHL	200,690,816 -4.71%	181,588,775 -13.78%	176,127,518 -15.89%
DPD	200,690,816 -4.71%	181,588,775 -13.78%	176,127,518 -15.89%
UPS	119,719,387 -6.03%	105,074,489 -17.52%	101,116,612 -20.28%
GLS	51,541,609 -8.97%	42,096,712 -25.65%	39,884,722 -29.56%
Red Parcel Post	4,297,959 -	38,681,632 -	52,650,000 -

This finding has an important implication. Even if we account for GLS' network size by assuming that GLS realizes the smallest fixed costs, it seems to be a reasonable assumption, that GLS is the first operator, which will exit the B2B parcel market. The reason for the relative weakness of GLS compared to other competitors is the necessity to realize economies of scale in the B2B parcel market as long as operators organize a classical multi-hub-and spoke network. Because the incumbent competitors are able to realize higher economics of scale, GLS has a competitive disadvantage. The importance to realize economies of scale is lower if an operator uses a new parcel delivery system and network that causes significantly lower fixed costs. This is one reason for the potential success of Red Parcel Post's market entry. Even if variable costs are high, compared to the incumbent operators, and therefore the realized market share is low, it is easier for Red Parcel Post to cover its relative low fixed costs.

5.3 Scenario 2

It is clear, that we can not predict market exit of any operator without knowing more about the true cost structures. However, using the same cost structure and demand as in the reference case, we are able to simulate the potential market outcome after Red Parcel Post's entry and the exit of GLS.

We summarize the results of the second scenario in Table 4 and Table 5. The price, number of parcels delivered by the incumbent operators, market shares of the incumbent operators, and total contribution margin depend positively on the variable costs of Red Parcel Post. It is obvious that the relations of these variables with the variable costs of Red Parcel Post are not affected by the exit of GLS. Therefore, the market volume is still negatively related to the variable costs of Red Parcel Post.

Table 4: Quantities, market shares and prices (Scenario 2)

$c_{red\ parcel}$	2.00	1.60	1.50
DHL	185,791,667 29.04%	176,041,667 27.11%	173,604,167 26.63%
DPD	185,791,667 29.04%	176,041,667 27.11%	173,604,167 26.63%
UPS	146,791,667 22.95%	137,041,667 21.10%	134,604,167 20.65%
Red Parcel Post	39,541,667 6.18%	88,291,667 13.59%	100,479,167 15.41%
Market Volume	640,888,213	650,736,698	653,198,819
Price	2.27	2.20	2.19

There are two important results in this scenario. First, in line with our theoretical findings, the equilibrium price increases as long as the variable costs of Red Parcel Post are higher than the variable costs of GLS. Therefore we observe a slightly lower market volume if the variable costs of Red Parcel Post are higher than the variable costs of GLS. In this case, we can also observe an increase in the market shares of DHL, DPD, and UPS as well as in the number of parcels delivered by the incumbent operators. As in the first scenario, we observe that the absolute change in the number of parcels delivered by DHL, DPD, and UPS is the same for each operator. However, the percentage change is slightly larger for UPS. For example, the increase in parcels delivered by UPS is about 7.54% in the first case ($c_{red\ parcel} = 2.00\text{€}$), whereas the increase for DHL and DPD is 5.86%. Note that the number of parcels delivered by the incumbent operators will increase even if total market volume decreases. The explanation for this remarkable result is quite simple. The reason is the competitive position of the incumbent operators. As long as variable costs of Red Parcel Post are higher than the variable costs of the former competitor GLS, each of the incumbent operators has larger competitive advantages compared to Red Parcel Post

than compared to GLS. The better competitive position allows DHL, DPD, and UPS to increase the number of parcels even if total market volume decreases.

Table 5: Total Contribution Margin and percentage changes (Comparing pre-entry to Scenario 2 equilibrium outcomes)

$c_{red\ parcel}$	2.00	1.60	1.50
DHL	236,024,228 12.07%	211,902,006 0.62%	206,074,575 -2.15%
DPD	236,024,228 12.07%	211,902,006 0.62%	206,074,575 -2.15%
UPS	147,335,339 15.65%	128,413,117 0.80%	123,885,686 -2.76%
Red Parcel Post	22,114,043 -	43,491,820 -	47,820,640 -

The second important result in this scenario is the development of TCM. As we can see in Table 5, the TCM of UPS is more sensitive to the variable costs of Red Parcel Post than the TCM of DHL and DPD. If Red Parcel Post enters the market with high variable costs, we will observe that the percentage increase in the TCM of UPS is higher than the increase of DHL and DPD. Nevertheless, if the variable costs of Red Parcel Post are low, we will observe a higher percentage decrease in the TCM of UPS compared to DHL and DPD. The reason for the higher percentage volatility of UPS's TCM is that the percentage change in the number of parcels of UPS is larger than the percentage change of DHL and DPD. This result highlights the importance of realized economies of scale for the prospects of the incumbent operators. The larger the realized economies of scale the lower will be the effects on the TCM. This means that the large operators will have better chances to stay in the market after the market entry of Red Parcel Post.

5.4 Sensitivity Analysis

Unfortunately, we do not have any insights regarding the demand structure in the German B2B parcel market. Therefore, we did our analysis with judgmental estimates of the price elasticity of demand. It is clear that the values of price elasticity directly affect the cost structure and thus TCM. However, as we can show in this section, our estimates for the market shares and the ratios of percentage changes in TCM are not sensitive to this assumption.

We did the simulation of our model for another four values of price elasticity (0.2, 0.4, 0.6, and 0.8). The corresponding values of DHL's variable costs are given by $c_{DHL} = 0.5$, $c_{DHL} = 0.75$, $c_{DHL} = 1.25$, and $c_{DHL} = 1.5$. To compare the different cases we assume, that in each case the variable costs of Red Parcel Post are 10% above the variable costs of GLS. The assumption on the magnitude of the cost disadvantage is again arbitrary. However, the results presented in this section do not change as long as we assume the same cost disadvantage for each case.

Table 6: Market shares for different values of c_{DHL}

c_{DHL}	DHL	DPD	UPS	GLS	Red Parcel Post
0.50	24.88%	24.88%	18.98%	12.09%	10.03%
0.75	24.98%	24.98%	19.08%	12.19%	9.53%
1.00	25.13%	25.13%	19.22%	12.32%	8.83%
1.25	25.36%	25.36%	19.44%	12.53%	7.74%
1.50	25.76%	25.76%	19.82%	12.88%	5.87%

Table 6 summarizes the market shares for different values of c_{DHL} . The market shares of the incumbent operators are robust to the assumed cost structure. The maximum difference is observable for DHL and DPD with $\Delta ms = 0.88\%$. This indicates that the market shares of the incumbent operators are a good approximation on the effect of Red Parcel Post's market entry. However, the market shares of Red Parcel Post are more sensitive to the assumed cost structure. The reason for this sensitivity is the following. For large values of c_{DHL} the variable costs of Red Parcel Post are closer to the market price which forces Red Parcel Post to offer just a small number of services.

Table 7: Change in TCM for different values of c_{DHL} (Comparing post-entry to pre-entry equilibrium outcomes)

c_{DHL}	DHL	DPD	UPS	GLS
0.50	-12.20%	-12.20%	-15.54%	-22.82%
0.75	-11.60%	-11.60%	-14.79%	-21.74%
1.00	-10.75%	-10.75%	-13.71%	-20.19%
1.25	-9.45%	-9.45%	-12.06%	-17.80%
1.50	-7.18%	-7.18%	-9.19%	-13.61%

To assess the prospect of the incumbent operators we calculated the percentage change of the TCM between the post-entry and the pre-entry outcome. At first glance Table 7 this seems not a

good idea. The percentage decrease in the total contribution margin is quite sensitive to the assumed cost structure. However, there is a constant that allows us to use the percentage change in total contribution margin as an indicator for the prospects of the incumbent service operators. It is the ratio of the decrease in TCM of UPS and GLS to the decrease in TCM of DHL. This ratio lies for UPS between 1.274 and 1.279 and for GLS between 1.870 and 1.879. Roughly speaking, the percentage decrease in TCM of UPS is about one third larger than the percentage decrease of DHL whereas the percentage decrease of GLS is twice as large as the decrease of DHL. This result shows that our conclusion on the relative weakness of GLS at the end of Section 5.2 is independent of the assumed cost structure.

6. Conclusion

In this paper, we analyze the market entry of Red Parcel Post, a new player in the German Business-to-Business (B2B) parcel market. We describe the German B2B parcel market, the traditional parcel delivery system used by the incumbent providers, and Red Parcel Post's business strategy and its new parcel delivery system. Subsequently, we develop a game-theoretic model to analyze the effect of Red Parcel Post's market entry on competition, market shares, prices, costs and profits. The model is a Cournot model with economies of scale and different cost functions.

We show that entry with a new delivery system that lead to lower fixed costs, but possibly higher variable cost is highly attractive for Red Parcel Post. As long all incumbent operators are still active in the market after the entry of Red Parcel Post, prices will decrease and the incumbent operators will lose TCM. In contrast, if Red Parcel Post drives out one competitor, the remaining competitors will benefit from Red Parcel Post's entry through higher prices, larger market shares and higher TCM.

However, it is not clear if and when we will see these developments in the market. The long run effects on prices and TCM depend on the evolution of the RFID technology, in particular the development of the unit tagging costs and the costs for RFID writing and reading devices (Kleist, Chapman, Sakai, & Jarvis, 2004; Dutta, Lee, & Whang, 2007) which determine Red Parcel Post's variable costs. Given that costs for the application of RFID on a unit level (i.e., parcel tagging) are expected to decrease over time (Tajima, 2007), there is a high likelihood that market entry of Red Parcel Post becomes feasible and that the developments outlined in this paper materialize.

However, in addition to the technical progress in the RFID technology, learning curve/experience effects will also work in favor of Red Parcel Post. If the decrease in variable cost of Red Parcel Post is high enough, we will observe lower prices and a decrease in TCM of the incumbent operators, even if Red Parcel Post drives out one competitor.

Logistics service providers have frequently been considered to be on a comparatively low level with respect to their innovation activities compared to firms in other industries. One broader conclusion that can be made from our paper is that innovation can change the structure and competitive forces in markets for logistics services. With a new market approach and a new, technology-driven parcel delivery system, Red Parcel Post's attempt includes both, product/service and process innovations (Sheffi, 2004; Wagner, 2008).

References

- BIEK (2007): *Beschäftigungs – und Einkommenseffekte der Kurier-,Express- und Paketbranche – Entwicklung und Prognose (KEP-Studie 2007)* [Employment and Income Effects of the Courier-, Express- and Parcel-Service Industry – Development and Forecast (CEP-Study 2007)], August 2007, Berlin: Bundesverband Internationaler Express- und Kurierdienste e.V. (BIEK)
- Böhmer, Reinhold; Cremer, Ludwig-Michael (2004): Still und leise [Calm and Quiet], in: *Wirtschaftswoche*, No. 52, 16.12.2004, pp. 60-62
- Brönnner, Bernhard (2006): Moderne Methoden der Materialflusssteuerung beim neuen Paketdienst [Modern Material Flow Control Systems at the New Parcel Service], in: *VDI-Berichte No. 1928*, Düsseldorf: VDI-Verlag, pp. 21-37
- Crew, Michael A.; Kleindorfer, Paul R. (2005) Competition, Universal Service and the Graveyard Spiral, in: Crew, Michael A.; Kleindorfer, Paul R. (Eds.): *Regulatory and Economic Challenges in the Postal and Delivery Sector*, Series ‘Topics in Regulatory Economics and Policy’, Volume 48, Bosten, MA: Kluwer Academic Publishers, pp. 1-30
- De Donder, Philippe; Cremer, Helmuth; Rodriguez, Frank (2002): Funding the Universal Service Obligation under Liberalisation: An Analysis of the Postal Market, in: Crew, Michael A.; Kleindorfer, Paul R. (Eds.): *Postal and Delivery Services: Pricing, Productivity, Regulation and Strategy*, Series ‘Topics in Regulatory Economics and Policy’, Volume 41, Boston, MA: Kluwer Academic Publishers, pp. 31-52
- Dietl, Helmut M.; Trinkner, Urs; Bleisch, Reto (2005): Liberalization and Regulation of the Swiss Letter Market, in: Crew, Michael A.; Kleindorfer, Paul R. (Eds.): *Regulatory and Economic Challenges in the Postal and Delivery Sector*, Series ‘Topics in Regulatory Economics and Policy’, Volume 48, Boston, MA: Kluwer Academic Publishers, pp. 53-72
- Dutta, Amitava; Lee, Hau L.; Whang, Seungjin (2007): Unlocking the Value of RFID, in: *Production and Operations Management*, Vol. 16, No. 5, October, pp. 646-655
- ITA Logistics (2005): *Product and Price Positioning in the German Market for BtoB Express and Parcel Delivery Services*, August 2005, Hamburg: ITA Logistics GmbH
- Klaus, Peter; Kille, Christian (2006): *Die Top 100 der Logistik: Marktgrößen, Marktsegmente und Marktführer in der Logistikdienstleistungswirtschaft* [Top 100 in Logistics: Market Size, Market Segments, and Market Leaders in the Logistics Service Industry], 4th Edition, Hamburg: Deutscher Verkehrs-Verlag

- Kleist, Robert A.; Chapman, Theodore A.; Sakai, David A.; Jarvis, Brad S. (2004): *RFID Labeling: Smart Labeling Concepts & Applications for the Consumer Packaged Goods Supply Chain*, Irvine, CA: Printronix
- Lee, Hau L.; Özer, Özalp (2007): Unlocking the Value of RFID, in: *Production and Operations Management*, Vol. 16, No. 1, January-February, pp. 40-64
- Rahn, Klaus-Peter (2004): *Optimierung der Distributionslogistik im Bereich der Kurier-, Express- und Paketdienstleister* [Optimization of the Distribution Logistics of Courier-, Express- and Parcel-Service Providers], Dissertation Universität Stuttgart, Stuttgart: Institut für Fördertechnik und Logistik
- Sheffi, Yossi (2004): RFID and the Innovation Cycle, in: *International Journal of Logistics Management*, Vol. 15, No. 1, pp. 1-10
- Tajima, May (2007): Strategic Value of RFID in Supply Chain Management, in: *Journal of Purchasing & Supply Management*, Vol. 13, No. 4, December, pp. 261-273
- Tirol, Jean (1988): *The Theory of Industrial Organization*, Cambridge, MA: MIT Press
- Triangle Management Services (2006): *2006 Annual German Domestic Parcels and Express Distribution Survey*, Buckinghamshire, UK: Triangle Management Services Ltd.
- Wagner, Stephan M. (2008): Innovation Management in the German Transportation Industry, in: *Journal of Business Logistics*, Vol. 29, No. 2, pp. 215-231
- Werners, Brigitte; Thorn, Jens; Freiwald, Stephanie (2001): Innerbetriebliche Transportoptimierung für ein Paketzentrum der Deutschen Post World Net [Optimization of Internal Transports in a Deutsche Post World Net's Parcel Sorting Center], in: *OR Spectrum*, Vol. 23, No. 4, November, pp. 507-523