Competition in Network Industries: The Case of the German Postal Market

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Contents

List of Figures

List of Tables

1   Introduction

The postal sector has a long monopolistic tradition in many countries; however, since the 1990s it has undergone considerable changes. At the beginning of that decade, the European Commission abolished exclusive rights within the postal system and opened up the market to new private postal providers and changes have continued to accelerate after two important European directives: Directive 97/67/EC of December 15, 1997 and Directive 2002/39/EC of June 10, 2002. Both directives were intended to improve the quality of service in the industry and to open up the market to competition.

Debate about the liberalization of the postal market is always accompanied by the question of accountability when it comes to universal service. People are concerned with ensuring that the postal service is provided to everyone, including isolated districts and more disadvantaged members of society. The postal sector provides services of general interest in society, just as the energy and telecommunication sectors do. As long as a single public sector operator provided a postal service there was no risk of a loss of universal service. Thus, opening up the market to competition created the need to check that all people had access to service.

Another topic related to the liberalization of postal markets concerns the vertical structure of postal networks. Firms operating in the postal industry must provide a sequence of intermediate services, such as collection, sorting, transportation, and delivery, in order to produce the total service customers need and value. Of course, the substantial differences between intermediate services raise the question of whether it is efficient for all services to be open to competition. If not, does the vertical structure of postal firms entail scope economies between intermediate services such that unbundling would include efficiency losses? In general, it is healthy for such markets to be open to competition as long as the postal sector is not a natural monopoly, i.e. provided that the total cost of providing a product or service is not lower if provided by a single firm. It must also be taken into consideration that even in the case of natural monopoly large firms may compete to provide the service as a monopolist on the market. This question, however, is not further pursued in this thesis because the analysis concentrates on small and medium-sized German postal providers and because competition from foreign postal providers is not within its ambit.

Since the issuance of the two EU postal directives mentioned above, several European countries have opened up their postal markets to competition. Germany is among the most progressive countries in the European Union in terms of liberalizing the postal market. The German postal market began the process of opening up to competition in 1998. The market was fully and completely open by January of 2008. Prior to complete opening, competition in the German postal market concentrated on higher-quality specialized services, such as express delivery.

What has changed since the opening of the German postal market? The abolition of legal entry barriers was not the only change in the recent past. Further major changes included the introduction and subsequent abolition of a minimum wage in 2007, and a change to the Value-Added Tax Act in 2010. A look at market shares measured by volumes of processed postal items, or by revenue, quickly reveals the prevailing dominance of the former monopolist Deutsche Post AG (DPAG).[1] Despite an increasing number of market entries by private postal providers, it seems the German postal market is still characterized by the old monopolistic structures and that the aim of creating a competitive environment has not been fully achieved.

Despite recent substantial changes in the German postal market, there is still a research deficit regarding the potential of competition. This lack of research motivated me to provide the first empirical evidence of these issues and to start closing the gap. In general, the focus of my thesis is a literature review on the state of the German postal market and adducing the first empirical evidence on the success of small and medium-sized private postal providers which entered the German postal market after the market was opened up.

In my analysis, I concentrate on competitors of the former monopolist DPAG. Because of the need to obtain a license to work in the German postal sector, I only consider licensed firms. For simplicity, I refer to these competitive firms as postal providers. As shown in this work, German postal providers are distinctly individual in terms of services provided. Despite the heterogeneity of the licensed providers, the commonality amongst them is that they provide services related to items brought from one location to another.

The complex structure of the postal sector discussed above, which certainly complicates the analysis, is accompanied by a lack of data. In fact, there are hardly any data concerning

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[1] These statistics are regularly published on the website of the German Federal Network Agency: http://www.bundesnetzagentur.de

the German postal market. Thus, in order to provide empirical evidence on the analyzed issue I use data which I collected within the framework of a written survey in 2010, as well as data gathered from in-depth interviews with German postal providers subsequent to the written survey. The data collected in the framework of the written survey and the case studies resulting from the in-depth interviews are presented and used in Chapters 3 and 4 of this thesis.[2]

One of the first authors to address the issue of natural monopoly in the postal sector was John C. Panzar. He hypothesized that of all postal services it is mainly the delivery function that is a natural monopoly, and thus he concluded all other operations should be open to competition for efficiency. Panzar also addressed the vertical structure of postal networks which hamper the unbundling of intermediate services (Panzar 1991; Panzar and Sherman 1993). In these early works, Panzar did not consider the contestability aspect. In the sixties, Harold Demsetz noted that sunk costs, which constitute a major prerequisite for contestability, constituted a major barrier to market entry (Demsetz 1968). In fact, Kessides found that sunk costs limited market entry for diverse industries (Kessides 1990).

The primary purpose of Chapter 2 is to summarize the basic conditions of natural monopoly theory and to review the approaches and results of studies dealing with the topic in relation to the postal sector. Moreover, in this chapter I provide an overview on contestability theory and its major conditions and discuss the relevance of this theory with respect to regulatory issues. In general, I find that most authors detect scale, scope, and density economies within the postal sector. The most uniform result is that there are significant scale economies primarily in the downstream operation or delivery of postal items. From this result I conclude that all upstream operations, such as collection, sorting, and transportation of postal items, would benefit in terms of efficiency if opened up to competition. Besides the importance of the contestability aspect in this context, previous literature concentrates only on analyzing subadditivity in the postal sector. As shown in Chapter 2, the existence of sufficient conditions for a natural monopoly does not inevitably justify the governmental maintenance of the monopoly if the market is contestable, at least not from the theoretical perspective. This point will be discussed in detail for both a single and a multi-product case. I conclude from the review that further research is required in order to account for contestability.

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[2] Questionnaire, interview guidelines and further insight into the reported data are available from the author on request.

None of the studies reviewed in Chapter 2 provided empirical evidence for the German postal market. Thus, the aim of Chapter 3, in which I investigate firm success and the potential for competition, is to provide the first empirical evidence of the German postal market. For this purpose, I analyze key success determinants of market leader competitors. The analysis is based on unique data stemming from a survey which I conducted in 2010 for the German postal market. From these data I draw descriptive evidence and conduct an econometric analysis based on ordinary least squares, ordered probit and ordered logistic estimations. The analysis is further supported by eight case studies from 2011 in which I conducted in-depth interviews during on-site visits to various postal firms. In general, I find that there are opportunities for smaller private firms to succeed and survive in the market despite the natural monopoly occurring within the postal industry. The success of these firms is often based on specialization, cooperation and combining the postal business with another business, such as publishing.

Having identified the possibility of cooperation as a major way to overcome natural monopoly disadvantages for small and medium-sized postal providers, I analyze this issue in more detail in Chapter 4. Because wide geographical coverage is a major success determinant in the postal industry, I pursue the question of how small and medium-sized German postal providers can ensure a nationwide coverage without the aid of the former monopolist and market leader DPAG. A closer look at the industry reveals that postal providers in Germany engage in different types of cooperation in order to expand their geographical coverage independently of the market leader. In order to shed light on the effects of cooperation, I conduct a theoretical analysis using a spatial economic model, which is complemented by a game-theoretical discussion. Moreover, I provide the first descriptive and case study evidence, again from the data elevated within the written survey and from the in-depth interviews. In general, I find that small postal providers engage in different forms of cooperation in order to extend their geographical service area and to succeed in the market. Furthermore, I find, in both the theoretical analysis and in the empirical evidence, that there is also a negative counter-effect stemming from cooperation because firms operate in the conflicting area of cooperation and competition.

This work makes several contributions to research. To my knowledge, it is not only the first to deal with the natural monopoly issues facing the German postal market, but also the first to provide empirical evidence and to analyze the consequences of the market's complete

opening-up in 2008. Chapter 5 summarizes the main results of this work and provides a brief outlook regarding the need for further research.

2 Subadditivity and Contestability in the Postal Sector: A Survey of Theory and Empirical Evidence

2.1 Introduction

Monopolies have a long tradition in the postal sector; however, this has already changed in several countries and many others will follow. To answer the question of whether this change is truly efficient, it is necessary to have a closer look at the features of this industry. Several studies concerning the postal sector have been conducted to analyze whether the postal sector exhibits properties of natural monopoly. The aim of the researchers was to test the existence of subadditivity in order to determine whether and how the postal sector should be regulated. The existence of such characteristics would have important policy implications. If conditions of a natural monopoly are present, it would be preferable that only one supplier operates in the postal market because competition would lead to efficiency losses.[3] Nonetheless, in this case there would be a strong need for governmental regulation, because of the risk of excessive prices. One of the major challenges in this context is the network characteristic of the postal service. As shown in this chapter, several researchers detected that there are some operations of the postal network where a competitive structure would be beneficial because they do not exhibit properties of natural monopoly. The existence of a natural monopoly can be tested by analyzing the existence of scale and scope economies or subadditivity, respectively. The question of the existence of a natural monopoly is strongly related to the question of whether or not market-entry is desirable for efficiency reasons. John C. Panzar was one of the first to address the issue of a natural monopoly for the postal sector; he also referred to the vertical structure of postal networks (Panzar 1991; Panzar and Sherman 1993). Many empirical investigations which followed referred to his hypothesis that the delivery function is a natural monopoly; however, as Harold Demsetz (1968) noted in the sixties, sunk costs—a major prerequisite for contestability—constitute a major barrier to entry. Despite

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[3] As mentioned in the introduction, in this thesis I focus on competitive potentials of small and medium-sized German postal providers. Competition from large foreign postal providers is not further considered.

this important finding, the aspect of contestability has not received much attention in previous empirical investigations.

This chapter focuses on both the theory of natural monopoly and the theory of contestability and econometric studies, which have been used to assess these issues for the postal sector. The aim of this chapter is to depict the principal ideas of the most relevant studies and to show the differences between the approaches. The chapter is divided into two main parts. To explain the approaches, a closer look at the theoretical background is provided in the first part. A central question addressed here is this: which set of conditions are sufficient for cost subadditivity and contestability? The second part of this chapter provides a review of econometric studies conducted to analyze these issues for postal sectors in different countries. In this part, the approaches, the underlying datasets and the results of the studies are presented and compared. The results will be summarized in the last section.

2.2 Theoretical Foundations

The postal service, like most forms of transportation, is a network industry (Panzar and Sherman 1993). From an industrial-economic perspective, two questions are of major interest in this context:

1. Is the postal sector a natural monopoly?

2. Is the postal sector contestable?

The conventional theories related to these questions are the natural monopoly theory and the contestability theory. Both are presented in the following two sub-sections.

2.2.1 Subadditivity

The subadditivity concept is used in order to determine whether an industry exhibits monopolistic features. For an industry to be characterized as a natural monopoly, its cost function must be strictly subadditive over the entire relevant range of output (Baumol et al. 1988, p. 17). In the case of the existence of a natural monopoly efficiency would mean that the whole output vector is being produced by one single firm. Economies of scale and economies

of scope are the two major conditions associated with this issue. They help to determine whether competition should be introduced in a specific market for efficiency reasons, and in which operational areas this must be done. If, for example, an industry does not exhibit features of natural monopoly, it may be beneficial to encourage competition in this area. This section includes a theoretical discussion of the sufficient conditions for natural monopoly in the single-product and multi-product cases, as the subadditivity concept can be applied to both.

In the single-product case, global economies of scale are sufficient for subadditivity and thus for the existence of a natural monopoly (Baumol et al. 1988, p. 22). Economies of scale denote the benefits of producing a higher amount of output. The existence of economies of scale therefore implies that a firm could save costs when operating on a higher output level. Thus, the average costs of production diminish at higher output levels, as illustrated in Figure 1 (Fritsch et al. 2007, p. 184).
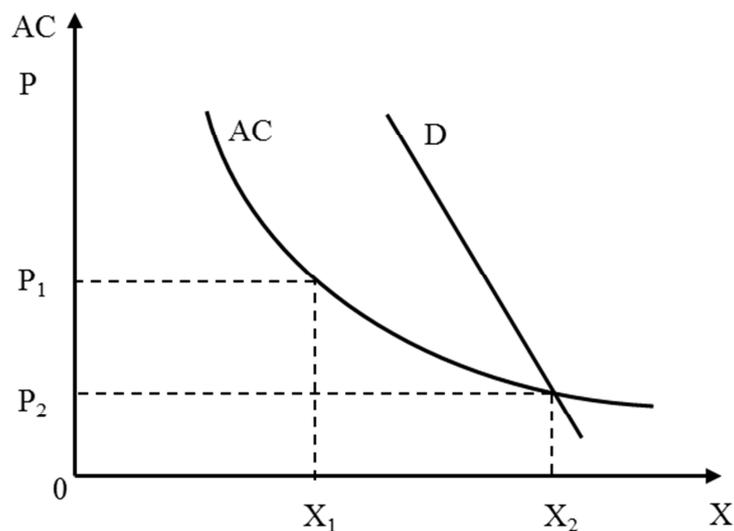
Figure 1: Average Costs in Natural Monopolies

The intersection of the demand function D with the average cost function AC determines the relevant market demand. From the declining average cost function, we see it is beneficial if the demanded quantity X_2 is supplied by only one firm at the price of P_2. Each output quantity

16

lower than X_2 can only be supplied at significantly higher average costs. If, for example, two firms supply the output X_2 together, each of them supplying the lower output X_1 at the price P_1, then the costs of producing one unit would be higher than in the case of production by a single firm.

There are various reasons which can account for the existence of scale economies. A few examples are a minimum required amount of the input factors, economies of density, stochastic savings and learning curve effects.[4] The existence of one or more of these determinants can lead to the existence of global scale economies and thus to a subadditive cost structure. With regard to industry structure, a subadditive cost structure implies it is cheaper for one firm to produce the whole output than for multiple autonomous firms to do so whereby each produces a subset of the total quantity. Formally, subadditivity of the cost function is given if the following inequality is fulfilled:

$$(1) \quad C(\sum_{i=1}^{n} X_i) < \sum_{i=1}^{n} C(X_i).$$

Following this inequality, the cost function $C(X)$ is subadditive, when for all output subsets X_i (with $i = 1,...,n$) less production costs arise, if only one supplier produces the whole amount. Also, at least two subsets X_i must be greater than zero in order to satisfy this condition. The left side of this inequality represents the case when only one firm produces the whole output and the right side the case of a separate production by different companies (Fritsch et al. 2007, p. 188).

The extent of the economies of scale is usually measured by the elasticity of total costs with respect to the total output produced. This construct is defined by the following equation:

$$(2) \quad \eta_C = \frac{\Delta C}{C} / \frac{\Delta q}{q} = \frac{MC}{AC}.$$

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[4] See Fritsch et al. 2007 for a closer discussion of the determinants of scale economies.

The elasticity η_C indicates the percentage change of the costs C, if the output q rises by one percent. If the value of this elasticity is less than one, it can be concluded that the industry exhibits substantial returns to scale. Thus it appears that, on the basis of the duality of production and cost functions, the inverse term of this elasticity can be used to measure the extent of the economies of scale (Varian 1997).

$$(3) \quad S = \frac{1}{\eta_C} = \frac{AC}{MC}$$

The optimal size of an enterprise measured in terms of the output follows this definition at the scale economies value $S = 1$ where the average costs AC equal the marginal costs MC (Baumol et al. 1988, p. 21).

The issue of subadditivity in multi-product cases was first discussed in detail by Baumol and colleagues in the eighties (1982 and 1988). Unlike the single-product case, scope economies play an important role in the multi-product case, because of the production of multiple heterogeneous commodities. In this context, decreasing ray average costs, the equivalent of declining average costs in the single-product case, is neither necessary nor sufficient for subadditivity of the cost function. Consequently, the isolated consideration of scale economies will not be sufficient to determine whether a natural monopoly is present in the multi-product case. Instead, it is important to analyze whether scope economies are also present in the industry under consideration. Scope economies denote cost savings resulting from production of several different outputs jointly rather than separately. Thus, a combined production provides strong potential for reducing costs. The analysis in the multi-product case is more complex and primarily based on the different cost functions of the products. Moreover, different proportions of the relevant market demand for the commodities additionally complicate the analysis. Similarly to the single-product case, there are several different reasons for the existence of scope economies in the multi-product case. One of the most common reasons is the utilization of the same input factors for production of the different outputs. Using the example of a two-product industry, scope economies can formally be defined as follows:

$$(4) C(X_1, X_2) < C(X_1, 0) + C(0, X_2)$$

The left side of this inequality represents the costs in the case of a joint production of two heterogeneous products by a single firm. Conversely, the right side represents the case when these two products are supplied separately by two different firms whereas $C(X_1, 0)$ represents the costs of the sole production of the commodity X_1 and $C(0, X_2)$ the costs of the production of the commodity X_2, respectively. If this inequality is satisfied, the two commodities X_1 and X_2 should for efficiency reasons be produced by a single firm because the costs of producing them in combination are less than the costs of producing them separately (Fritsch et al. 2007, p. 192). To analyze whether subadditivity in a multi-product sector is fulfilled, it is necessary to examine if the cost-function in the multi-product case exhibits two particular features. Declining ray average costs and trans-ray convexity must be present in order for the cost-function in the multi-product sector to exhibit subadditivity (Baumol et al. 1988, p. 47). The combined presence of declining ray average costs and trans-ray convexity indicates the existence of a natural monopoly because it is technically efficient for only one firm to produce a particular mix of products. Declining ray average costs denote the cost savings of producing a higher amount of the product mix, whereas trans-ray convexity denotes the existence of scope economies in a multi-product case. Figure 2 illustrates an idealized average cost surface in which both subadditivity conditions are satisfied.
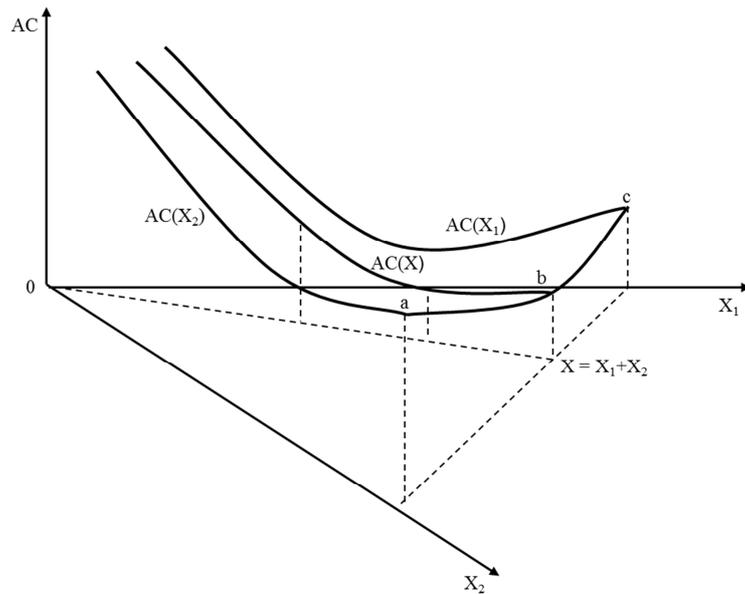
Figure 2: Declining Ray Average Costs and Trans-Ray Convexity

The existence of declining ray average costs is the first characteristic of the cost surface. Since average costs cannot be defined in the multiproduct case, the analysis of the average cost function does not refer to single products, but to whole output bundles whereby the proportions among the commodity quantities remain constant. Thus, an arbitrary output vector or ray is chosen as a co-product in order to analyze the effect of a simultaneous and equivalent increase or decrease of both products on costs (Baumol 1982, p. 6). In Figure 2, the dashed line between the two points 0 and X represents this ray and $AC(X)$ represents the associated average cost function of this product bundle. The essential features of the function $AC(X)$ in Figure 2 are analogous to those shown in Figure 1. The trans-ray convexity of the cost function denotes the existence of scope economies, which result from the combination of both products X_1 and X_2. Trans-ray convexity can be applied to a multi-product setting and implies that it is less expensive for a single firm to produce a particular combination of different products than for different firms to produce the single products in isolation. This effect is illustrated in Figure 2 and can be best seen with the aid of a cross-section of the cost surface. The sole production of either X_1 (point c) or X_2 (point a) causes higher costs than a combination of both products (point b) (Baumol et al. 1988, p. 48). The convexity of the cost function across all possible rays between the X_1-axis and the X_2-axis through the origin indicates trans-

20

ray convexity and thus the existence of scope economies. However, if the effect of product-specific scale economies outweighs the effect of the scope economies, it would be better for firms to specialize in the separate production of single goods. The joint presence of scale economies and trans-ray convexity is sufficient for the presence of subadditivity in a multi-product industry and hence constitutes a natural monopoly.

Just as for scale economies, the magnitude of scope economies can be calculated with an analogical measure. This measure quantifies the additional costs that occur if two or more heterogeneous goods are not produced in common but separately. Formally, the degree of scope economies can be defined as follows:

$$(5) SC_T(X) \equiv \frac{[C(X_T) + C(X_{N-T})] - C(X)}{C(X)}.$$

The variable $SC_T(X)$ can be interpreted as the percentage change of the costs as long as the whole product set N is produced by more than one firm. Thus, this measure quantifies the relative increase in cost which occurs if the productions of the two subsets T and N-T are separate. This, in turn, could lead either to an increase or a decrease of total costs. Of course, there is a possibility that the separation does not have an effect on total costs. These three cases are indicated by the measure $SC_T(X)$, if it takes a value which is greater than, less than, or equal to zero, respectively (Baumol et al. 1988, p. 73). Combined production of all goods or services is thus less expensive if the industry exhibits scope economies.

2.2.2 Contestability

As presented in the previous section, the natural monopoly theory helps to determine if it is more efficient to have only one supplier within a market for a specific good or service. Two major regulatory issues arise in this context. The first one refers to the question of whether it is necessary to regulate market entry in order to prevent or allow the entry of potential competitors. The second one refers to the necessity of price regulation such that in the case of a natural monopoly the monopolist does not charge excessive prices or exploit con-

sumers in any way. The sole existence of subadditivity as discussed in Section 2.2.1 does not automatically justify market regulation. In fact, the combined consideration of both subadditivity and contestability sheds light on regulatory issues (Fritsch et al. 2007, p. 214). For this reason, the contestability concept will be examined more closely in this section in order to analyze its relationship to subadditivity and its contribution to solving regulatory issues.

The notion of contestability was primarily used by William Baumol in the eighties. In simple words, this concept was developed in order to characterize markets by determining whether market entry was possible or not. Although this theory is applicable to a broad variety of market forms, it pertains primarily to markets with substantial attributes of a natural monopoly. In short, a contestable market can be defined as one which can easily be entered and exited by potential competitors.

Generally, two main features are helpful for characterizing a contestable market: free and easy entry and costless exit (Baumol 1982, p. 3). Free entry indicates that potential entrants are not at a disadvantage compared with incumbent firms. This refers mainly to the aspects of costs, consumer preferences and access to required production technology. Of course, it also refers to the access of resourcing and selling markets. If potential entrants are at a disadvantage in terms of these points compared with incumbent firms, asymmetrical market access barriers would exist. Free entry also implies that there is no regulation prohibiting it. A costless exit, on the other hand, implies that firms can leave the industry without suffering a financial penalty (Griffiths and Ison 2001, p. 83).

In general, an exit from the industry is especially expensive if firms need to invest in so-called "sunk cost facilities." These are facilities which cannot be resold or rented without loss if firms intend to exit the market. Consequently, the costs of acquiring such facilities cannot be recouped if the firm exits the industry. These costs are called sunk costs and the decision is in this case characterized as irreversible, because it cannot be revised without financial losses (Bailey 1981; Baumol 1982; Griffiths and Ison 2001). It is important not to equate sunk costs with fixed costs because of the characteristics of sunk costs mentioned above (Bailey 1981, p. 178). Irreversible costs represent fundamental barriers to entry and can be causative for lower contestability of a market. Indeed, sunk costs are only one example of a barrier to entry.[5]

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[5] Essentially, sunk costs do not represent entry barriers but exit barriers.

A further necessary condition for contestability identified by Baumol is that potential entrants are able to enter the market just before incumbents have the possibility to react to this entry threat by reducing their prices. The entry lag, which represents the period necessary for entering the market, must be smaller than the price adjustment lag, which represents the period necessary for incumbents to lower their prices in response to the market entry and thus the increased competition in the industry (Shepherd 1984, p. 572).

Apart from the above, contestability theory is suitable for analyzing the effect which potential market entrants are likely to have on the strategic behavior of incumbent firms. It can be assumed that even the threat of new entry into the market by potential competitors could affect incumbents' behavior in terms of price and output decisions, disciplining them to behave as they would if competition existed within the market (Baumol 1982). Consequently, contestable non-competitive markets behave in a competitive fashion, forcing incumbents to charge prices equaling their long-run average costs.

Although the market structure calls for a single seller, the threat of potential entrants asserts that they are without monopoly power. This effect is higher the easier it is to access and leave the market. Nevertheless, if the incumbent charges excessive prices, potential entrants will enter the market and undercut the incumbent, attracted by the opportunity to earn profits in the industry. This behavior is named "hit-and-run entry" in the literature. Hit-and-run entry is more likely if sunk costs are not present because the costs of leaving the industry become lower (Griffiths and Ison 2001, p. 83). This, however, implies there is sufficient pricing flexibility in the industry, which is certainly not necessarily true for some industries. Often, prices cannot be changed by implication.

Strategically, market entries can be prevented by incumbents if they do not exploit monopolistic power particularly with regard to their pricing behavior. Hence, it is concluded that the need for public intervention is dispensable in a contestable market. If, on the contrary, the market is characterized by irreversibility, entry is not possible by implication because firms outside the market are at a disadvantage compared with incumbent firms. Unlike incumbents, firms wishing to enter the market need to account for sunk costs in their calculations. Moreover, the threat of potential entrants could force incumbents to be more efficient in terms of production. Also, inefficient production by incumbents could attract potential entrants to pro-

duce a specific service or good at lower costs and thus charge lower prices and increase their competitiveness.

In terms of regulation, it can be concluded that if there is a natural monopoly and the market is contestable at the same time, regulation becomes unnecessary from a theoretical perspective. If the natural monopoly is not contestable, there is the risk that a monopolist will charge excessive prices which, in turn, makes governmental price regulation indispensable. In addition, there is the possibility that the government may need to stimulate market entry if a natural monopoly does not exist but there is no competition on the market and a small number of suppliers in the industry. This could arise from the absence of contestability and the fact that it is not easily possible. A contestable market without a natural monopoly, however, describes an accustomed competitive environment within the market. Figure 3 summarizes the four possible combinations (Fritsch et al. 2007, p. 214).

		Contestability (Irreversibility)	
		Yes	No
Subadditivity (Natural Monopoly)	Yes	Potential Competition	Monopolistic Bottleneck
	No	Competition	Too much Competition

Figure 3: Subadditivity and Contestability

Source: Fritsch et al (2007)

In summary, it can be said that in theory the sole existence of a natural monopoly does not justify regulation. There is only a necessity for regulation if the natural monopoly is not contestable. Indeed, contestability can replace governmental regulation to a certain degree. Although the practical relevance of the contestability concept has been mistrusted by several studies, it appears that it is appropriate to describe market structure and processes for many reasons. Figure 3 clearly demonstrates the dimensions, which must be considered in order to decide on regulatory issues in postal markets. Both subadditivity and contestability must be considered in the analysis.

2.3   Characteristics of the Postal Sector

Suppliers of postal services represent a typical example of multi-product and multi-input enterprises. Firms operating in the postal sector serve a complex network of a large number of customers, providing them with different postal services. The main service consists of the carriage of postal items, although most firms provide further services such as the carriage and delivery of parcels, newspapers and magazines, or further transportation services. The network structure of this industry plays an exposed role because it is indispensable in order to provide an area-wide delivery of postal items. The vertical structure of postal networks is because postal companies must provide a sequence of intermediate services in order to guarantee the full service (Panzar and Sherman 1993). This is why the postal sector is counted among network industries such as telecommunications or railways, although it does not exhibit the sunk costs typical of network industries (Panzar and Sherman 1993). The basic network elements are mailboxes, offices and counters, processing facilities, and means of transportation such as road vehicles, airplanes, etc. Figure 4 illustrates a basic model of a stylized postal network.
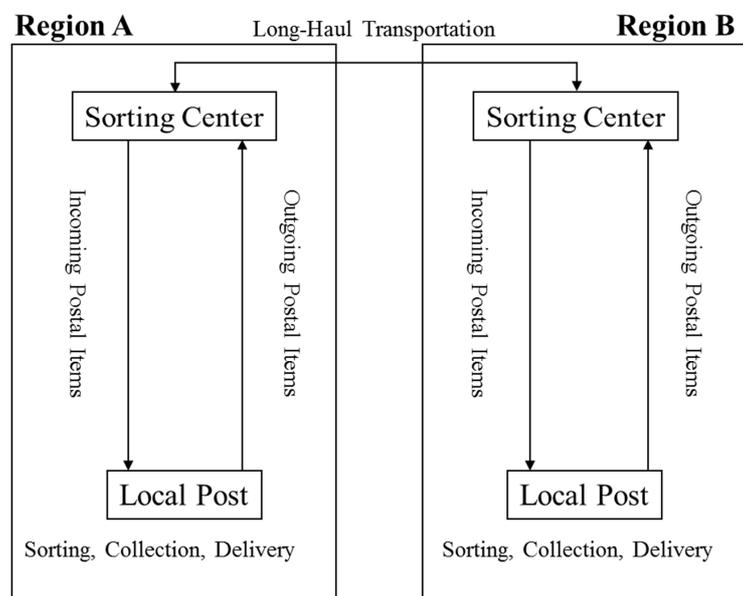
Figure 4: Simplified Stylized Postal Network

Source: Wein (2009) and Panzar and Sherman (1993)

25

Postal networks mainly encompass the five basic intermediate services: collection, inward sorting, outward sorting, transportation, and delivery of postal items (Panzar and Sherman 1993).[6] The first step in the postal process consists of collecting postal items. Typically, these items, which have been dropped into letterboxes or left at the post office counter are sorted and transported, usually in trucks or vans, to the next sorting center where they are again sorted and prepared for long-haul or air transportation. Subsequently, the mail is brought to another mail-sorting center located in the target region: one can distinguish between long-haul and short-range transportation, use of air or rail transportation facilities and trucking facilities. When the mail has been sorted in the sorting center, it is transported further to the delivery base where it is sorted according to delivery routes and lastly it is delivered by foot, car or bicycle to the recipient.[7] The delivery function is the most meaningful among all postal operations because the costs associated with providing this operation form the largest proportion of the total costs (Kruse and Liebe 2005, p. 18). This function is typically divided into three components: route time, access time, and load time. Route time represents the time which is required to cross the route. In general, these routes are longer in rural areas than in urban areas. In the next step, the deliverer must depart from the routes to access destinations; this is called access time. Finally, load time represents the time required to drop the mail into the letter-box or to hand it over to the recipient (Rogerson and Takis 1993, p. 114).

Postal providers may provide all intermediate services mentioned above or only selected ones (Christmann 2004, p. 31). If a provider offers multiple or all intermediate services, it is vertically integrated. Hence, the degree of vertical integration denotes how many of this sequence of services is provided by the firm on its own. Vertical integration can range from two to all intermediate services (Schoelermann 2005, p. 3). The opposite of the vertical integration is when the provider ensures merely one of the intermediate services and obtains the rest of the services from the market. The decision to provide vertical integration depends on profitability. Vertical integration is particularly beneficial for postal providers when technological and organizational scope economies between single services are highly pronounced. More precisely, it is beneficial for a firm to offer multiple operations of the postal network if scope economies exist between them. That is to say, if it is cheaper to provide the specific opera-

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[6] These intermediate services are named "operations" or "functions" in the following.

[7] Of course, this is only one example of the process. A significant number of postal items are, for example, collected and delivered within the same region and thus long-haul or air transportation is not necessary.

tions combined rather than separate. In most instances, coordination economies between the different operations are present. With regard to natural monopoly theory, coordination economies may lead to subadditivity of the network as a whole if only one single operation of the network exhibits features of natural monopoly (Rogerson and Takis 1993, p. 113). In such a case, the subadditivity feature of the whole network can also be attributed to the source of scope economies between the single operations. Further examples include the sharing of resources and transaction advantages through the combination of two or more operations of the postal network. The natural monopoly theory discussed above can be applied either to the whole network or to single steps. In this context, it is necessary to determine whether the network as a whole or some of its operations satisfy the sufficient conditions of the natural monopoly. Technically, this can be tested by estimating cost function and analyzing whether cost structure is subadditive, as described earlier in this chapter. The next section reviews empirical studies conducted to analyze subadditivity and contestability in the postal sector.

2.4   Empirical Studies

As a consequence of the worldwide developments in the postal sector, a large number of studies have been conducted in the economic literature. The research efforts have developed in different directions. Recent studies dealing with the postal sector concentrate on the "electronization" of the postal sector and on intersectoral competition (see for example Cuomo et al. 2013, Veruete-McCay et al. 2013, Elkelä and Nikali 2013). Another focus of numerous studies is the universal service obligation (USO). The issue of ensuring a universal service in postal markets especially in the context of liberalization is still one of the most discussed topics in the literature (see for example Cuomo et al. 2013, Crew and Kleindorfer 2009, Boldron et al. 2009, Bradley et al. 2009, Jaag et al. 2009, Cigno et al. 2009, Crew and Kleindorfer 2008). Postal sectors are still regulated in almost every part of the world. Thus, numerous studies deal with different aspects of regulation and competition in the postal sector (see for example Maegli and Jaag 2013, Leskinen et al. 2009, Dietl et al. 2005, Moriarty and Smith 2005). The most important studies on postal issues have been presented at Center for Research in Regulated Industries (CRRI) conferences and also been printed in CRRI publications. The Rutgers CRRI conferences, which have been organized since 1990, represent in-

ternationally acknowledged conferences dealing with postal and regulatory issues. A good literature overview on the developments and economic themes since the beginning of these conferences is provided by Rodriguez (2013). The issue of natural monopoly is in fact one of the crucial aspects of postal markets. As will be shown in this section, there is a lack of studies dealing with this issue in the German postal market.

In practice, the conditions of natural monopoly are difficult to prove. However, numerous empirical investigations shed light on the presence of these conditions in the postal sector. This section reports on the empirical investigations conducted to determine whether there are scale and/or scope economies in postal services. The authors of the reviewed studies estimate cost functions in order to analyze the existence of these economies. The theme of scale and scope economies is not only analyzed for the whole network but in a few cases for single postal operations as well. Most econometric studies rely on an analysis of the postal delivery function, a result of the fact that it accounts for the largest proportion of costs within all operations (Kruse and Liebe 2005). The number of studies which deal with the collection, transportation, and sorting of postal items is significantly smaller. In their studies, most authors assume an operational structure resembling the one discussed in Section 2.3. In connection with the estimation of scale and scope economies, the authors discuss the public policy implications of their theoretical and empirical results. Despite the importance of this topic for public policy there is still not enough evidence for it. Table 1 summarizes the results of the main studies.[8]

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[8] Note: This table includes only studies dealing with natural monopoly issues.

Table 1: Summary of Major Research Efforts

Authors	Date	Title of Work	Data	Region	Approach	Results
Gupta and Gupta	1985	Economies of Scale and Economies of Scope in the US Postal Service	Published postal data for 1961to1980	USA	Estimation of postal translog cost function and inferences regarding scale and scope economies	Economies of scale estimates between 0.196 and 0.448
Norsworthy et al.	1991	Productivity and Cost Measurement for the United States Postal Service	Two hundred management sectional centers in 1984	USA	Translog variable cost function	10% (scale coefficient: 1.099)
Rogerson and Takis	1993	Economies of Scale and Scope and Competition in Postal Service	PRC data / several recent empirical studies of economies of scale and scope in the USPS	USA, EU	Derivation of measures of economies of scale and scope from marginal cost based rates	Scale economies in delivery but no scope economies; returns to scale in some portions of the transportation function
Bradley and Colvin	1994	An Econometric Model of Postal Delivery	A sample of routes from roughly 150,000 city delivery routes maintained by the USPS	USA	Non-linear least squares	Mainly significant scope economies
Wada et al.	1997	Empirical Analysis of Economies of Scale, Economies of Scope, and Cost Subadditivity in Japanese Mail Service	Cross-sectional data (180 observation points from 1980 to 1994)	Japan	Usual translog cost function; generalized translog cost function	Existence of scope economies and returns to scale between 1.03 and 1.06
Cohen and Chu	1997	A Measure of Scale Economies for Postal Systems	CCS data for 1993 (8,000 route-level observations) and data from an unpublished paper (1988) based on UPU statistics which	USA, UK	Delivery function; comparison of the cost of providing delivery by a single firm with the cost of providing delivery by two identical firms	Existence of economies of density, delivery costs are in the case of two firms are around 50% higher, value of scale USA 1988 (1993): 12% (13%) of the total cost, UK 1988: 17%, effects of economies of scale in

			are in turn based on communications with officials			delivery represent significant barriers to entry
Cazals et al.	1997	Scale Economies and Natural Monopoly in the Postal De-livery: Comparison between Parametric and Non Paramet-ric Specifications	Cross-section of 400 post offices in 1992	France	Parametric and non-parametric	Global elasticity of labor demand: 91%; 50%
Cazals et al.	2001a	An Analysis of some Specific Cost Drivers in the Delivery Activity	Data from 1997 cross-sectional data from 1998 (i), and panel data for the periods 1994 to1998(ii)	France, EU	Translog cost function	Scale economies: 1.13-1.68 for France and 1.17 for EU countries, a 10% increase of postal density leads to a 2.7% decline of costs in France and 2.9% decline of the average costs in the EU countries, 0.885(i) and 0.594(ii)
Cazals et al.	2001b	An Econometric Study of Cots Elasticity in the Activi-ties of Post Office Counters	Data of 9,168 French post offices	France	Ordinary Least Squares	Scale economies measure: 80%
Bernard et al.	2002	Delivery Cost Heterogeneity and Vulnerability to Entry	Data from 39,737 rural routes and a stratified sample of 8,300 city routes	France, USA	Analysis of economies of density (USA: trans-log-specification, F: engineering cost model)	Postal density is low: France 23 % and USA 42 %; postal density is high: France 13 % and USA 36 %
Gazzei et al.	2002	On the Output Elasticity of the Activities of Post Office Counters in Italy	Database of 11,415 counters in Italy	Italy	Estimation of production functions: Model I: OLS over the whole sample, Model II: OLS over a subset of observations filtered by a sto-chastic frontier, Model IIa: like Model II but including quadratic terms in x, Model III: OLS over a subset of observations filtered with DEA model	Model I: 1.2063, Model II: 1.2034, Model IIa: 1.2225, Model III: 1.1060 and returns of scale in all offices between 10 and 25%
Bradley et al.	2006	Measuring Scale and Scope Economies with a Structural	Data from 145 zip codes daily observa-	USA	Two equations recursive structural model	Scope economies measure: 1.662

		Model of Postal Delivery	tions over a 2 week period (11 delivery days in the spring of 2002)			
Farsi et al.	2006	Economies of Scale, Density and Scope in Swiss Post's Mail Delivery	cross-section data from 2004 (information on 327 postal units)	Switzerland	Quadratic specification to estimate measures of economies of scale, density and scope (between mail and parcels)(4 different models)	Scale economies as well as scope economies
Fenster et al.	2008	Are there economies of scale in mail processing? Getting the answers from a large-but-dirty sample	USPS data including quarterly observations from 1999 to 2005 of up to 368 USPS processing plants	USA	Maximum likelihood estimation	USPS mail processing plants predominantly operate at levels where returns to density and scale are decreasing
Bozzo	2009	Using operating data to measure labor input variability and density economies in United States Postal Service mail processing operations	USPS operating data from 1999 to 2006	USA	"Hedonic" factor demand model	Modest density economies in the USPS sorting function
Cigno et al.	2013	Estimates of US postal price elasticities of demand derived from a random-coefficients discrete-choice normal model	Models are fitted using two different measures of US postal prices provided by USPS	USA	Random coefficients discrete choice logit model	Own-price elasticities ranging from -0.8 to -3.5

One of the first studies was conducted by Gupta and Gupta in 1985. In their empirical investigations they analyze the existence of scale and scope economies within the operation of the United States Postal Service (USPS), using published postal data from 1961 to 1980. They estimate postal cost function on the basis of a translog cost function, and account for labor, capital, transportation and space as factor inputs. The outputs were aggregated to two products because of the limitations of the data. They computed the scale economy estimates from the translog cost function and drew conclusions regarding the existence and intensity of scale and scope economies. Unlike most other authors, these authors demonstrate in their early study the existence of diseconomies of scale and scope economies. The scale economy estimates vary between 0.196 and 0.448. The striking variation in the estimates results from the sensitivity of the estimates of scale elasticity to capital cost changes, which are included in the dataset and in the estimation. This, however, does not affect their main finding that there are diseconomies of scale (Gupta and Gupta 1985).

One study which examined the postal network as a whole (i.e. all operations are considered in the analysis) was conducted by Norsworthy and colleagues in 1991. The authors estimated the costs of management sectional centers (MSCs) in their study. MSCs operate in the USA in the whole postal network and are therefore responsible for collection, sorting, and delivery of postal items. The estimation was processed with data from 200 MSCs in 1984. The analysis was based on a translog cost function in which the authors detected economies of scale amounting to 10% in their estimations (scale coefficient: 1.099) (Norsworthy et al. 1991).

In 1993, Rogerson and Takis also analyzed whether USPS postal operations exhibit scale or scope economies. They used a simple model of the USPS postal network which resembles the model discussed in Section 2.3 and in which they considered the intermediate services sorting, transportation, and delivery. To analyze whether scale economies existed, the authors chose the cost elasticity of the output as a measure, and derived the measures from marginal cost-based rates. Moreover, in their study they used information from PRC data and several recent empirical studies about scale and scope economies within the USPS. They calculated a value amounting to 35 percent for the delivery function. They found that there are scale economies in the delivery function, but not in the sorting and long-haul transportation functions (Rogerson and Takis 1993).

In their analysis of 1994, Bradley and Colvin analyzed whether the postal delivery function is a natural monopoly. They tested for subadditivity and estimated the degree of scope economies among individual products for the postal operation. They modeled costs as numbers of stops but focused only on the access portion of delivery and ignored loading time.[9] Furthermore, they implied in their model a direct and positive relationship between the volume of delivered items and delivery costs. The authors used a non-linear, least squares estimation in which the explanatory variables were the volume, the possible number of stops, and the likelihood that an increase in the volume would generate additional actual stops which equaled accesses to the delivery points. The data used in this study consisted of mail volumes and delivery stops from a cross-section of the USPS city carrier routes and encompassed a sample of roughly 150,000 city delivery routes maintained by the USPS. The authors found both subadditivity of the delivery cost function and scope economies. Moreover, they found that there are scale economies in the transportation function, but only small effects for the long-haul transportation by railroad or airplane, estimating scale economies on average amounting to 1.03. They estimated greater effects for the road haulage which varied between 1.11 for long and 1.52 for short ranges (Bradley and Colvin 1994).

In 1997, Cohen and Chu examined the impact of scale economies using the delivery function of the USPS as an example. In their approach, they first calculated the costs of the delivery function by assuming that there was only one firm on the market. In the next step, they deviated from the assumption of the existence of a monopoly and recalculated the costs assuming that there were two identical firms offering the delivery function. They assumed that these two firms shared the market equally and that each of them served the entire country every delivery day. For their analysis, they disaggregated street delivery time into three sub-components: a fixed route time, a partly variable access time depending on volume, and a variable load time also depending on volume.[10] The data used in this study encompassed a representative sample including street delivery costs data, such as volumes and delivery point characteristics collected by the postal service. These data were observed every two weeks over a one-year period for about 300 routes. As a result, the authors calculated higher costs in the duopoly case than in the single firm case. This is deeply rooted in the fact that the fix

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[9] The single components of the delivery function are discussed in Section 2.3.

[10] These components of the delivery function are discussed in Section 2.3.

costs accrued two times in the duopoly case, because each firm had to establish its own delivery network. From this, the authors inferred subadditivity in the cost structure of the US delivery function (Cohen and Chu 1997).

The study by Wada and colleagues (1997) differs predominantly from most of the abovementioned studies in two points. First, the study did not deal with the US postal market, but with the Japanese postal market. Secondly, the authors did not only concentrate on the delivery function, but also measured overall scale and scope economies and cost subadditivity. Therefore, the objective of investigation in this study was the postal network as a whole as per the study of Norsworthy and colleagues (1991) mentioned earlier in this section. They used two different multiproduct cost functions of the Japanese postal service, one based on a usual translog cost function and the other on a generalized translog cost function, and conducted the estimation using cross-sectional data from 1980 to 1994 encompassing 180 observation points. The total costs were estimated from the number of mail items, labor price input, and goods price input. The results from this study show there are significant scope economies and overall scale economies lying between 1.03 and 1.06 in the Japanese postal market (Wada et al. 1997).

Cazals and colleagues (1997) attempted to provide empirical evidence for the subadditivity of the delivery process in the French postal services. The authors estimated both a parametric and a non-parametric model, concentrating on the specifications and results of the parametric model. They used this parametric model in order to obtain a measure for returns to scale and to run simulation scenarios to test for subadditivity. For their estimation, they used data about mail volumes, labor quantities and environmental characteristics for a cross-section of 400 post offices in France during 1992. Moreover, information on the types of delivery and on the time worked in the different activities was considered in the study. The authors detected global elasticity of labor demand between 50 percent and 91 percent (Cazals et al. 1997).

Their study of 1991 also focused on the delivery function. Their objective was to analyze possible cost drivers for postal delivery activities and to explore the size effects of the delivered items on the cost of delivery using French data. The authors defined the characteristics of postal items (e.g. weight of the postal items) or environmental features (e.g. density of the delivery area) as the appropriate cost drivers. This study used index models to analyze cost

34

drivers. After estimation of cost functions, the measures of size effects were derived. For their estimation in this study, the authors used a fixed effects approach with a parametric specification of the cost functions applied within an estimation procedure. The main variables in the equation were the outdoor delivery costs, measured by the number of hours worked per week, the vector of output quantities, and the density of the delivery area of each post office, which was measured by the number of delivery points divided by the length of the route. The data stemmed from a database of La Poste with data from 1994 to 1998 and included around 9,000 French delivery post offices. The five periods were used to estimate the panel data model with a translog cost function. The cross-sectional analysis was processed with data from 1998 because of the high quality of data in this period. In both estimations, the authors found increasing returns to scale; the value for returns to scale in the fixed effects approach was higher than in the cross-sectional analysis. In short, the estimation with cross-sectional data yielded a scale economies measure amounting to 1.13, whereas the panel data estimation result amounted to 1.68 (Cazals et al. 2001a).

Cazals and colleagues (2001b) dealt with front-office activities in the postal counter network of La Poste in France. The aim of the authors was to obtain estimates of cost elasticity for all activities performed at counters in post offices by analyzing their cost function. To do this, the researchers decomposed the production process of counters into front and back office activities to obtain an estimate of the cost elasticity for the counter activities. The output of postal counters was measured by all operations and services offered to the customers at these counters. To derive the estimates, the authors chose OLS regression and ran different scenarios using the same data. In the first scenario, the authors assumed that two firms shared the existing volume of mail; in the second scenario they assumed that one firm took all offices whose volume of mail was above the average, and two firms shared the remaining offices. In the third scenario, one firm took all offices where the volume of mail was lower than the average and two firms shared the rest of the post offices. All models were used to compute an average amount of labor per post office. The obtained values were used by the authors for comparison with the values obtained by La Poste as a whole. The variables considered in these estimations are the cost of counter activity for a post office, sales and after-sales services, financial services, and the back-office activities for each post office. The data used to estimate the models came from 9,168 post offices of the French public postal network observed in 1999. The authors found that on average counter activities were characterized by

scale economies amounting to 80 percent. Furthermore, they concluded that scope economies might also be present for the various front office activities (Cazals et al. 2001b).

Bernard and colleagues published a study in 2002 in which they tried to explain the differences in delivery costs among different geographic areas. They compared delivery costs between two different countries: France and the United States. After presenting demographic and postal delivery characteristics, they developed the concept of postal density to account for characteristics in the estimation. The authors choose two different approaches to derive the average costs. For the USA, they econometrically estimated a translog equation of street time, whereas for France they estimated this variable using an engineering cost model. The dependent variable in the estimation was, as already mentioned, street time and the independent variables were the volume of pieces of mail per address, the postal density, and the number of addresses. The French data represented delivery data for La Poste, available for each delivery area and each delivery area represented a postcode. The US data were from the City Carrier Cost System and the Rural National Count System and encompassed data from 39,737 rural routes and a stratified sample of 8,300 city routes for the year 1999. The authors found that volume is a more important cost driver in low postal density areas than in high postal density areas. The French postal density is higher at every quantile. At high postal densities the fixed costs are lower and thus the potential for scale economies is lower (Bernard et al. 2002).

A further study was published by Gazzei and colleagues in 2002 dealing with the output elasticity of post office activities in Italy. The authors estimated several production functions to evaluate the role of universal service obligations (USO).[11] To resolve the problem of the relation between unsaturation and scale economies, the authors estimated production frontiers and chose the translog functional form because of its flexibility.[12] The overall scale economies were then derived through the proportional change of all input factors and the corresponding change of the output. The authors chose four different models in order to estimate

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[11] The USO ensures the supply of standard postal services at uniform and affordable quality and rates. This task was traditionally imposed on the monopolist.

[12] The translog function, a generalization of the Cobb-Douglas and CES functional forms, does not imply constant substitution elasticity in all factor combinations. Thus, this functional form allows for an approximation of the real cost structure by the development of a second-order Taylor series approximation. An application of this functional form is especially appropriate, if the real functional form is unknown (Schierjott and Schulze 1985, p. 190).

the scale economies and used data from 11,415 counters in Italy for the year 2000. They detected returns to scale in all offices regardless of size. Furthermore, they found that the bigger the post office, the smaller the resulting unsaturation and therefore the smaller the potential for scale economies. These results were uniform across all estimations made by these authors (Gazzei et al. 2002).

Bradley and colleagues applied themselves to measuring scale and scope economies for the postal delivery function in their 2006 study. Their aim was to obtain reliable measures of the magnitudes of these economies by modeling the USPS method to optimize its delivery network. To do this, they specified a two-equation recursive model in order to reproduce the two-step delivery process of the USPS. First, the number of routes per zip code was determined, and after that the time per route within the zip code. For their estimation they chose a quadratic functional form because of its ability to allow for increasing, constant or decreasing returns to scale and because of its ability to accommodate zero volumes in the dataset. The included variables were prepared mail, cased mail and delivered mail. The dataset consisted of daily observations on the total street time and volumes delivered. These observations were made over a two-week period equaling 11 delivery days in spring 2002. Moreover, the density variable was added to the estimation to control for the geographic density of a zip code. The authors found that increases in delivered volume within a zip code led to an increase in the number of routes needed to provide the delivery service. An increase in the routes caused an increase in delivery time. In sum, the finding of this study was that the postal service exhibits characteristics of a natural monopoly. Not only could scale and scope economies be detected, but also coordination economies between the postal operations (Bradley et al. 2006).[13]

In a study made for the Swiss postal market conducted by Farsi and colleagues in 2006 the authors analyzed the existence of scale, scope and density economies on the basis of a quadratic cost function using a cross-section dataset from the Swiss Post in 2004. The cost function for the delivery units of Swiss Post considered the two outputs: mail and parcel, and the two input factors: labor and capital. Furthermore, the labor price, measured as the average annual salary of a full-time-equivalent delivery employee, and the capital price, measured as the ratio of the non-labor expenses to a measure of physical capital, was used for the estima-

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[13] The notion of coordination economies is explained in Section 2.3 of this chapter.

tion. A variable representing the number of delivery points in the service area and a further one representing the number of affiliated local delivery units were included in the model. Additionally, dummy variables representing northern, eastern, western and southern regions were considered. The model was estimated with four different econometric specifications: ordinary least squares model, two different weighted least squares models and a multiplicative heteroscedastic regression model. The data used in the study consisted of a cross-section of 328 mail delivery units operated by Swiss Post's letter section which were organized as 241 local delivery units and 87 regional centers. In this study, the authors could find empirical evidence for economies of scale, scope and density in all models but the last model yielded the best results (Farsi et al. 2006).

Despite the variety of new themes recently discussed in terms of the postal industry, three recent studies analyze issues relating to the natural monopoly theme. Fenster and colleagues (2008) analyze scale economies in the mail processing function. The authors provide econometric evidence indicating that the USPS mail processing plants predominantly operate at levels where returns to density and scale are decreasing. The results are derived from a maximum likelihood estimator used to fit two-regime linear stochastic switching regressions with a panel from the USPS management operating data system, which consisted of quarterly observations from 1999 to 2005 for up to 368 USPS processing plants (Fenster et al. 2008).

A similar focus is found in the study conducted by Bozzo in 2009. He measured labor input variability and density economies in mail processing operations of the USPS, also using USPS data sources. However, this analysis is based on a "hedonic" factor demand model. These models are estimated for letter and flat sorting operations using data from 1999 through 2006. One of the statistically robust results of this study is that there are only modest density economies in the USPS sorting function (Bozzo 2009).

The last study to be mentioned is that conducted by Cigno and colleagues in 2013. These authors estimated own-price and cross-price elasticities on the basis of a random-coefficient discrete-choice logit model. Their model was fitted with two alternative postal price measures: average revenue per piece and fixed-weight index prices. The authors derived price and cross-price elasticities from parameter estimates and found that their estimates of price elasticities were considerably different from estimates resulting from conventional economet-

ric methods, suggesting that US postal products are much more sensitive to price changes. They estimated own-price elasticities ranging from -0.8 to -3.5 (Cigno et al. 2013).

In summary, all authors found evidence for the existence of significant scale and scope economies in delivery. The results of the different investigations are uniform, and they differ mainly in degree of scale and scope economies detected. All studies have in common that they only consider the incumbent and not the actual or potential competitors on the market. This is manifest in the models built for the analysis, and in the underlying dataset used to estimate the measures. Regarding approaches, there are differences in methodology selected as well as in the underlying data. Consequently, a comparison between the different studies is only possible to a limited extent because of these differences. Most authors concentrate on analyzing whether scale or scope economies exist in individual postal operations and ignore the existence of coordination economies between the different operations. Furthermore, the widespread use of the translog specification is not without controversy.[14]

To analyze whether the postal sector should be regulated as a monopoly for efficiency reasons, the authors test only for the existence of the conditions of a natural monopoly. In their approaches, they do not consider the contestability aspect discussed in Section 2.2.2. In fact, there is a lack of studies providing empirical evidence on the contestability of the postal market. Previous studies dealing with this issue, such as Elsenbast (1999) or Knieps (2002), concentrate on verbal argumentation without verifying their results using concrete data or closer firm observations. However, the issue of contestability has already been applied to non-postal industries. Kessides, for example, found that sunk costs limited entries based on a diverse sample of industries (1990). It was shown in this chapter that if a natural monopoly existed and the market was at the same time contestable, the market tended to result in an efficient outcome—meaning that prices were not as high as in a monopoly which is not contestable. The same argument applies to the quality of the services. This is concluded from the fact that the incumbent in a contestable monopoly encounters a durable threat of potential competitors which forces him to set prices and quality level akin to the competition case. As a result of this, efficient outcome and a legal regulation becomes dispensable. Thus, the existence of a natural monopoly is necessary but not sufficient to decide on legal regulatory

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[14] That is why some authors choose the quadratic functional form, because, unlike the translog form, it can accommodate zero volumes in the dataset. Logarithmic forms like the Cobb-Douglas or translog would require additional adjustments.

measures. The different facets of the contestability aspect should rather be included in the analysis, which is certainly what Demsetz had in mind when he remarked that it is sunk costs and not scale economies which constitute the barrier to entry that confers monopoly power (1968, p. 55). Recent studies concentrate primarily on analyzing the changes in the postal industry primarily in terms of electronic competition (see for example Crew and Kleindorfer 2013). Despite this trend in the literature, in practice the physical distribution of postal items still plays a key role in the economy and the question remains to be answered of whether the German postal market has features typical of a natural monopoly.

2.5   Summary

The analysis in this chapter focused on the exploration of the theoretical foundations of natural monopoly and theory and contestability theory, and reviewed the major empirical studies which were conducted to analyze these issues for the postal sector. The primary implications of the theoretical analysis refer to the question of whether competition should be introduced in the postal market, and in which area of the postal network it should be done. Competition should be encouraged where the sufficient conditions of natural monopoly are not present. Although an integrated network can be reasonable in an industry in certain circumstances it can carry the disadvantage of inefficiency. This is the case even if only one of the operations of the postal network is a natural monopoly whereby the rest of the steps should be organized competitively. Vertical integration may hamper the installation of competition in the other steps so that efficiency potentials cannot be exploited. In relation to the postal sector, it was found that the delivery operation particularly exhibits natural monopoly features. Hence, the delivery operation should, for efficiency reasons, not be organized competitively whereas the other steps should be.

It has also been shown that it is essential to account for the contestability of a market in order to decide on regulatory issues. This aspect has not been considered in previous studies. Beyond limitations referring to econometric methodology and data, empirical investigations suffer from some further weaknesses. For example, in most estimations the authors only use data from the monopolist or market leader. Another question to consider is how competition can be introduced in the specific operations of the postal network if necessary. Separation of

the postal delivery function could be one solution. However, this could lead to the disruption of scope and coordination economies. In this context, a great deal of research is still required.

The main contribution of this thesis consists in providing the first empirical evidence for the German postal market. Moreover, in contrast to the studies mentioned in this chapter, I do not focus the analysis on former monopolist and market leaders but analyze the competitors in the market. The self-collected data and case studies used in Chapters 3 and 4 allow for a more in-depth analysis of the German postal market.

3 Are New German Postal Providers Successful? Empirical Evidence Based on Unique Survey Data

3.1 Introduction

Since the first EU Postal Directive in 1997, several European countries have completely opened their postal markets to competition. Despite the abolition in 2008 of an exclusive license to the leading postal services provider in Germany, Deutsche Post AG (DPAG), the revenue and postal volume distributions within the German postal sector still indicate a rigorous dominance of the former monopolist regardless of their loss of market share to the open market. DPAG still has a market share of more than 90 percent in Germany (BNetzA 2013). Moreover, recent statistics collected by the German Federal Network Agency confirm a striking number of market exits compared with previous periods,[15] which may mean the market is still undergoing the first stages of development toward a more competitive environment and that the original objective to stimulate competition within the German postal market has not yet materialized.

Numerous studies show the postal sector lends itself naturally toward monopoly, even in open markets. Nonetheless, empirical studies were not completely uniform and some researchers concluded, from a regulatory perspective, that some operations within the postal network would be more efficient if opened up to competition. However, if even one of the operations collection, sorting, transportation or delivery is a natural monopoly, it is likely the postal network as a whole is a natural monopoly, based on its vertical structure (Panzar and Sherman 1993). Currently there are no studies shedding light on these issues within the German postal market. The lack of data and empirical evidence is the motivation behind my research. Through the analysis of the success and survival of entrant firms within the German postal market, this chapter provides the first evidence of natural characteristics of success within that market.

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[15] This information is provided by the German Federal Network Agency in market analyses regularly published online (http://www.bundesnetzagentur.de).

The main objective of this chapter is to identify the major success determinants within the German postal sector. I provide evidence from descriptive data and econometric evidence from self-collected data. The descriptive and econometric evidence is supported by case studies that examine in-depth interviews with German postal providers. The remainder of this chapter is structured as follows. In Section 3.2, I provide a brief summary of the literature related to this issue. In Section 3.3, I introduce the survey and data used for analysis. In Section 3.4, I present the descriptive and econometric analyses, the case studies, and the results. The main conclusions are presented in the last section of this chapter.

3.2   Related Literature

In contrast to previous studies, I do not concentrate on the market leader in this analysis but rather assume that the market is split into two parts in the sense of a dominant firm model. I focus the analysis on the competitors of the market leader. There is a wide range of empirical studies dealing with the natural monopoly feature of the postal industry which highlights important implications for the success of firms, especially for small and medium-sized firms. In fact, several studies show that scale and scope economies play a major role in the postal industry. After Gupta and Gupta (1985) detected the existence of scale economies using published postal data for the USA, several other authors—for example, Norsworthy and colleagues (1991), Rogerson and Takis (1993), and Cohen and Chu (1997)—also confirmed the existence of scale economics using data from the US postal market. Other researchers detected similar economic situations using data from various countries, such as the study on the Japanese postal market by Wada and colleagues (1997). Cazals and colleagues (1997, 2001a, 2001b) focused their analyses on studies of the French and EU market and proved a scale economic environment within these markets, which is similar to the results of the other authors. Moreover, Gazzei and colleagues (2002) also detected scale economies using data for the Italian postal market and Farsi and colleagues (2006) verified these effects on the basis of data on the Swiss postal market.

The role of scope economies in postal industries is another important condition for the existence of natural monopolies, and is analyzed in several studies. Bradley and Colvin (1994) found significant scope economies using US data; Wada and colleagues (1997) found scope

43

economics in addition to the detected scale economies in the Japanese postal market; Bradley and colleagues (2006) detected scope economics for the US postal market; and Farsi and colleagues (2006) found scope economics in their study of the Swiss postal market. Some authors focused their studies on examining whether economies of density were also present in the postal sector. Cohen and Chu (1997), for example, detected the existence of economies of density using US and UK data and Bernard and colleagues (2002) did the same on the basis of data for France and the US.

As pointed out by Christmann (2004) and Schoelermann (2005) the network characteristic of the postal sector typically requires a vertical integration so that postal providers ensure a sequence of intermediate services (collection, sorting, transportation, and local delivery). The liberalization of the postal market and the multiple entries of new postal organizations introduced numerous business models. Included in these models were firms that concentrated on providing single postal operations; in this context, they obtain the rest of the services through their local market. One consequence of specialization may be the loss of synergy, which is present between various postal operations within the more traditional model. The necessity for coordination between postal operations is associated with costs. In fact, researchers found the delivery function has the predominant features of a natural monopoly. As Panzar (1991) and Rogerson and Takis (1993) observed, the vertical integration of the postal network, and the scale economies within the delivery function, provides sufficient evidence for assuming that the postal network as a whole exhibits scale economies. Despite the plausibility of the idea that there are substantial scope economies between postal operations (Panzar and Sherman, 1993), specialization could be one reason for small firms' success and survival in the German postal market, because specialty firms are not bound by the disadvantages of natural monopoly.

In sum, it can be deduced from these studies that there are scale, scope, and density economies in the postal market, primarily in the delivery function. Because scale, scope, and density economies have been detected from data for different countries, it can also be concluded that the postal business itself is characterized by these effects regardless of the location of the firm. Thus, it can be assumed with certainty that the German postal market has the same characteristics as those previously analyzed. Unfortunately, there are no empirical studies for the German postal market, until now, which primarily accounts for the lack of data. Since the

German postal market was completely opened up to competition in 2008, it should be possible to observe whether scale, scope, and density economies really are decisive for the success of new market entrants and small firms.

So far, despite a significant number of market exits, both small and medium-sized firms seem to be able to survive in the open market. Thus, beyond the natural monopoly conditions discussed above, which certainly determine the potential for success of alternative postal service providers on the market, there must be further postal-specific success determinants. However, as stated above, there is still a strong need for analyses dealing with firm survival and success in the German postal market. In this respect, this chapter provides the first evidence of the characteristics of survival and success of entrants in the German postal market.

On the basis of the literature survey and the characteristics of the postal business, different variables representing age, size, postal operations supplied, primary business area, delivery radius, cooperation activity, management by founder, and location in Germany (east/west) are chosen as predictors in the estimations presented later in this chapter. In all estimations, I try to find out the effects which these predictors have had on the firms' success.[16] In terms of the signs of the estimated coefficients, a specific expectation is reasonable, which is primarily based on literature, previous studies or logical reasoning. The expectation of positive effects from the variables "age" and "size" results from the far-reaching consensus in scientific literature dealing with firm survival and firm success issues (see for example Agarwal and Gort 1996). Moreover, numerous studies dealing specifically with the postal industry indicate the existence of natural monopoly features within the industry, which in turn further supports the expectation of a positive effect of firm size on firm success (see the brief literature review earlier in this section). Deductive approaches analyzing the natural monopoly issue for single postal operations only detect for the delivery function unambiguous natural monopoly features. The results for the other postal operations, however, are equivocal in the literature and the detected effects rather small and thus of negligible economic significance (see the detailed literature review in Chapter 2). Thus, albeit the expected sign for the delivery function is clearly negative, no specific expectations relate to postal functions such as collection, sorting (in), sorting (out), and transportation. Instead, the results of this chapter

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[16] The independent variables are described in Table 7 in Section 3.4.1.

could be used to draw new conclusions. Postal providers supply different postal and non-postal (but in general postal-similar) services. In the econometric analysis I control for this by including the variables "letter market," "postal market," and "other market" in the estimations. As the complete opening of the licensed market (here "letter market") was fairly recent, the question which still must be answered is whether the activity of the licensees in this domain promotes success or not. As discussed earlier, the natural monopoly feature could be a first indication that activity in this domain is not advantageous. However, contrasting with this is the fact that a significant number of postal items are collected and delivered within the same region, which could be a chance for smaller firms to survive in the market despite the existence of a natural monopoly. Moreover, the innovations which can be expected from the new postal licensees await analysis. For these reasons, no clear expectation regarding activity in the licensed market is made in this case. The situation is different, however, for the activity in the parcel and other markets. As the population and thus the estimation sample consists of German licensees, it can be assumed that additional activity in the parcel and other market yields synergistic effects for the licensees which stem from scope economies and the opportunity to ensure high capacity utilization. This, in turn, will likely have a positive effect on firm success. The expected signs for the variables representing the delivery radius are also based on the natural monopoly characteristic of the postal industry. Again, given the predominance of small firms in this case, it can be assumed that activity on the regional and German federal state level are beneficial, whereas activity on the national and international level is either impossible or strongly adverse because of the disadvantages of natural monopoly. Furthermore, I expect a positive effect of the variable "cooperation" because this enables firms to specialize in regions or specific services or postal operations. Moreover, a positive effect of the variable "founder" is assumed because it is very likely that firms benefit from being still under the management of their original founder especially because of the importance of industrial know-how and learning effects. Lastly, as the economic situation in western Germany is better than that in eastern Germany, a positive effect of a location in the former on firm success is expected. The estimations using these variables are presented in Section 3.4.2.

3.3   Survey and Data Description

There are hardly any data available concerning the German postal market. Data used for the analysis in this chapter derive from a survey which I conducted in 2010 in order to analyze the competitive potentials in the German postal market. The first step of the survey involved the identification of postal providers. To operate in the German postal market one needs a license, which is issued by the German Federal Network Agency. However, a license is not required for all postal services. For this reason, the German postal market can roughly be separated into license-free and licensed postal services. According to §5(1) PostG (*Postgesetz*), which is the German Postal Law, a license is required for the conveyance of letters up to 1000 grams. Simply, the licensed domain consists of all letter services. The remaining postal services are license-free. In fact, many firms combine the supply of licensed and license-free postal services, because this enables them to exploit scope economies and to ensure high capacity utilization. As presented in Section 3.2, the existence of scope economies between different services in the postal industry has already been proven in different studies (e.g. Wada et al. 1997, Bradley et al. 2006, Farsi et al. 2006). Moreover, a report published by the German Federal Network Agency supports these findings, identifying the following three groups of postal providers in Germany:

- firms focusing their activities on licensed services,
- firms focusing their activities on license-free services,
- firms combining the supply of licensed and license-free services (BNetzA 2013, p. 37).

Because this thesis focuses on the effects of the liberalization of the German postal market in 2008, the population consists exclusively of license holders. In order to identify them, I used a list of all licensees provided by the BNetzA in January 2010. Despite the information provided on license holders, defining the market is challenging for two major reasons. First, firms operating within the postal market do not necessarily provide homogeneous services. Many firms provide a wide range of services ranging from direct postal services to postal-related services and in some cases even non-postal services. Additionally, I found that firms differ with respect to the postal operations on which their entrepreneurial activity is concentrated. Whereas some firms cover all functions of the postal network, others operate only selected postal functions. As a result, some firms seem to be comparable only to a limited ex-

tent. Nonetheless, because the firms I considered all have the same license, general comparability is a reasonable assumption. Furthermore, I control for heterogeneity within the interviews as well as in the econometric analysis.[17]

In the analysis, I account for this heterogeneity by distinguishing the following three business areas:

- letter services,
- parcel services,
- and other services.

In general, letter services constitute the licensed domain, which is of primary interest in this case. Moreover, it is suitable for dealing with parcel services as an own domain, because this is a quite large and independent sector. Lastly, because there are numerous further postal services, it is necessary to distinguish a third domain here called "other services," which encompasses everything that does not belong to the letter or parcel services category.

A further challenge in dealing with the postal market is that the number of licenses issued does not adequately reflect the number of active firms. Doubts about the suitability of the number of licensees as an indicator of the number of active firms in the postal market were confirmed by survey responses, as will be shown later in this section. Indeed, it turned out that only a part of the listed firms actively use their license and generate turnover in the postal sector. The disparity between license holders and active firms was discussed in a study conducted in January 2010 by the Association of the German Postal Providers (*Bundesverband Deutscher Postdienstleister* (BvDp)) in cooperation with TellSell Consulting (BvDP and TellSell Consulting 2010). More precisely, they proved in their study that in 2008 only about 700 firms were active on the German postal market, even though a total of 1,461 licenses were in circulation.

The list of licensees provided by the BNetzA names 1,475 firms. In sum, a total of 1,459 questionnaires were sent nationwide in the framework of my first written survey conducted in 2010.[18] In a second elevation a few months later, a reminder was sent to 169 firms, in order to increase the response rate. The second elevation was based on exactly the same written ques-

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[17] In this chapter, I use the term "postal provider" or in general "firm" in order to refer to the licensees.

[18] There were some doubles in the list of the BNetzA.

tionnaire as the first elevation. For cost reasons, the second elevation was restricted to the three German states of Hamburg, Bremen, and Lower Saxony. I chose these states because they were close by and I planned to conduct in-depth interviews in a next step. The fact that all 1,459 firms operated under the same license ensured that the sample reflected the German postal market very well. The well-known heterogeneity in the German postal market primarily in terms of service portfolio is evident in the dataset. Nonetheless, it is essential to conduct a detailed non-response analysis in order to evaluate the quality and representativeness of the sample. The main question that arises here is whether there are significant differences between the firms in the dataset and those which are not included. To answer this question, several analysis steps have been conducted, which will be presented in more detail subsequently. Altogether, in both elevations a total of 179 firms answered the survey and 133 of the returned surveys were completed.[19] The other 46 declined to participate. They informed me per e-mail, phone, or an annotation on the questionnaire which they returned. Table 2 summarizes the reasons why these firms did not want to participate.

Table 2: Reasons for Negative Response

Reason	Absolute Frequency	Percentage
Not active in this business area	31	67.39
No longer active	13	41.94
Not yet active	6	19.35
Not active	12	38.71
Firm closed/insolvent	3	6.52
Did not want to participate	12	26.09
Sum	**46**	**100**

This table includes the reasons and frequencies given by the firms.

Table 2 clarifies that with about 67 percent of negative responses inactivity is the most frequently mentioned reason. Furthermore, about 42 percent of the inactive firms mentioned that they were **no longer** active. Almost 20 percent of these firms mentioned that they were **not**

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[19] If we fully agree that only a fraction, say 48 percent as found in the study of BvDP and TellSell Consulting, is actually active on the market, then 133 (number of completed questionnaires in the first and second elevation) answers represent an acceptable response rate.

yet active, which indicates that there are licensees who are keeping the license "in stock" and possibly still planning to operate in this market. For about 39 percent of these licensees, it was not clear which group they belonged to. Only about 6.5 percent of the 46 answers in this category contained the information that the firm had closed or become insolvent and about 26 percent did not want to participate for different reasons (e.g. too many questionnaires, contact person is no longer with the firm, licensee is only a subcontractor or agent in this business area).

About 133 questionnaires were returned as undeliverable. It is very likely these firms had already exited the market. Despite this intuitive assumption, I conducted a detailed multi-stage online inquiry, in order to find out why these questionnaires could not be delivered. In a first step, I searched for the firm on the internet, looking primarily for a homepage or something similar. I searched for company name, name of the CEO or owner (if the latter was included in the original list of the BNetzA) and also for the address of the firm. In cases where the search was successful, I saved the phone number and in a next step rang the firms so that I could ask them personally about their activity status and reasons. In cases where an e-mail address was available, I also wrote an e-mail, if I could not reach the firm by phone. The results of this secondary inquiry are summarized in Table 3.

Table 3: Secondary Inquiry of Undeliverable Questionnaires

Search Result	Absolute Frequency	Percentage
Problem with the address	34	25.56
Firm not found at all	42	31.58
Firm found but further contact attempts (phone and e-mail) unsuccessful	51	38.35
Firm closed/insolvent	5	3.76
Not active in this business area	1	0.75
Sum	**133**	**100**

This table includes the search results of the secondary inquiry of undeliverable questionnaires.

The results of the secondary inquiry strongly indicate that many of these firms must have exited the market. I found that in only about 25 percent of these cases could a change of ad-

dress be the reason for the unsuccessful mailing of the questionnaire.[20] In about 32 percent of the cases I did not find any information about the firm and for about 38 percent I succeeded in finding phone numbers or e-mail addresses, but could not contact any firm representative for different reasons (most frequently because the phone number was not assigned, nobody answered, or the number belonged to a private individual). About four percent of the firms were insolvent and in one case I found that the firm was actually active in a non-postal business area, but owned a license for operating in the German postal market.

Of primary interest is the question whether the sample of 133 firms in the dataset adequately represents the population of licensees in the German postal market. For a further analysis of the representativeness, I concentrate on the firms in the dataset, focusing on the following four characteristics: duration of activity in the licensed domain, regional restriction of license, size measured by number of employees, and main business area. These four characteristics were chosen because they are in fact crucial for the postal business, which is a network industry.

Duration of activity in the licensed domain

This characteristic has been chosen instead of the firms' ages for two reasons. First, this information is available for all licensees, because the date of the issuance of the license is available to me and thus I can calculate since when the firm is operating in this domain. Second, this indicator is suitable because the licensed domain is of primary interest in this thesis. Table 4 summarizes the results of this variable for all licensees and the firms in the data set.

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[20] Thus, the list provided by the BNetzA contained outdated addresses. For cost reasons, I did not send the questionnaire to these firms again.

Table 4: Duration of Activity in the Licensed Domain

Figure[a]	All Licensees	Licensees in Dataset
Minimum Value	0	0
Maximum Value	12	12
Mean Value	6	5.88
Standard Deviation	3	3.50
Number of Observations	**1459**	**133**
a) all figures in years		

Table 4 reveals that the key figures are very similar for the two groups. The maximum value of twelve years for both groups results from the fact that there are exactly twelve years between the time of the survey (2010) and the initial market opening and thus the issuance of the first licenses in 1998. There are only small differences regarding mean values and standard deviations between both groups. As a result, in terms of duration of activity in the licensed domain, the licensees in the dataset represent the population of all licensees very well. Nonetheless, in the econometric investigation (see Section 3.4.2), I use the age of the firms given in the written questionnaire. The advantage of this variable is that it is not restricted to activity in the licensed market since 1998 but dates further back to the establishment of the firm, as several firms were active in this sector prior to the full opening-up of the market.

Regional restriction of license

Like other network industries, regional coverage is a crucial aspect of the entrepreneurial activity in the postal sector. The licenses issued by the BNetzA legitimate postal providers to operate only in a specific regional area, which must be defined by the applicant prior to the issuance of the license, in accordance with §6(1) PostG. Consequently, this information is an appropriate measure for the regional delivery radius of the firms. Table 5 summarizes for comparative purposes the frequencies of this variable for the groups in the dataset and all licensees.

Table 5: Regional Restriction of License/Delivery Radius

Delivery Radius	All Licensees			Licensees in Dataset		
	Absolute Frequency	Percentage	Cumulated Percentage	Absolute Frequency	Percentage	Cumulated Frequency
Rural District/Region ("*Landkreis u. Bezirk*")	333	22.82	22.82	31	23.31	23.31
German federal state ("*Bundesland*")	339	23.24	46.06	31	23.31	46.62
Germany	787	53.94	100	71	53.38	100
Sum	**1459**	**100**	**-**	**133**	**100**	**-**

In terms of delivery radius, the licensees in the dataset also represent the population very well. As summarized in Table 5, in both groups about 46 percent of the licensees are at their most active on the German federal state level, and the rest seem to be more active nationwide. This variable has, however, one major drawback: the information represents the maximum possible delivery radius. Consequently, it is feasible that there are firms who own a nationwide license but are only active on the German federal state level or even only on the regional level. This is suggested by the dataset used for the estimations. In sum, 83 firms in the dataset have a nationwide license but in fact only 29 of them have a delivery radius (including cooperation partners) on the national level. These figures derive from the written survey.

Firm Size

A further firm characteristic, which is considered in the representativeness analysis, is firm size. In fact, because of the network character of the postal business, the delivery radius (see item 2.) could be used as an indirect measure of size, since large firm size is a necessary precondition for a large delivery radius or regional coverage. Despite this, a brief glance at the firms' sizes in the postal sector measured by the number of employees will be provided. The German postal market is characterized by a large number of small firms and only a few large ones. The latest figures on the number of employees in the postal sector provided by the BNetzA were published in the twelfth market survey in September 2009. Although the market survey includes this information only for 2000 until 2007, the figures reveal a high pre-

dominance of small firms in this sector. In 2007, more than 75 percent of the firms had fewer than 51 employees and only 1.89 percent of the postal providers had more than 500 employees (BNetzA 2009, p. 66). In 2013, the BNetzA published market data for the German postal market for 1999 to 2011. Unfortunately, this report no longer contains specific information on the number of employees but instead includes information on the revenue in the postal sector. However, firm size is also very often measured by revenue. In this respect, the report also reveals a predominance of small firms in the postal sector. In concrete terms, almost 75 percent of the firms have a turnover of under 500.000 €. Moreover, more than 25 percent have a turnover of under 10.000 € and only about 3.5 percent have a turnover of more than 10 million € (BNetzA 2013, p. 35). The predominance of small firms is also reflected in the dataset used for the estimations in Section 3.4.2. About 77 percent of the 133 firms in the dataset have fewer than 50 employees, about 11 percent have between 50 and 250 employees and only about 2 percent have more than 250 employees. Thus, measured by the number of employees, the firms in the dataset adequately represent the population of all licensees.

Main Business Area

As indicated previously, the services supplied by postal providers can range from letter services to parcel services to other (in general, postal-related) services. Consequently, it is essential to analyze whether this heterogeneity between postal providers is actually represented in the dataset. To do this, I again refer to the report published by the BNetzA in 2013. In this report, the BNetzA describes how many firms are active in the licensed domain and how many are operating only in the license-free domain. The BNetzA estimates the proportion of postal providers supplying both licensed and license-free services at about 75 percent. The remaining 25 percent of the firms supplying license-free services do not provide licensed services. In fact, these firms do not actively use their license (BNetzA 2013, p. 37). In order to analyze whether the dataset fits these results, I also calculate the number of licensees who provide licensed and license-free services and those who provide only license-free services

despite having a license.[21] Table 6 summarizes the results for the dataset used in the estimations.

Table 6: Primary Business Area

Business Area	Absolute Frequency	Percentage
Firms operating only in the licensed domain (letter services)	76	57.14
Firms operating in the license-free domain	57	42.86
Letter, parcel, other	2	3.51
Letter, parcel	15	26.32
Letter, other	22	38.60
Parcel, other	0	0
Parcel	3	5.26
Other	15	26.32
Number of Observations	**133**	**100%**

According to this table, about 68 percent of the firms operating in the license-free domain combine these services with licensed services and about 32 percent of the firms providing license-free services do not provide licensed services. Both figures are very similar to the BNetzA figures presented above.

In general terms, the representativeness analysis suggests that the dataset seems adequately to represent the population of all licensees. Nonetheless, one major limitation should be noted: the population of all licensees also encompasses firms which are not active. Despite this limitation, the data are used to provide initial evidence. The econometric analysis is, furthermore, complemented by a case study-based analysis in order to support the findings and to provide more evidence.

Subsequent to the written questionnaire, in 2011 I conducted in-depth interviews with postal providers who participated in the written questionnaire and volunteered for an interview. Eight cases were identified that proved helpful in providing better insight into the in-

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[21] Similarly to the BNetzA, I concentrate on licensees operating in the license-free domain and calculate the proportion operating in both domains or only in the license-free domain. This is done in order to ensure comparability of the figures resulting from the dataset with those published by the BNetzA.

dustry, particularly because interviews were conducted in combination with my visiting the interviewees' locations. The interviews were recorded, transcribed, and evaluated through multiple rounds of independent assessments in order to ensure the reliability of findings. Moreover, a pilot test was conducted in order to ensure construct validity. The face-to-face interviews were conducted with firm representatives at the interviewees' locations. All interviews followed the same semi-structured protocol and provided enough time for the interviewees to give their own statements and to add further relevant information. The results of the questionnaire and interviews are presented in the following section.

3.4   Evidence of Firm Success

3.4.1   Descriptive Statistics

Completed questionnaires were returned from all German states. Because the firms are widely distributed across the country, their heterogeneity with respect to the population density of their served area is included in the dataset. Overall, 97 of 133 observations are included in the econometric estimations presented in Section 3.4.2. Table 7 includes the major descriptive statistics of the estimation sample and, furthermore, for comparative purposes, the mean values of the whole data consisting of 133 observations. One very large firm has been dropped from the estimation sample because the analysis in this thesis concentrates on small and medium-sized German postal providers.[22] The remaining 35 observations are not included in the estimations because of missing values of the predictor variables.

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[22] Nonetheless, the estimations in Section 3.4.2 were also conducted with the very large firm included in the estimation sample. There were no significant differences in the results.

Table 7: Descriptive Statistics of Predictors

Variable	Description	Nature	Obs. (Estimation-Sample)	Mean (Estimation-Sample)	Std. Dev. (Estimation-Sample)	Min (Estimation-Sample)	Max (Estimation-Sample)	Obs. (Whole Data)	Mean (Whole Data)
Age	Age of the firm at the time the data were collected	Metric	97	10.16	6.84	<1[a]	37	128	9.19
Size	Average number of employees in the last three years	Metric	97	27.62[b]	51.24	1	323	103	26.32[b]
Size squared	Squared average number of employees in the last three years	Metric	97	3,361.77	12,260.51	1	104,329	103	3,168.94
Collection	Firm provides the collection of postal items	Dichotomous	97	0.72	0.45	0	1	132	0.75
Sorting (in)	Firm provides the sorting of incoming postal items	Dichotomous	97	0.53	0.50	0	1	132	0.55
Sorting (out)	Firm provides the sorting of outgoing postal items	Dichotomous	97	0.56	0.50	0	1	132	0.60
Transportation	Firm provides the transportation of postal items	Dichotomous	97	0.69	0.46	0	1	132	0.68
Delivery	Firm provides the delivery of postal items	Dichotomous	97	0.71	0.46	0	1	132	0.72
Letter market	Firm operates primarily in the mail market	Dichotomous	97	0.74	0.44	0	1	132	0.75
Parcel market	Firm operates primarily in the parcel market	Dichotomous	97	0.15	0.36	0	1	132	0.14
Other market	Firm operates primarily in another market	Dichotomous	97	0.30	0.46	0	1	132	0.30
Delivery radius 1	Delivery radius (incl. cooperation partners): local/regional	Dichotomous	97	0.41	0.49	0	1	132	0.41
Delivery radius 2	Delivery radius (incl. cooperation partners): (German) state	Dichotomous	97	0.09	0.29	0	1	132	0.08
Delivery radius 3	Delivery radius (incl. cooperation partners): Germany	Dichotomous	97	0.28	0.45	0	1	132	0.28
Delivery radius 4	Delivery radius (incl. cooperation partners): international	Dichotomous	97	0.19	0.39	0	1	132	0.28
Cooperation	Firm cooperates with other postal services providers	Dichotomous	97	0.51	0.50	0	1	132	0.55
Founder	Firm is still managed by the original founder	Dichotomous	97	0.84	0.37	0	1	129	0.81
West	Firm is located in west Germany	Dichotomous	97	0.78	0.41	0	1	132	0.78

Displayed values are rounded; a) There are firms in the dataset, which have been founded in 2010. b) One observation has been dropped because of the very large size of the firm.

Table 7 reveals some very interesting facts about the estimation sample. The firms in the sample have a mean age of 10.16 years with a standard deviation of 6.84 years, which is relatively young compared with other industries. Moreover, most of them are rather small, indicated by the average number of employees over the last three years. The majority of the firms in the dataset (about 90 percent) have 50 or fewer employees, which appropriately describes the current firm landscape of the German postal market. This could be attributed to the fact that there are no significant barriers to receiving a license from the BNetzA. The average size of the firms in the estimation sample measured by the number of employees is about 27 persons. This small size is also reflected in their delivery radius (with the help of cooperation partners). About 41 percent of the firms are active on a local/regional level and only 19 percent are active on an international level.[23] Only about half of the firms provide sorting of incoming or outgoing postal items, respectively. Collection at the customers' locations and delivery of postal items is provided by more than 70 percent of the surveyed firms; 69 percent transport postal items by themselves. About 74 percent of the firms operate primarily in the mail market while only 15 percent operate primarily in the parcel market. Surprisingly, a fairly large proportion of about 30 percent operates primarily in another market. The latter includes other postal services such as advertising mail.[24] About 84 percent of the firms are still owned by their original founder. Of the firms in the estimation sample, 51 percent cooperate with other postal services providers and 78 percent are located in western Germany.

In the survey, the CEOs of the firms were asked to assess their profit situation in 2007 and their current profit situation (2010) measured on a scale from one, which represented "very good," to five, which represented "unsatisfactory." It is important to note that the numbers do not mean anything in terms of value. It is only the ordering which shows the lowest to the highest. The year 2007 was chosen because this was the last year before the complete opening-up of the German postal market to the competitors. In the following, I recode both variables and one represents "unsatisfactory" and five "very good," as it is a more logical approach. Table 8 summarizes the absolute, relative, and cumulated frequencies for both variables.

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[23] These figures do not represent the regional restriction of license as explained in Section 3.3 but result from a question in the written survey regarding the delivery radius (including cooperation partner).

[24] Multiple entries were possible in this question.

Table 8: Absolute and Relative Frequencies of Grades

Variable	Frequency	Grade[a]					Sum[b]
		1	**2**	**3**	**4**	**5**	
Profit Situation 2007	Absolute	12	14	31	31	6	94[c]
	Percent	12.77	14.89	32.98	32.98	6.38	100
	Cumulated	12.77	27.66	60.64	93.62	100	-
Profit Situation 2010	Absolute	15	16	38	25	3	97
	Percent	15.46	16.49	39.18	25.77	3.09	100
	Cumulated	15.46	31.96	71.13	96.91	100	-

a) from 1=unsatisfactory to 5=very good. b) This table summarizes the frequencies of grades in the estimation sample (n=97; see Section 3.4.2) for the profit situation in 2007 and the profit situation in 2010. c) There are three missing values for the profit situation in 2007.

The figures reveal that in terms of self-reported profitability in 2007 most firms lie somewhere in the middle and, moreover, that the percentage of firms reporting "very good" is the lowest among all grades. Furthermore, the table clearly shows that this picture did not change much in 2010. Transition probabilities help to provide an overview on this issue. The transition probability matrix in Table 9 contributes to a better understanding of the change in profit situation.[25] The transition probability is the probability of transitioning from one state to another. This matrix reveals that 24.6 percent of the firms in the estimation sample improved their profit situation whereas for 30 percent of the firms the profit situation deteriorated. The profit situation of the remaining firms did not change.

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[25] The transition probabilities are calculated according to the formula $p_{ij}=N_{ij}/N$.

Table 9: Transition Probability Matrix

		Profit Situation 2010				
		1	2	3	4	5
	1	0.043	0.032	0.053	0	0
	2	0.021	0.064	0.043	0.021	0
Profit Situation 2007	3	0.032	0.043	0.170	0.085	0
	4	0.053	0.021	0.085	0.160	0.012
	5	0.012	0.012	0.021	0	0.021

Number of observations: 94; Missing values are dropped from both variables; Displayed values are rounded

Although these figures are very useful for an initial overview on the profit situation of the firms, one disadvantage should be noted: the firms' profit situation in 2007 dates back three years at the time of the survey and thus the self-reported grade for 2007 may be distorted because of memory bias. For this reason, this variable is excluded from the econometric investigations in Section 3.4.2.

3.4.2 Econometric Methodology and Results

What are the characteristics which predict entrepreneurial success in the German postal industry? This is the key question which will be pursued in the following. Using the data collected within the framework of the written questionnaire, I develop six models in order to analyze the success determinants of the German postal market. The firms' self-reported profit situation in 2010 is chosen as an indicator of economic success in all models (see Section 3.4.1). This variable is used as the dependent variable in all estimations. Because it is a discrete outcome with a natural ordering but no quantitative interpretation, an ordered probit estimation is most suitable for this setting. In the following, three ordinary least squares estimations will be conducted and afterwards, in order to account for the qualitative nature of the dependent variable, three ordered probit models. The six models across those two estimation methods will be estimated in order to reveal the robustness of the results.

The econometric analyses conducted in this section are based on different specifications. The gradual inclusion of more predictors in the estimation model is appropriate in order to analyze the systematic bias of the estimated parameters. Indeed, the different model specifications entail different assumptions. In Models 1 and 4, it is assumed that there is no variation in the delivery radius and, moreover, that firms provide a homogeneous service which cannot be further divided into subservices. Moreover, I assume in these two models that there is no interaction between postal providers (e.g. through cooperation) and also do not consider the role of the management by distinguishing if firms still are managed by the original founder. The latter is especially relevant in this case because, as shown previously, the dataset and the population of all licensees are both characterized by a predominance of young firms. As these assumptions are based on predictors, which are crucial for entrepreneurial success in the postal industry, they are relaxed in order to allow more variations. Thus, in Models 2 and 5, variations referring to the service provided are allowed. This is done by considering that firms in fact provide licensed (letter) services and non-licensed (parcel and other) services. In Models 3 and 6, more assumptions are relaxed and variations in terms of delivery radius, firm interactions, management (by original founder) and location (eastern or western Germany) are incorporated in the estimations. Equation 6 specifies the basic OLS regression function.[26] The dependent variable Y is the firm profit in year 2010. The parameters to be estimated are denoted by β and ε is the usual error term.

$$(6)\ Y_i = \beta X_i + \varepsilon_i \quad with\ X \in \left\{ Age, Size, ..., West \right\} and\ \varepsilon_i \sim N(0,1)$$

In sum, 18 of the variables included in the dataset are used as predictors in the estimations. Those variables were selected which were assumed to have a significant economic effect on the firms' success. These important predictors of economic success in the postal industry have already been described in the previous section (see Table 7). To test for collinearity, I analyze the correlation between the predictor variables. The results of the collinearity

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[26] OLS (Ordinary Least Squares) is a method for estimating the unknown parameters in a linear regression model. Consistency of the OLS estimator requires that the explanatory variables are exogenous and that there is no perfect multicollinearity. Moreover, optimality of the estimator requires that errors are homoscedastic and serially uncorrelated.

test for the estimation sample are summarized in the correlation matrix in Table 20 in the appendix of this thesis. Two correlation coefficients stand out in this table: the correlation coefficient of the variables "Sorting of in-coming mail" and "Sorting of out-going mail" with a value of 0.6902 and the correlation coefficient of the variables "Letter Market" and "Other Market" with a value of -0.6964. The high linear correlation between the two sorting functions probably indicates the sharing of the same human and/or technical resources for sorting tasks, and the high negative correlation coefficient between letter and other market very likely results from the fact that the firms were asked to name their primary business area in the survey. Thus in most cases only one business has been named and the negative correlation coefficient indicates that these two business areas do not tend to occur together in the dataset.

The results of the ordinary least squares estimations are based on robust estimations. Thus, the standard errors (values in parentheses in Table 10) take into account several minor concerns, especially regarding heteroscedasticity and normality.[27] The results of the ordinary least squares estimations are presented in Table 10.

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[27] All OLS estimations were conducted with the Stata regress command, including the robust option.

Table 10: Results of OLS Estimations

Variable	Exp. sign[28]	Model 1 Coef.	Model 2 Coef.	Model 3 Coef
Age	Pos.	-0.013 (-0.69)	-0.009 (-0.54)	-0.013 (-0.74)
Size	Pos.	-0.004 (-0.75)	-0.002 (-0.36)	-0.009e-3 (-0.00)
Size squared	Neg.	0.002e-2 (1.22)	0.002e-2 (1.29)	-0.001e-2 (0.75)
Collection	Neg./Pos.	0.524* (1.85)	0.476* (1.83)	0.497* (1.80)
Sorting (in)	Neg./Pos.	-0.186 (-0.57)	-0.263 (-0.83)	-0.202 (-0.62)
Sorting (out)	Neg./Pos.	0.027 (0.08)	-0.153 (-0.43)	-0.172 (-0.51)
Transportation	Neg./Pos.	0.163 (0.60)	0.260 (1.01)	0.227 (0.84)
Delivery	Neg.	-0.483* (-1.88)	-0.583** (-2.32)	-0.659** (-2.29)
Letter market	Neg./Pos.		-0.195 (-0.49)	-0.113 (-0.27)
Parcel market	Pos.		0.138 (0.53)	0.163 (0.59)
Other market	Pos.		-0.854** (-2.37)	-0.722* (-1.83)
Delivery radius 1	Pos.			0.477 (0.67)
Delivery radius 2	Pos.			0.583 (0.73)
Delivery radius 3	Neg.			0.446 (0.60)
Delivery radius 4	Neg.			0.188 (0.25)
Cooperation	Pos.			-0.235 (-1.04)
Founder	Pos.			0.161 (0.58)
West	Pos.			0.081 (0.29)
Const.	0	2.951*** (7.54)	3.413*** (7.02)	2.870*** (3.63)
N		97	97	97
R^2		0.086	0.167	0.195
Adjusted R^2		0.003	0.059	0.010

t statistics in parentheses (robust standard errors)

* $p<0.1$, ** $p<0.05$, ***$p<0.01$

The OLS estimation in Model 1 yields two statistically significant effects. According to these results, the supply of collection services increases the profit situation by about 0.5 grades compared with firms that do not provide this service. A negative effect detected within this estimation model stems from the firms' supply of delivery services. Such firms suffer a prof-

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[28] The expected signs are explained at the end of Section 3.2.

itability loss amounting to about 0.5 grades. Similar results have been found for both varia-
bles in Model 2 and Model 3. In Models 2 and 3, more variables have been added to the esti-
mations in order to analyze the robustness of the results and also to detect further significant
effects stemming from other predictors. The estimations in Model 2 and 3 reveal a further
statistically significant effect: firms which claimed to be primarily active on another market
experienced a negative effect on their profit situation in 2010. According to these estimations,
such firms suffer a profit loss between 0.7 and 0.85 grades. In fact, the effects estimated in
the OLS regression model seem to be economically significant because of their size.

The analysis using OLS regression is problematic because using this method with a non-
interval dependent variable violates the assumptions of OLS. In the next step, I calculate the
effect of various explanatory variables on success based on ordered probit regression models
in order to account for the qualitative character of the dependent variable. In this model, the
central idea is that there is a latent continuous metric underlying the ordinal responses. Thus,
the latent continuous variable is a linear combination of the predictors plus the error term.
The dependent variable Y_i^* is the latent index of reported profit situation. Equation 7 specifies
the ordered probit regression function. The dependent and explanatory variables in the or-
dered probit models are the same as in the OLS estimations.

$$(7)\ Y_i^* = \beta X_i + \varepsilon_i \quad \text{with } X \in \{Age, Size, ..., West\} \text{ and } \varepsilon_i \sim N(0,1)$$

The ordered probit model is estimated with the maximum likelihood method and the estima-
tion results are akin to those of the OLS regression models. The estimation results of all three
ordered probit models are summed up in Table 11.

Table 11: Results of Ordered Probit Estimations

Variable	Exp. sign[29]	Model 4 Coef.	Model 5 Coef.	Model 6 Coef.
Age	Pos.	-0.014 (-0.78)	-0.010 (-0.54)	-0.014 (-0.78)
Size	Pos.	-0.004 (-0.73)	-0.002 (-0.35)	0.002e-1 (0.04)
Size squared	Neg.	0.002e-2 (0.98)	0.002e-2 (1.02)	0.001e-2 (0.61)
Collection	Neg./Pos.	0.522* (1.82)	0.499* (1.72)	0.538* (1.76)
Sorting (in)	Neg./Pos.	-0.144 (-0.46)	-0.218 (-0.67)	-0.155 (-0.46)
Sorting (out)	Neg./Pos.	0.019 (0.06)	-0.184 (-0.52)	-0.215 (-0.59)
Transportation	Neg./Pos.	0.148 (0.57)	0.262 (0.99)	0.245 (0.88)
Delivery	Neg.	-0.519** (-1.97)	-0.655** (-2.39)	-0.742** (-2.33)
Letter market	Neg./Pos.		-0.182 (-0.49)	-0.096 (-0.25)
Parcel market	Pos.		0.141 (0.46)	0.154 (0.48)
Other market	Pos.		-0.897** (-2.41)	-0.790** (-2.00)
Delivery radius 1	Pos.			0.491 (0.66)
Delivery radius 2	Pos.			0.595 (0.71)
Delivery radius 3	Neg.			0.532 (0.70)
Delivery radius 4	Neg.			0.210 (0.27)
Cooperation	Pos.			-0.319 (-1.26)
Founder	Pos.			0.199 (0.64)
West	Pos.			0.105(0.36)
Const. (cut1)	0	-1.202*** (-3.31)	-1.721*** (-3.40)	-1.163** (-1.33)
Const. (cut2)	0	-0.624* (-1.77)	-1.096** (-2.24)	-0.531 (-0.61)
Const. (cut3)	0	0.463 (1.31)	0.024 (0.05)	0.618 (0.71)
Const. (cut4)	0	1.822*** (4.48)	1.432*** (2.71)	2.080** (2.29)
N		97	97	97
Pseudo R^2		0.031	0.061	0.075

Z statistics in parentheses

* $p<0.1$, ** $p<0.05$, ***$p<0.01$

In the estimations conducted in Models 4, 5, and 6 the same predictors as before yield significant effects and the signs of these effects also match the previous results. The estima-

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[29] The expected signs are explained at the end of Section 3.2.

tions yield a positive effect on the profitability of providing collection services and negative effects of providing delivery services and operating primarily on another market. However, because of the well-known limitations of probit regression models, only the signs of the estimated coefficients can reasonably be interpreted in Table 11. For this reason, I calculate the marginal effects at the means (MEM) of the statistically significant predictors.[30] Because of the multiple outcome feature of the dependent variable in this case, it is necessary to run the MEM calculation separately for each outcome. The results are summarized in Table 12.

Table 12: Marginal Effects of Statistically Significant Predictors

| Model | Grade | Variable | | |
		Collection	Delivery	Other Market
	5	0.026 (1.49)	-0.039 (-1.35)	-
	4	0.136* (1.92)	-0.144* (-1.92)	-
Model 4	3	0.031 (0.88)	0.012 (0.43)	-
	2	-0.060* (-1.82)	0.068* (1.80)	-
	1	-0.132 (-1.64)	0.103* (2.13)	-
	5	0.021 (1.38)	-0.046 (-1.45)	-0.035 (-1.57)
	4	0.131* (1.82)	-0.184** (.2.30)	-0.221*** (-2.70)
Model 5	3	0.031 (0.87)	0.018 (0.53)	-0.074 (-1.23)
	2	-0.064* (-1.72)	0.092** (2.15)	0.102** (2.47)
	1	-0.119 (-1.53)	0.119** (2.56)	0.228** (2.05)
	5	0.019 (1.34)	-0.048 (-1.35)	-0.028 (-1.41)
	4	0.142* (1.89)	-0.212** (-2.28)	-0.201** (-2.23)
Model 6	3	0.035 (0.88)	0.027 (0.63)	-0.060 (-1.04)
	2	-0.070* (-1.78)	0.105** (2.16)	0.096** (2.14)
	1	-0.126 (-1.55)	0.128** (2.55)	0.193* (1.71)

Z statistics in parentheses

* p<0.1, ** p<0.05, ***p<0.01

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[30] The marginal effects are calculated with the Stata command *mfx*. By default, *mfx* calculates the marginal effects at the means of the independent variables (MEM). This command numerically calculates the marginal effects and their standard errors and follows ordered probit estimations.

Marginal effects reveal more about the sizes and thus the economic significance of the detected effects. In general terms, the figures in the table provide information on how likely it is that firms will report a specific grade. For example, the number 0.136 at grade 4 for the variable "Collection" in Model 4 indicates that firms providing this postal service are 13.6 percentage points more likely to report grade 4, which represents a good profit situation in this case. In the same way, the marginal effect estimated for grade 2 indicates that firms providing collection services are 6.4 percent less likely to report this grade according to the results of Model 4. Thus, both marginal effects indicate that providing collection services had a statistically and economically significant positive influence on firm success in 2010. All other statistically significant marginal effects in this table can be interpreted analogously. The statistically significant marginal effects of all three variables are of significant size. For example, the table also reveals that firms providing delivery services are 14.4 percentage points less likely to report grade 4 (Model 4) and that firms operating in another market are 22.1 percentage points less likely to report grade 4 (Model 5). The results are very homogeneous across all estimation models with only a few differences in the sizes.

The results of the econometric estimations across all six models are homogeneous. Among the five postal operations included in the estimations, only the coefficients of the variables representing the supply of collection and delivery services are statistically significant. The effect detected for the variable collection is clearly positive and the effect for the variable delivery is clearly negative across all models. The positive effect for the collection in this case could be explained by the fact that the collection of postal items from the customer's location is an extra service offered by the postal services provider. This service is usually offered by the postal provider free of charge and thus represents an important extra service. Indeed, there are firms in this market which focus their activities on this postal operation.[31] Although this service is free of charge, firms collecting postal items generally receive a discount from the DPAG, because the postal items are usually brought to the facilities of the DPAG for further processing and delivery. Consequently, this service is not only an important extra service but also a key source of revenue, especially for small postal providers, and significantly contributes to their entrepreneurial success. The negative effect of the variable delivery detected in all models is reasonable because it is the most costly of all opera-

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[31] Evidence on this is provided in Section 3.4.3.

tions. This has already been proven in several studies (see for example Kruse and Liebe 2005 for an overview). In fact, this effect was expected because it has been shown in numerous studies that there are significant scale economies in this postal operation (Panzar 1991; Rogerson and Takis 1993). Thus, small firms providing this service have a significant disadvantage compared with the market leader or other large firms. As shown previously, in the estimation sample—like the population consisting of all German licensees—small firms make up the majority of the German postal market.

The econometric investigation indicates that the activity in "other markets," as defined in Section 3.3, is disadvantageous for postal services providers. The coefficient of this measure is statistically significant in all six models. In fact, for the variables representing activity in the parcel and other market positive effects on the profit situation were expected because this would likely imply that firms combine different business areas, which makes it possible for them to exploit the scope economies existing between these different business areas. Moreover, on the basis of these data, no positive effect of activity in the letter market has been detected.

The expected positive effect of the explanatory variable "size" on the firms' profitability could not be proven in all models. In the case of the postal sector, a positive effect of the firms' size could indicate that a larger size simultaneously represents larger regional network coverage, which in turn positively contributes to the firms' profitability. Moreover, this could also be another (indirect) hint of the existence of scale economics in the industry, which has already been proven in numerous studies (see Section 3.2). This consensus within firm survival literature is the reason why a positive effect was expected in this case (Agarwal and Gort 1996). Moreover, there is no statistically significant positive effect of firms' age on success, which is another effect already proven in numerous studies with other non-postal industries (Agarwal and Gort 1996). However, the fact that the liberalization of the German postal market does not date back very far could provide the answer to the counter-intuitive finding. The average firm age in the estimation sample is about ten years, and thus we are in fact dealing with a group of relatively young firms.

The assumptions underlying ordered probit and ordered logistic regressions are often violated. One such assumption is the parallel regression assumption which is also known as proportional odds assumption. In short, this assumption implies that the relationships of each

pair of outcome categories are the same (see Long and Freese 2006 and Wooldridge 2010). Thus, applied to this case, the following series of binary logistic (or binary probit) regressions referring to the response categories of the dependent variable must be compared:

- 1 versus 2, 3, 4, and 5;
- then 1 and 2 versus 3, 4, and 5;
- then 1, 2, and 3 versus 4 and 5;
- and lastly 1, 2, 3, and 4 versus 5.

The parallel regression assumption is not violated if the estimated coefficients of these regressions would be the same (except for sampling variability). If the parallel regression assumption is violated, the results of the ordered probit or logistic estimations should not be interpreted without further validation. In Stata, there are two possible commands that can be used in order to test the parallel regression assumption: *omodel* and *brant*. Subsequently, I will use the Brant test to do so.[32] As the Brant test can only be computed after a logistic (not probit) regression, I estimate Model 4, Model 5, and Model 6 again based on an ordered logistic regression.[33] The results of these estimations are presented in Table 21 in the appendix of this thesis. The Brant test can only be computed, if all independent variable categories are contained in all respective binary models. This was only the case for Model 7 (see Table 21). The Brant test could not be computed for Model 8 and Model 9, which can be attributed to the large number of independent variables.[34] Thus, only the results of the Brant test for Model 7 are presented in Table 22 and Table 23 in the appendix. According to these results, there is evidence suggesting the parallel regression assumption has been violated. As mentioned above, all of the coefficients presented in Table 22 would be the same (except for sampling variability), if the parallel regression assumption has not been violated. Consequently, there is necessity for further validation of the regression results obtained in Models 1-9. In order to do so, I conduct a logistic regression using a binary dependent variable. In this model, the dependent variable representing profit situation is transformed into a dichotomous variable. The variable takes the value 1, if the profit situation is 3, 4, or 5. Thus, firms who answered that

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[32] The *brant* command is part of the Spost ad-on.

[33] The ordered logistic regression is very similar to running an ordered probit regression and the main difference refers to the interpretation of the coefficients. In Stata, it can be computed using the the *ologit* command.

[34] The Brant test cannot be computed for models that have few observations in the extreme categories and a large number of predictors.

their profit situation is satisfactory, good or very good are considered to be successful. The variable takes the value 0, if the profit situation is 1 or 2. These firms are not considered to be successful in the market. Again, three models are estimated using the same predictors as previously. The results of these binary logistic regressions are presented in Table 24 in the appendix. The previous results of the estimations using an ordered dependent variable still hold. The coefficients of the variables "Collection", "Delivery", and "Other Market" are statistically significant as it was the case in the previous estimations. Moreover, Model 12 provides a first hint that activity on local or regional level could promote success in the postal industry. As will be shown later in the framework of the in-depth interviews, regional specialization is in fact counted among the crucial success determinants in this industry.

The econometric investigation provided an appropriate preliminary insight into what predicts entrepreneurial success in the German postal market. The most interesting finding is that activity in the delivery function is disadvantageous for postal providers because, and this fits the consensus in previous research, the delivery function is a natural monopoly and, moreover, contradicts the liberalization of the market. To my knowledge, this is the first study to provide evidence on this for the German postal market. A natural monopoly requires for efficiency reasons that only one firm provides a specific service, which in turn contradicts the liberalization policy within the German postal market. Thus, the crucial question is if the German postal market will ever be able to bring large competitors to the market leader and how small and medium-sized firms can overcome the disadvantages of natural monopoly. Are there more important success determinants? In Section 3.4.3, eight case studies are presented in order to provide more evidence on this question.

3.4.3   More Evidence from Case Studies

The eight firms that were selected for in-depth interviews are all license holders operating in the German postal market. Nonetheless, as discussed earlier, they display a certain heterogeneity, particularly regarding their main business area. Moreover, these firms also differ with regard to other aspects such as their size and the extra services they provide. The firms' profiles are summarized in Table 13.

Table 13: Sample Firm Characteristics

Case	Age[a]	Size[b]	Main Business Area	Business Area Description	Profit[c]	Δ Profit[d]
A	22	Size > 250	Other Market	Letter and parcel services in the medical sector	4	=
B	4	Size < 5	Letter Market	Firm has mainly business customers; cooperates with consolidators	3	=
C[35]	11	Size > 250	Letter Market	Private customers and key accounts; covers all operations of the postal network	1	↓
D	5	Size < 5	Letter Market	Originally active in the publishing industry; covers all operations of the postal network	1	↓
E	1	10 ≤ Size < 50	Letter &Parcel Market	Originally active as a service provider in the banking sector; only reception of postal items	2	-
F	2	5 ≤ Size < 10	Other Market	Mainly active in the newspaper business; processes all logistics tasks of the entire company group; covers whole postal network	2	-
G	34	Size > 250	Parcel Market	Covers all operations of the postal network; very well established infrastructure of transportation devices, sorting and delivery centers	4	↑
H	3	Size < 5	Other Market	Postal and courier services mainly for public institutions; mainly active on local level	2	=

Answers from the written questionnaire and in-depth interviews

a) In years at the time of the survey; b) Measured by the number of employees at the time of the survey; c) Measured on a scale from 1 (=unsatisfactory) to 5 (=very good); d) Difference between 2007 and time of the survey (2010)

The ages of the selected firms range from 1 to 34 years with an average age of 10.25 years and a standard deviation of 11.80 years. Five of these firms have fewer than 10 em-

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[35] This firm did not provide information on its number of employees, but from the plant visit and interview it was established that it has more than 250 employees.

ployees, and three of them have more than 250 employees. The firms' sizes did not change noticeably over the last three years. With regard to the business area, four of the eight firms stated that they operate primarily in the mail market, two of them that they operate primarily in the parcel market, and three of them that they operate primarily in another market.[36] Despite these results, it can be concluded that most firms combine the supply of the above services. Moreover, five of the eight firms stated that they operate on all functions of the postal network: collection, sorting of in-coming postal items, sorting of out-going postal items, transportation, and delivery. One of the remaining three firms combines collection with transportation services, one of them combines sorting of in-coming mail with transportation and the last firm provides only collection services. This brief overview of the sample demonstrates the heterogeneity of the selected firms and appropriately reflects the heterogeneity existing within the German postal sector.

The objective of the case-based analysis was to identify crucial success determinants in order to assess the success and survival of alternative private postal providers in Germany. As the results of the econometric analysis of the previous section are limited, in-depth interviews at the firms' locations were needed to provide further evidence on the analyzed issue. During the in-depth interviews, the firms were asked to list the major success determinants in the market. The main results of these interviews are summarized in Table 14 and Table 15. The major success determinants identified by the interviewees can be categorized as general success determinants and postal business-specific success determinants. In some cases, clear classification of the success determinant is not unequivocally possible.

Prior to its opening up in 2008, the German postal market was traditionally serviced by one large firm. Despite the market's opening up, the original monopolistic structures are still present and demonstrate the rigidity of the market. Thus, in order to be successful, it is all the more important that firms consider all general success determinants valid for any industry. This assertion was confirmed in the in-depth interviews. The general success determinants most frequently mentioned by the interviewees are listed in Table 14.

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[36] One of these firms gave a multiple answer.

Table 14: General Success Determinants

No.	Success Determinant
(a)	Supply of extra services (free of charge)
(b)	Maintain close contact with customers
(c)	Know-how
(d)	A number of "soft skills" were mentioned as important (e.g. friendly appearance of the deliverer)
(e)	Providing a high-quality service

This table includes the most frequent answers given in the in-depth interviews.

There are not many opportunities to compete in the postal market, largely because the supplied service is rather simple. One possibility for firms to increase their competitiveness is to provide extra services, though the range of such services in the industry is limited. The most common extra service identified in the interviews was the collection of postal items at the customers' locations free of charge or tracking services. Moreover, a number of other general success determinants were mentioned in the interviews, such as maintaining close contact with customers and providing high-quality service. The latter refers essentially to the delivery time. Beyond these general success determinants, the interviewees identified a number of other success determinants crucial in the postal industry. These postal-specific success determinants are of primary interest in this chapter. Here, again, Table 15 includes the determinants most frequently mentioned by the interviewees.

Table 15: Postal-Specific Success Determinants

No.	Success Determinant
(f)	A quick delivery
(g)	A safe process
(h)	Cooperation with other postal services providers
(i)	Existing structures
(j)	Exploiting scope economies
(k)	It is crucial that the firm achieves a high volume as quickly as possible (large region, cooperation; densely populated region)
(l)	Regional coverage (with or without cooperation)
(m)	Possibility to finance foundation phase (solid financial background)
(n)	A second business area (here: postal-specific; also results from (h) and (j))
(o)	Specialization (region, customer groups or postal operations)

This table includes the answers given most frequently in the in-depth interviews.

The postal sector is strongly characterized by the confidential nature of the supplied service. Several success determinants identified in the case studies are linked to this. Because postal items contain, in many cases, sensitive information, a quick and safe delivery process is a firm necessity in this market (success determinants f and g). It can also be assumed that the willingness to change postal providers seems to be rather inelastic once a customer has found a suitable provider. If these success determinants are violated, it becomes harder for firms to acquire new customers, even if they can provide their service at a lower price. The service quality of predominantly fast and secure processes is thus among the crucial success determinants in the postal business. The consequence of this inelasticity is further aggravated by the fact that alternative suppliers have little chance to provide extra services or to lower prices in this industry, even more pronounced with regard to the supply of business clients.

The ability to cover a specific geographical area is also among the crucial success determinants (success determinant l). Although a high number of postal items are transported within the same region, customers generally expect postal providers to cover a wide area. It can be assumed that customers tend to choose a supplier who provides a wide range of services and offers wide network coverage. Also, it seems unlikely that customers will demand the services of multiple parallel firms, e.g. one firm for local post and another for supra-

regional post. Cooperation as a further success determinant is directly linked to determinant l (success determinant h). However, it must be noted that in some cases cooperation is also a consequence of the fact that a firm has chosen to specialize in regions or single postal operations. From this results the obligation to cooperate with other postal providers so that the whole service can be ensured. Whereas operational specialization always requires cooperation, regional specialization only requires cooperation in the case of supra-regional post. Lastly, it is important that new market participants are able to finance the foundation phase of their business. Establishing a business is a costly matter and the fact that firms generally do not have the necessary volume at the beginning of their activity (see regional coverage) makes it hard for them to survive at the beginning.

The interview results confirm that firms significantly differ with regard to their major business area, further additional business areas, extra services provided and the specific postal operations in which the firm is active. Scope economies play an essential role in the postal business. This applies to scope economies between different products as well as to scope economies between different business areas. In particular, combining the postal business with another business area yields noticeable synergies and represents a crucial success determinant in the German postal market. The joint supply allows firms not only to exploit scope economies between the different business areas, but also to cross-subsidize. More precisely, the results suggested that firms which build their business on the structures of an existing business area are likely to be more successful. Building the postal business on existing structures helps to finance the foundation phase and also allows the entrepreneurial activity to be started on a higher volume level. Other way to start the business on a high volume level could be achieved through cooperation or through operating in a densely populated region.

To sum up, the interviews showed that a lot of firms in the postal sector must, because of their size and their own statements regarding their regional coverage, necessarily be active on a low scale level. Consequently, this finding creates the impression that scale economies are not pronounced enough in this industry for firms to survive. A closer look at the firms and their activities reveals that specialization and cooperation are essential ways of disarming the small-size disadvantage. Whereas cooperation enables firms to be active on a supra-regional level, specialization generally ensures firm success through operation in a niche market. Moreover, the interviews revealed three major types of specialization. Some firms specialize

in supplying selected customer groups, e.g. business clients, some specialize in specific regions, and some firms specialize in selected postal operations, e.g. transportation of postal items. Moreover, the in-depth interviews confirmed that firms not only benefit from the scope economies existing between different services, e.g. between mail and parcel services, but also from scope economies existing between the postal business and other business areas. It is very striking that many firms in the postal industry are active in different business areas. Whereas Panzar and Sherman (1993) assumed that the vertical structure of postal networks implies scope economies between different postal operations, the empirical evidence in this chapter rather indicates that single operations promote firm success.

3.4.4   Concluding Remarks and Discussion

In order to analyze the success and survival of entrant firms operating in the German postal sector, I focused on finding the key success determinants. The in-depth interviews provided insight into the success determinants and challenges of the German postal market. The interviews revealed that the confidential nature of the service in the postal sector is crucial for firms' success. Moreover, firms must be able to cover a specific geographical area from the beginning and start their entrepreneurial activity on a high volume level. Because most firms in the German postal market are small, active cooperation was a further success determinant identified in the interviews but surprisingly not in the econometric investigation. Cooperation is, especially in this case, a consequence of the regional and operational specialization of firms, which according to the finding in this study is quite common in the German postal market. Being active in a niche market, specialization, and cooperation are all possible determinants of firm survival on the market, even though the industry has the features of a natural monopoly. A further very decisive success determinant identified in the in-depth interviews was activity in a second business area, which also allows small firms and new market entrants to finance the foundation phase. The combination yields synergistic effects especially because firms have the opportunity to establish postal services within existing structures. Consequently, firms may exploit scope economies, which exist not only between different services but also between different business areas. This is a further major finding in this study. In fact, as a consequence of these findings the following question must also be asked:

do successful firms owe their success primarily to a second non-postal business area which allows them to cross-subsidize a weak postal business?

Overall, it can be concluded that the German postal sector still seems unable to provide the necessary framework for a competitive environment. Moreover, in order to be competitive, firms need not only to meet customers' needs but also provide the service at a lower price, regardless of the disadvantages of natural monopoly. The existence of scale economies as a crucial success determinant could be indicated by the negative effect of providing delivery services found in the econometric investigation. Numerous studies have concluded that the delivery function is a natural monopoly (see Section 3.2). The finding by Panzar (1991) and Rogerson and Takis (1993) that the vertical integration of the postal network means that the network as a whole has characteristics of a natural monopoly even in the case where only the delivery function is a natural monopoly fades into the background because of the possibility of operating single postal services identified in the in-depth interviews and plant visits. The interviews provided the first confirmation of the intuitive proposition that there are density economics and that specialization in selected postal operations also constitutes a success determinant. Finally, a further aspect which must be addressed in this brief discussion is that no positive significant effects of the variables "size," "age," and "cooperation" could be detected in the econometric investigations.

Despite the satisfactory results obtained from the econometric investigation, the underlying dataset suffers from weaknesses. The small number of observations is one of the major ones. Although the number of observations in the dataset was limited, econometric investigations were conducted in order to derive initial evidence of the analyzed issue. The small number can be justified by the fact that the relevant population, the number of licensees, is small as well. If we account for the lower number of active licensees as the relevant population, then the adequacy becomes much better. Another major weakness is manifested in the dependent variable used in the estimation models. The variable "success" is based on the assessment of the interviewees regarding their profit situation and is, moreover, of a qualitative nature. Moreover, the results must of course be methodically and critically evaluated with regard to causality. Thus, a few remarks on the aspects of selection bias and unobserved heterogeneity are made subsequently. In general, a sample selection bias occurs if the dataset used for the analysis is based on a sample which is not randomly selected or if the survey

design has drawbacks or is poorly constructed. As mentioned in Section 3.3, the written questionnaire was sent to all licensees in the German postal market. Despite the great care taken, the existence of a selection bias cannot be completely ruled out. Indeed, one such bias could be deduced from the strong competitive environment in the German postal market which increases the response probability of firms facing fierce competitive behavior from the market leader DPAG. The in-depth interviews conducted subsequent to the written questionnaire showed that the competitive behavior of DPAG is in fact a major issue. This in turn could mean that firms used the opportunity presented by the written questionnaire to express their opinion. The in-depth interviews provided hints of this but there is no conclusive proof, because many of these firms cooperate with the DPAG. Despite these possible limitations, it has been shown that in terms of several crucial characteristics, the collected dataset adequately represents the population of all German licensees. The analyses conducted in this thesis are based on these self-collected cross-section data. This type of data is suitable for investigating differences between observation units but, in contrast to panel data, does not provide evidence on developments over time. Indeed, panel data facilitate the identification of causal effects because they allow us to control for time-invariant unobserved heterogeneity and enable the use of further econometric models such as difference-in-difference estimations. Although panel data do not allow us to control for all sorts of unobserved heterogeneity, they can offer better insights into an industry. A particular problem is the unobserved heterogeneity which changes over time. In the case of the postal sector, changes in the economic power of regions over time could distort the econometric results. Moreover, because of the relevance of scale, scope, and density economies in the postal industry, changes in the population density should be incorporated in the estimation models.

It can be concluded from these considerations that there is a strong need for further research analyzing market developments after the liberalization of the German postal market. In particular, there is a strong need for data which enable the execution of advanced econometric methods. Given the results of this work, the next step recommended is to make a distinction between firm-specific, industry-specific, and perhaps also geographical success determinants. The distinction between specific success determinants could be helpful in addressing policy implications in order to create the necessary framework for competition in the German postal market. Another recommended aspect for further research is the cooperative

behavior and strategies adopted among postal service providers and the suitability of cooperation for increasing regional coverage.

4 Competition through Cooperation? The Case of the German Postal Market

4.1 Introduction

It was found in Chapter 3 that cooperation plays a major role and is widespread in the postal industry. Thus, I conduct a closer examination of this issue in this chapter, again focusing on the competitors of the market leader.

Like other European countries, the German postal market gradually opened up to competition after the first EU postal directive in 1997. Since then, many market entries and exits have taken place, yet it seems the former monopolist has not lost any of its market power. Competition in the German postal market can only happen if new postal providers are sufficiently profitable and stay in the market. Analysis of success determinants in network industries shows that wide geographical coverage is among the crucial success factors, and in the postal industry it may be the most important success factor. Because the development of a wide postal network is a very costly matter and because such markets are generally characterized by scale economies, the question arises of whether there is a way to ensure wide geographical coverage. The main option is to buy into an existing network, which presupposes that the network owner provides access to other market participants and new market entrants. This in turn also requires that the network owner is willing to engage in a cooperative relationship with its competitors.

One of the major consequences of cooperation could be that incumbent firms may lose revenue shares to other firms. For this reason, incumbent firms, such as the network owner, might have incentives to prevent competitors from entering their network, which they can realize through corresponding strategic behavior. The study of the German postal market presented in this chapter shows different forms of cooperation are practiced by postal providers in order to expand their geographical service area. A promising cooperation strategy within the postal industry is cooperation within an organized network. Currently, there are two such large networks in the German postal market: Mail Alliance and P2-Network. In fact, as long

as postal providers expect benefits from cooperation, it is very likely that such behavior will be pursued because it results in a win-win situation for both cooperation partners and, moreover, they can ensure the delivery infrastructure with or without the aid of the market leader.

The analysis presented in this chapter is based on the fundamental findings of various studies that show scale and scope economies are strongly pronounced in the postal industry (see Chapter 2 for a literature review) and, moreover, on the idea that cooperation constitutes an appropriate avenue to exploit these economies. There is hardly any research on the cooperation behavior of postal providers, which can certainly be attributed to the regulation history of the postal market.[37] There, are, however, a large number of studies, mainly located in the strategy literature, dealing with the performance of firms which engage simultaneously in cooperation and competition with other firms in their industry. These hybrid relationships of firms are called coopetition. The term was coined by Brandenburger and Nalebuff (1996) and describes the collaboration of firms, for example, in sharing capacities, although they are rivals and compete for customers and market share.[38] Lado and colleagues (1997) and Zelding (2004) also used this term in their analyses. Despite the high number of studies dealing with coopetitive behavior of firms in general, none refers directly to the postal market. Empirical evidence for the postal market provided by Abdallah (2011) found that firms pursuing a coopetitive strategy perform better than firms only focusing on either cooperative or competitive strategies. Cooperation behavior of German postal providers has also not been analyzed until now. In order to help close the research gap, this chapter provides the first evidence of German postal cooperative behavior.

In contrast to other network industries such as railways or telecommunications, in the case of the postal sector, cooperative relationships can be established quickly and without significant investments or, more precisely, without sunk costs. In short, the main question answered in this chapter is whether cooperation has a place in competitive network industries such as the German postal market. I provide initial evidence on cooperative behavior in the German postal market, which derives from data collected within a written survey and from in-depth interviews conducted subsequently. I focus the investigation on small and medium-sized postal providers, the competitors of the former monopolist. The evidence from the case

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[37] Cooperation did not really matter as long as the postal sector was regulated as a monopoly.

[38] In the following, I use the terms "cooperation" and "collaboration" synonymously.

studies provides detailed insights into the specific cooperation strategies currently used by German postal providers in order to increase their geographical coverage. Here, the focus is on identifying whether there are reciprocal effects between cooperation and competition and whether these competitive counter-effects, if any, outweigh the advantageous effects of cooperation. It is very likely that cooperation not only yields positive effects but also negative ones. Prior to evidence from the survey and the interviews, the focus was on a theoretical analysis using an economic spatial model and applying it to the analyzed issue.

This chapter is organized as follows. First, in Section 4.2, I present an economic spatial model of the geographical characteristics of the postal sector, followed by a brief game theoretical discussion, and lastly two hypotheses. Subsequently, in Section 4.3, I provide descriptive and case study evidence. Finally, Section 4.4 summarizes the main conclusions of this chapter.

4.2   Theoretical Framework

Because of the geographical character of the postal industry, a spatial model seems most appropriate for its analysis. In this chapter, I build an analysis based on the spatial model which Harold Hotelling first presented in 1929. As will be shown in Section 4.2.1, most assumptions are the same as in the original model. However, whereas Hotelling used his model primarily for analyzing product differentiation, I have changed the model to fit my research question, and focus on the effects of cooperation and competition in the postal business.

4.2.1   A Spatial Model of Cooperation

To simplify the analysis, I assume there are three identical postal providers on the market supplying a homogeneous delivery service. As demonstrated in Figure 6, the whole area is divided into three regions and a regional monopolistic service provider controls each region. The firms are located in the center of their service areas according to the Hotelling rule, as

this is the optimal location which allows them to minimize distance to the customer.[39] Where-as in the original model it is argued that customers minimize their transportation costs to the firm's location, in this analysis I switch the perspective and refer to the transportation costs of the firm that delivers the postal items to the customers. Figure 6 also shows firms' transportation cost functions consisting of a fixed portion f and a variable portion td, whereas d is the traveled distance and t the transportation cost for each unit of distance. The transportation cost is the cost of one round trip to and from the customer. The fixed costs represented by f in this case are not assumed to be sunk costs in the postal sector (Panzar and Sherman 1993). The firms' cost of providing the service to customers is thus given by the following equation:

$$(8) \quad c = f + td$$

For the sake of simplicity I do not distinguish the five postal operations as is usual (Panzar 1991), but all upstream and downstream operations are aggregated into one operation representing the transportation of postal items. From this it follows that the collection process (downstream) and the delivery process (upstream) are of equal length for each round trip. This also allows for focus on the total transportation costs and the sum of these operations. The potential customers, who are assumed to be identical, are located with uniform density along the stretch of land in each region and it is assumed that firms charge a uniform price for providing the service in each region.[40] Uniform pricing depending on geographical distance between customer and supplier is widespread in the delivery and transportation service indus-tries. Because in the initial setting firms face no competition in their own region, they may charge a service price above their marginal production costs, which is assumed to be limited by the customers' uniform reservation price in this setting.

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[39] D'Aspermont and colleagues (1979) asserted in their response to Hotelling's so-called *Principle of Minimum Differentiation* that it is invalid and that it cannot be assumed that sellers tend to agglomerate in the center of the market. However, because of the characteristics of the postal industry, it is nonetheless reasonable to as-sume that postal providers locate in the center of their service area, provided that customers are equally dis-tributed, which is a given in this scenario, and that ceteris paribus there is no further heterogeneity, such as differences in the rental costs, which distinguishes the locations.

[40] As argued later in this chapter, the assumption that customers are equally distributed entails the neglect of the role of density economies in this setting.
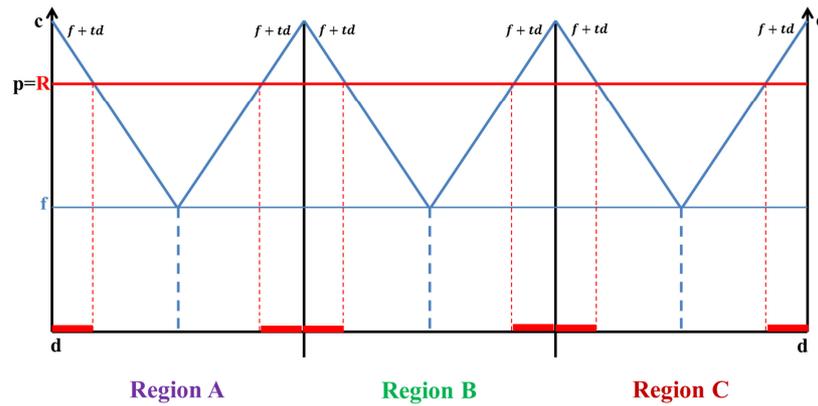
Figure 5: Activity on Regional Level

Source: Modeled after Hotelling (1929)

As shown in Figure 5, transportation costs are lowest at the firms' locations and they rise on a linear basis with greater distance between the firms' locations and the customer's location. All postal providers operate on a regional level as it is too costly to collect and deliver postal items to and from other regions. According to the cost function, it is not even possible for the firms to serve all potential customers in their own region. Outside the area marked by the two vertical red dashed lines, the transportation costs exceed the reservation price of the potential customers and are consequently not compensated. Thus, the firms maximize their profit by serving only customers between these two lines. In fact, two groups of potential customers cannot be served in this scenario because the transportation costs exceed the reservation price. Group 1 includes potential customers who are located too far from the firms' locations and group 2 represents potential customers who want to send supra-regional items whereby the latter are only metaphorically represented in the graphical analysis.[41] In order to serve all potential customers located in one region, either the price p must be increased or the service costs must be reduced. Increasing the price is not an effective measure in this setting because of the uniform reservation price of the customers. Moreover, because I do not assume inefficiency in production it is not feasible for firms to reduce costs.

A further important implication of the model is the existence of scale and scope economies in the industry, which has been proven by different researchers for various countries

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[41] In practice, the stretches of land, which are too expensive to serve, could also be characterized by low population density.

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(see Chapter 2).[42] Consequently, working on a larger scale, or in this case serving more customers, lowers the costs per unit of distance. Exploiting scale economies in this scenario, however, requires the firms to expand their service areas. It is furthermore assumed that this is not possible without the cooperation of other postal providers.

The scenario depicted in Figure 6 represents the initial situation without cooperation between the postal providers of different locations. In this situation, however, a large part of the market is served in all three regions, but customers who are located too far from the firms' locations and the supra-regional market are not served. Thus, if the firms cooperate, they could serve more customers and lower transportation costs by exploiting scale and scope economies. As shown later in this chapter, German postal providers do cooperate because they expect advantages from this collaboration ex ante. With regard to cooperation, the following are assumptions of the behavior of the agents in this model:[43]

- Cooperative partners make decisions fully independently of each other. This relates to the question of whether to cooperate or not, as well as whether to enter the service area of a cooperative partner when the costs have dropped so far that it would be profitable.

- Moreover, it is assumed there is no agreement between cooperative partners mandating that each will not enter the cooperative partner's service area. Consequently, firms are free to enter and operate in the cooperative partner's service area, despite the cooperative relationship.

- The last important assumption of the behavior of the cooperative partners is that they do not adjust the charged price; for example, in response to another cooperative partner's entry into their own service area.

The positive effect of cooperation applied to the developed model is shown in Figure 6.

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[42] Density economies are not relevant in this case because in the model it is assumed that customers are equally distributed in the area consisting of regions A, B, and C.

[43] In fact, these assumptions are central to the model and determine its outcome significantly. For this reason, in Section 4.2.2 I address the question of what changes if these assumptions vary.
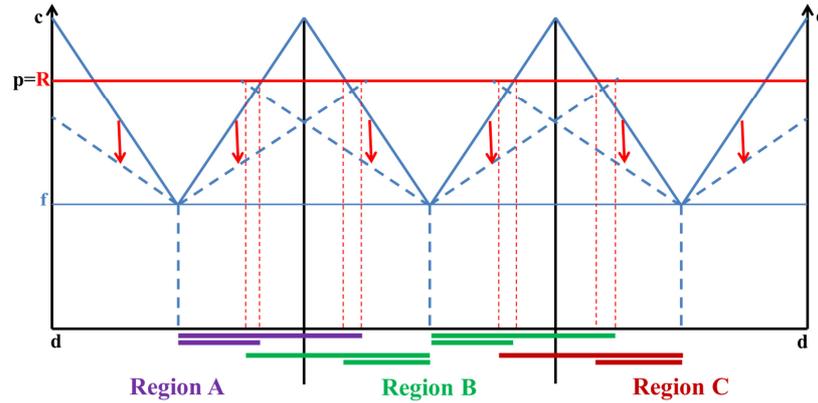
Figure 6: Cost Savings through Cooperation

As illustrated, the cost functions shift downward in the case of cooperation. This is attributed to a decrease of transportation costs *t* of each unit of distance. It is not assumed that the fixed proportion *f* is affected by cooperation. Moreover, the increased necessity for coordination of cooperative relationships also affects transportation cost because the coordination refers to each service assignment and thus to the distance units traveled. The colored bars below the X-axis in Figure 6 demonstrate, for comparative purposes, the firms' feasible delivery radius with and without cooperation and their entry into other regions. Obviously, both cooperative partners symmetrically benefit from the cooperative behavior in this model and are now able to expand delivery radius around the Hotelling optimum and eventually to enter other firms' regions.

In this scenario firms are not assumed to move locations, as is the case in the original model. Each firm's direct neighbor is confronted only with half of the total expansion effect if we focus on a one-dimensional approach where each firm can only have at most two neighbors. As presented in the literature, the cooperative relationship of firms is not isolated from their competitive relationship. The evidence presented later in this chapter in fact confirms that postal providers operate in a tense area of cooperation and competition. Whereas the strategy literature focuses on the argument that firm performance in case of simultaneous cooperation and competition with rivals exceeds firm performance in case of either cooperation or competition, I rather find that, because of the expansion into other firms' regions, cooperation yields not only advantages but also disadvantages in this industry.

Consequently, in the case of the postal sector it is very likely that a competitive counter-effect follows the advantageous effect of cooperation, again lowering performance of the cooperating firms. This can be attributed to induced competition between the firms through activity in the same regions. Both firms will expand delivery radius into neighboring regions and it is likely that each of them will try to take customers from the other, if there is no arrangement preventing such behavior, which is assumed in this setting. Independent of the above-mentioned strategic behavior of firms, a negative effect could also simply stem from the fact that customers have the possibility to choose and change suppliers if there are two suppliers in a specific region. The described counter-effect leads to a loss of customers, which again causes an increase of the marginal transportation costs because firms operate on a lower scale again and exploit fewer scope economies. In the graphical analysis, this leads to an upward back shift of the cost curve. Finally, firms will probably return to the initial point, lowering their delivery radius because of increased costs. Figure 7 illustrates the backward shift of the cost functions.
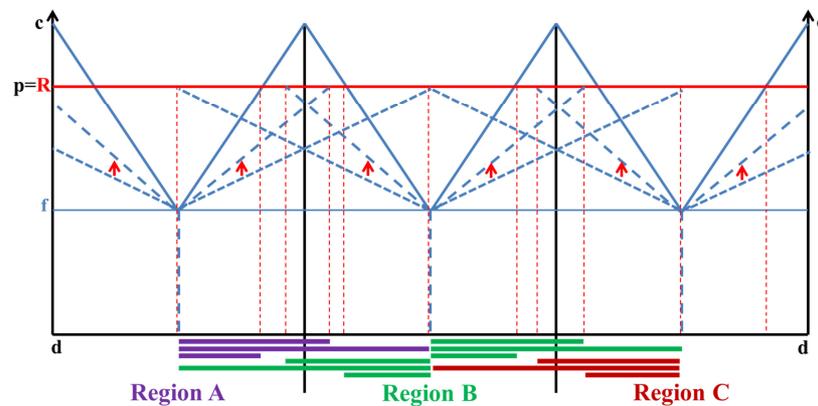

Figure 7: Backward-Shift through Counter-Effect

Theoretically, this process may be repeated continually and the question is whether and, if so, where the equilibrium of this process is. This depends on the strategy and aggressiveness of the cooperative partners.[44]

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[44] In Section 4.2.2, I use a brief game theoretical discussion to shed more light on this issue.

Of course, firms may also adopt different cooperation strategies at the same time. Given the scenario in Figure 6 and Figure 7 where cooperation benefits are realized, firms may also relocate in order to increase network coverage and serve more customers. Figure 8 demonstrates this issue for firm A and firm C.
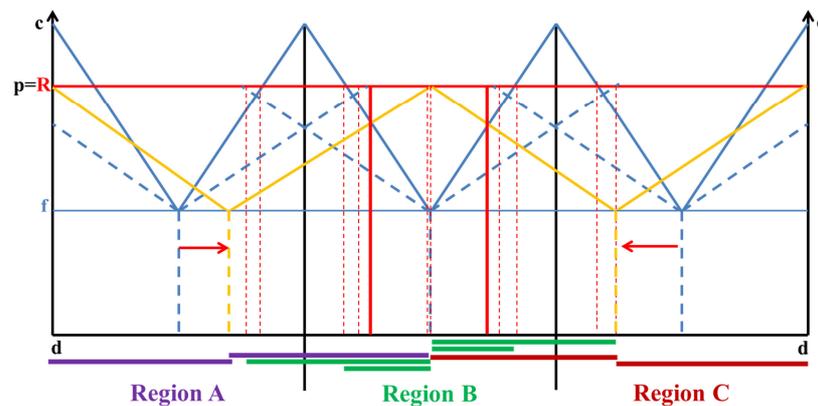
Figure 8: Relocation

Now it becomes obvious that the whole area consisting of regions A, B, and C can be served by firms A and C, and furthermore that firm B is only more profitable than A and C in its own region between the two red solid vertical lines. As a consequence, the market exit of firm B becomes more likely. This illustration shows how scale and scope economies may lead to market exits of postal providers operating on a comparatively low volume level, in other words operating in a comparatively small region. This is particularly problematic when firms do not have many opportunities to increase competitiveness by other means, e.g. through extra services or through price reduction as the range of possible extra services is limited and prices are rather low in the postal industry. Modeling the positive effect of cooperation resulting from the exploitation of scale and scope economies has shown how this helps firms expand their service area. On the other hand, this leads to enhanced competition because firms operate in the same regions. It is primarily scale economies which can lead to the squeezing out of small, less profitable firms from the market in this setting.

4.2.2 Game Theoretical Considerations

The assumptions about the behavior of cooperating firms made in Section 4.2.1 were central to the model outcome. It is interesting to know what is likely to change if these assumptions are relaxed.

First, it has been assumed that firms do not anticipate anti-cooperative behavior by their cooperation partner but expect advantages and thus cooperate; however, as demonstrated in the spatial model, after establishing the cooperation relationship, they may find the cooperative partner entering their own service area with the consequence that they lose customers to their competitors. In fact, if firms anticipated non-cooperative behavior of cooperative partners, it could affect their willingness to participate in a cooperative relationship, or in choosing a coopetitive strategy. As demonstrated in the model established in Section 4.2.1, cooperation is necessary in order to lower transportation costs because it enables firms to exploit scale and scope economies. The positive effect could, however, be foiled by the anti-cooperative behavior of the cooperation partner. A theoretical game analysis is best conducted by using a two-player sequential game as illustrated by the game tree in Figure 9.
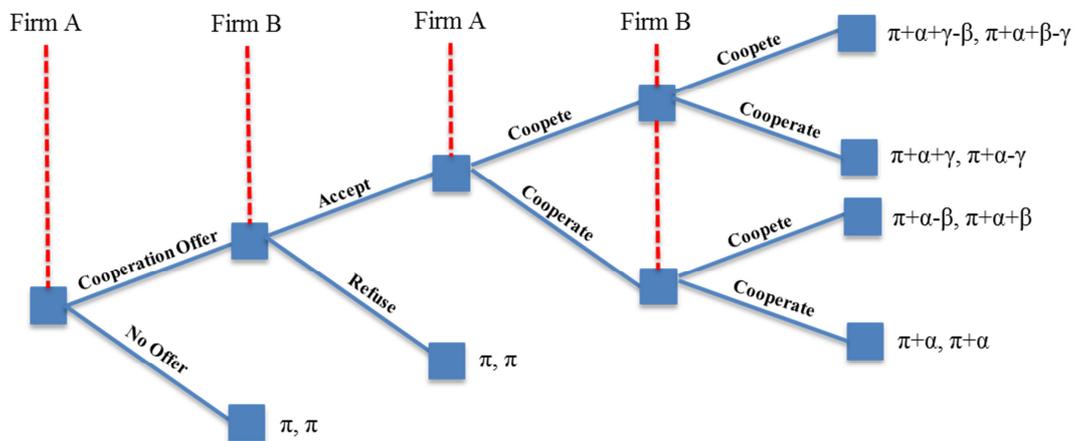

Figure 9: Game Tree of Two-Player Sequential Cooperation/ Coopetition Game

At the beginning of the game one of the two firms makes an offer of cooperation, which can either be accepted or refused by the other. Subsequently, after firms have realized the advantages of cooperation (see the spatial model in Section 4.2.1), their reduced transporta-

tion costs allow them to enter the cooperation partner's service area. Thus, following the co-operation agreement, each of the two firms has the opportunity to coopete, meaning they can expand the delivery radius and enter the cooperative partner's region. Taking into account these aspects, each agent in this model has a set of three strategies: no cooperation, coopera-tion, and coopetition. In this case, the payoff is represented by the firm profit as conveniently done in game theory, and moreover I assume that both players simply try to maximize their profits. If firms do not cooperate, each of them generates a profit of π. No cooperation im-plies in this context that each of the two firms is able to provide its service only on a regional level (see Section 4.2.1). As a consequence, there is no competition between them either.

Through cooperation each of the two firms can realize an additional profit of α.[45] If the firm chooses to coopete, which implies it cooperates and competes simultaneously, it in-creases its profit by γ (firm A) or β (firm B), respectively. Because β and γ are both greater than zero, it is very likely that each firm will choose to engage in coopetition rather than in mere cooperation. The parameters β and γ are greater than zero, because it is assumed that engaging in coopetition positively contributes to the firms' profits. At the same time, because firms share the whole market (see Section 4.2.1), this is a zero-sum game and thus the addi-tional gain from coopetition of the one firm is the loss of the other firm. In this context, adopting a coopetitive strategy implies that one firm enters the other firm's service area and provides its service there despite an existing cooperation relationship.

Parameters β and γ may be seen as the strategy parameters and their exact sizes depend on the aggressiveness of the respective firm. Lowering the price charged or extending sales and marketing activities are possible strategies to enhance competitiveness. The existence of a cooperative relationship depends on the value and relation of the parameters β and γ. A sim-ple answer to the question of what firms would do if they anticipated anti-cooperative behav-ior from their cooperation partner could be that their willingness to cooperate would dimin-ish. However, it is likely that firms will also take into account the benefits of cooperation and thus weigh the opportunities and risks. In fact, they would coopete if the benefits of coopera-tion outweighed the risks or disadvantages. Table 16 summarizes the effects for both firms.

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[45] I assume that cooperation is advantageous in any case. Moreover, additional profit is the same for both be-cause of the symmetry discussed in Section 4.2.1. Payoff: (Payoff Firm A, Payoff Firm B)

Table 16: List of Cooperation and Competition Effects

Effect	Firm A	Firm B
Positive cooperation effect	$+\alpha$	$+\alpha$
Effect from competitive behavior of A	$+\gamma$	$-\gamma$
Effect from competitive behavior of B	$-\beta$	$+\beta$
Net effect from coopetitive behavior of A only	$\alpha+\gamma$	$\alpha-\gamma$
Net effect from coopetitive behavior of B only	$\alpha-\beta$	$\alpha+\beta$
Net effect from coopetitive behavior of both	$\alpha+\gamma-\beta$	$\alpha+\beta-\gamma$

The game in this case can be solved with the aid of backward induction, assuming that the preconditions for the applicability of this solution method are fulfilled.[46] As Firm B has the last choice in this case, the first step consists of comparing this firm's payoff in the subgame. Coopetition is the dominant strategy of this firm because of the following equations:

$$(9) \; \pi + \alpha + \beta > \pi + \alpha \quad \textit{with } \beta > 0$$

$$(10) \; \pi + \alpha + \beta - \gamma > \pi + \alpha - \gamma \quad \textit{with } \beta, \gamma > 0$$

Having found the dominant strategies for Firm B, backward induction requires going one step back in the tree and analyzing the maximum payoff of Firm A. Because Firm B chose to coopete, only two payoffs of Firm A need to be compared, and the following inequality shows that Firm A will also choose to coopete:

$$(11) \; \pi + \alpha + \gamma - \beta > \pi + \alpha - \beta \quad \textit{with } \beta, \gamma > 0$$

In fact, this game does not end here because in this setting a coopetitive relationship will not be stable if at least one of the following two inequalities is fulfilled:

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[46] The game is finite, sequential, and can be displayed with a game tree, and players act rationally and are perfectly well informed about the rational behavior of the opposing player (common knowledge).

$$(12) \; Firm\,A : (\gamma - \beta) < -\alpha \quad with \; \beta, \gamma > 0$$

$$(13) \; Firm\,B : (\beta - \gamma) < -\alpha \quad with \; \beta, \gamma > 0$$

In simple terms, both inequalities imply that in a coopetitive relationship the advantages must outweigh competitive counter-effects otherwise the firm for whom the inequality is fulfilled will not cooperate, and both of them will have a profit of π. Firm B will reject the offer to cooperate if it expects aggressive anti-cooperative behavior of Firm A. On the other hand, if this is not the case, backward induction again requires going one further step back so that Firm A will only make an offer if it does not expect aggressive anti-cooperative behavior by Firm B. Because of the negative correlation of both inequalities, it becomes very likely that cooperation will not be stable in this setting. A Nash equilibrium would result in this game if both firms coopete, but only if the following equation is fulfilled:

$$(14) \; (\gamma = \beta) \quad with \; \beta, \gamma > 0$$

If both firms choose to coopete and equation 14 is fulfilled, both firms would lose if they deviated from this strategy. In this case the payoff for both firms equals the payoff in the case of a strategy mix whereby both firms choose to cooperate. The equality of the parameters γ and β is, for example, fulfilled if both firms have a pareto-optimal agreement on their coopetitive strategies, whereby in this case equal market shares would result. Of course, both firms must adhere to this agreement.

Consequently, relaxation of the assumptions made in Section 4.2.1, which primarily imply that firms do not anticipate the anti-cooperative behavior of the cooperation partner and that firms will not lower the price charged in order to be more competitive, the game theoretical considerations in this section provide additional understanding, clarify the weakness of a coopetitive relationship and demonstrate the high probability of a prisoner's dilemma in this setting. Both firms choose to coopete although they could be better off if both of them cooperate, achieving a payoff amounting to $\pi+\alpha$. If both firms coopete and do not have an agree-

ment on their behavior, or do not adhere to an existing agreement ($\gamma \neq \beta$), cooperation will not be pursued by any of the firms so each of them achieves a payoff amounting to π. In accordance with the graphical model presented in Section 4.2.1, firms will fall back on the original scenario without cooperation if they anticipate the competitive behavior of the cooperation partner or would not engage in cooperation to begin with.

As demonstrated in Section 4.2.1, in the case of the original scenario without cooperation, not all customers are served for cost reasons. One of the major risks in the postal sector is that individuals who are located too far from the firms' location or in sparsely populated areas are not served and the universal service obligation (USO) is constituted in order to ensure that every individual has access to the postal service. In the model of this chapter, without the existence of the USO, it may be desirable from the social perspective that firms exploit scale and scope economies because this would ensure that they supply the service to all households at affordable prices.[47] However, the result of the game illustrated in Figure 10 shows that firms will probably not cooperate nor compete in our setting and will concentrate their activity on a local level, as illustrated in Section 4.2.1, and thus will not supply all customers in their regions under certain circumstances. Lastly, it would also be interesting to find out whether a cooperation network covering the whole service area outperforms a large network also covering the whole service area. An answer to this question is essential in order to evaluate whether the joint efforts of small and medium-sized German postal providers covering the whole service area without the aid of the former monopolist would ensure universal service. According to the analysis, competitive counter-effects make the cooperation network fragile. The fact that postal networks are not physical unlike, for example, railways or electricity, intensifies this. Finally, there is a strong need for research dealing with these issues.

4.2.3 Derivation of Hypotheses

From the model analysis in the previous sections, the following two hypotheses can be derived:

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[47] Note that firms could also raise the price, especially in the case of a regional monopoly, which would ensure the supply of the service to all customers. However, it makes sense to assume that there is a reservation price at the demand side, an assumption which is also incorporated in the spatial model in Section 4.2.1.

Hypothesis 1: *Cooperation between postal providers has a positive effect on their economic success.*

Cooperation enables postal providers, especially small and medium-sized ones, to achieve higher geographical coverage, to process supra-regional mailings, and thus to operate on a higher volume level. This in turn allows them to exploit scale and scope economies and to lower their average or marginal transportation costs, respectively. Consequently, small and medium-sized firms benefit from advantages usually reserved for large firms in network industries.

Hypothesis 2: *Cooperation also yields a negative effect which stems from increased competition between the cooperation partners. This, in turn, negatively influences economic success.*

This negative effect is assumed to result from the positive effect described in Hypothesis 1. As shown in the spatial model, greater geographical coverage and improved success lead to an expansion of firms into the neighboring regions of their cooperation partners, which primarily results from the geographical character of the postal service. This, on the other hand, leads to increased competition in the regions where these postal providers operate simultaneously. This is especially true for business clients because they usually send a high volume of postal items. Consequently, although postal providers benefit from cooperation and improve their competitiveness, especially towards the market leader, this probably leads to mutual suppression of alternative postal providers from the market.

The simple model presented in Section 4.2.1, which is based on the spatial model of product differentiation presented by Hotelling, was able to demonstrate how cooperation advantages stemming from the exploitation of scale and scope economies result in positive as well as in negative effects regarding firms' delivery radius. The two hypotheses on the effects of cooperation in the postal business derived from the spatial model are analyzed in Section 4.3 in the light of the collected data and interviews.

4.3 Evidence on Cooperation Behavior in the German Postal Market

Until now, there have been no studies dealing with cooperation in the postal sector. Furthermore, there is a lack of appropriate data for the German postal market. For this reason, I collected data within the framework of a written questionnaire and, moreover, conducted in-depth interviews in order to provide preliminary evidence. In the following, I provide a brief description of the survey and the collected data and after that present the case study evidence.

4.3.1 Survey Description

The written questionnaire was conducted in 2010. For the identification of the postal providers, a list of all licensees in the German postal market provided by the German Federal Network Agency was used. The written questionnaires were sent to 1,459 licensees nationwide and in a second elevation again to 169 postal providers located in the German federal states of Hamburg, Bremen, and Lower Saxony, who did not respond to the first questionnaire. In sum, 179 firms answered the survey. One hundred and thirty-three of these answers included completed questionnaires, and the other 46 answers included the information that the firms were currently not active in the postal market. Regarding the response rate, only about a half of the licenses in circulation are indeed actively used by the firms.[48]

The in-depth interviews were conducted subsequent to the written questionnaire in 2011. The interviewees were picked from a number of firms who volunteered to give an interview. After a pilot test, the interviews were conducted at the interviewees' locations. All interviews followed the same semi-structured protocol and were recorded, transcribed, and evaluated repeatedly. In sum, eight case studies resulted from the in-depth interviews, of which seven are included in this chapter because they provided sufficient evidence on the analyzed issue.

4.3.2 Descriptive Statistics

Table 17 contains a summary of the major firm-specific characteristics, providing a brief overview of the data used in this chapter.

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[48] BvDP and TellSell Consulting 2010

Table 17: Firm-Specific Characteristics

Category	Subsample	Frequency[a]	Percentage	Cumulative Percentage
Size[b]	size < 5	55	41.35	41.35
	5 ≤ size < 10	17	12.78	54.13
	10 ≤ size < 50	30	22.56	76.69
	50 ≤ size < 250	15	11.28	87.97
	size > 250	3	2.26	90.23
	Missing Values	14	10.53	-
Age	age < 5	37	27.82	27.82
	5 ≤ age <10	37	27.82	55.64
	10 ≤ age < 20	43	32.33	87.97
	Age > 20	12	9.02	96.99
	Missing Values	4	3.01	-
Delivery Radius[c]	Local/Regional	54	40.60	40.60
	German State	10	7.52	48.12
	Germany	37	27.82	75.94
	International	29	21.80	97.74
	Missing Values	3	2.26	-
Number of Competitors[d]	0	20	15.04	15.04
	1-2	41	30.83	45.87
	3-4	22	16.54	62.41
	≥ 5	39	29.32	91.73
	Unknown	10	7.52	99.25
	Missing Values	1	0.75	-
Cooperation	Yes	72	54.14	54.14
	No	61	45.86	100
	Missing Values	0	0	-

a) In sum 133 observations; values at the time of the survey; b) One firm did not provide information on the number of its employees (the indicator used as a measure of size) but the plant visit showed that this firm has more than 250 employees. This information is added here.; c) With cooperation partners; d) Number of competitors operating in the own region except market leader

The presented descriptive statistics reveal that the German postal market is primarily characterized by small and young firms. More than 75 percent of them have fewer than 50 employees. What is more, about 56 percent of the firms are under 10 years old and almost 90 percent of them are under 20 years old. The small size of the firms is also reflected in their

delivery radius. The delivery radius, with the aid of cooperation partners, of almost 50 percent of the firms is confined to the German federal state of their location, which seems unsatisfactory given the geographical character of the service provided in this industry. Consequently, it seems that most firms are active on a small scale.

Furthermore, the firms face high competitive forces in their geographical area. Only about 46 percent have two, or fewer than two, competitors in their own region, except the market leader. The rest of them have more than two competitors operating in their region. The average number of competitors in the own region equals 1.8. This suggests that postal providers face high competition not only from the market leader but also from other small postal providers. Despite this, about 54 percent of them cooperate with other postal providers, which in turn indicates that something like coopetition must exist among postal providers in the German postal market.

The collected data reveal that cooperation is an important issue for postal providers. About 72 percent of the firms could envisage cooperating with other firms. The participating firms were also asked in the written questionnaire to state the reason why they cooperate. In sum, 63 of the 72 firms who stated that they cooperate mentioned a reason why they do so. The most frequently mentioned answer, given by 38 percent of the participants, was that firms wished to expand their area of delivery, exploit density economies, and thus increase their volume. In fact, the greater the service area, the more the firms benefit from scale economies. The second most frequent answer, given by 29 percent of the participants, was that they wanted to exploit synergy effects and efficiency gains and thus reduce their costs. The third most frequent answer to this question, submitted by 19 percent of participants, was that firms wished to use the capacities of other firms, such as their delivery or sorting services. Finally, 14 percent of firms mentioned that they wanted to exchange postal items, combine services and cover a greater product portfolio, which primarily results in the exploitation of scope economies. Figure 10 summarizes these findings.
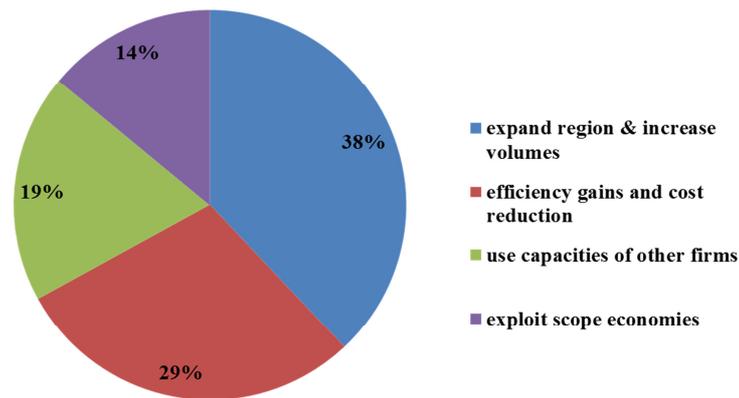
Figure 10: Reason for Cooperation

Source: Own survey data[49]

The econometric analysis in Chapter 3 did not produce a statistically significant effect of the variable representing cooperation activity on firm success (see Section 3.4.2). Thus, in the following first descriptive statistics and the results of the case studies are used in order to provide first insight into this issue.

The firms were also asked in the written questionnaire to assess the intensity of competition on a scale from one (very low) to five (very high). It can be stated with confidence that there is high perceived competition intensity in the German postal market. Whereas only about 25 percent stated that the competition intensity is low (sum of intensity grades "1" and "2"), about 42 percent stated that the intensity is high (sum of intensity grades "4" and "5"). The exact distribution of answers is presented in Figure 11.[50]

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[49] This information has been provided in the written questionnaire in an empty response field.

[50] It is possible that the competition intensity grades mentioned by the firms also involve the competitive pressure stemming from the market leader, although the market leader has been excluded from the question on the number of competitors in the same region.
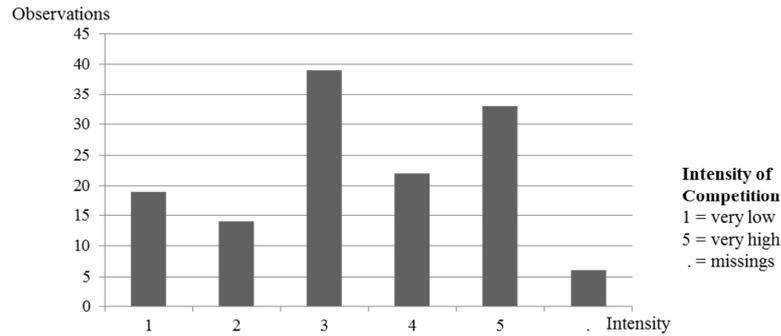
Figure 11: Perceived Intensity of Competition

Source: Own survey data

This descriptive analysis confirms the findings in the theoretical analysis in Section 4.2.1 that firms operate in an area of conflict between cooperation and competition. Thus, as stated in Hypothesis 1 and Hypothesis 2 in Section 4.2.3, cooperation not only yields advantages but also seems to be accompanied by tension. Further indications of the two suspected effects of cooperation can be derived from the correlations of relevant variables. The variables "intensity of competition" and "profit 2010" are ordinal variables, whereas the variable "cooperation" is binary and the variable "number of competitors" metrical. In order to account for the scale level of the variable, I calculate the Pearson's correlation coefficient when the variable "cooperation" is included. All other correlation coefficients are calculated with Spearman's rank correlation coefficient in order to avoid any information loss.[51] Table 18 includes the correlation coefficients, number of observations and p-values calculated.

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[51] The correlation coefficients are calculated with the Stata command *pwcorr* (Pearson's correlation coefficient) or *spearman* (Spearman's correlation coefficient) including the *sig* and *obs* options in order to display the p-values and number of observations.

Table 18: Correlation Matrix of Cooperation and Competition Variables

	Number of Competitors[a)]	Cooperation[b)]	Intensity of Competition[c)]	Profit 2010[d)]
Number of Competitors	1 Obs=114			
Cooperation	-0.0823 (0.3674) Obs=122	1 Obs=123		
Intensity of Competition	0.2417 (0.0096) Obs=114	0.0117 (0.8994) Obs=119	1 Obs=114	
Profit 2010	0.0597 (0.5278) Obs=114	0.0504 (0.5879) Obs=118	0.1334 (0.1571) Obs=114	1 Obs=114

P-values in parentheses; a) Choice of 1 to 5; the answers "more than 5" have been replaced with 6 and the answers "unknown" have been dropped.[52]; b)Variable of dichotomous nature; c) Measured on a scale from 1 (=very low) to 5 (=very high); d) Measured on a scale from 1 (=unsatisfactory) to 5 (=very good)

First, the coefficient computed for the variables "number of competitors" and "cooperation" indicates that there is a negative correlation between these two variables. Moreover, the correlation matrix reveals that the number of competitors is positively correlated with the intensity of competition and the firms' profit. Although it makes sense that the intensity of competition rises with the number of competitors and vice versa, the positive correlation of the variables "number of competitors" and "profit 2010" seems counter-intuitive, probably indicating a second, positive effect stemming from the relationship between the competitors. In fact, this is indicated by the positive correlation coefficient of the variables "cooperation" and "profit 2010." The positive correlation of the variables "cooperation" and "intensity of competition" seems to verify this suspicion. Lastly, the positive correlation of the variables "intensity of competition" and "profit 2010" again seems counter-intuitive, but probably results from the two countervailing effects of suspected cooperation. Although the correlation

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[52] For control, I also replaced the answers "more than 5" with "10" and found no significant change in the correlation coefficients.

measures are rather small, they provided initial indications of the direction. Furthermore, the ambivalent results indicate the existence of multiple effects, which are probably oppositely directed. It is very important to note that in terms of statistical significance only the coefficient of the variables "intensity of competition" and "number of competitors" provides a reliable value because only in this case is the p-value less than 0.05. However, in terms of economic significance, it must be noted that a correlation coefficient of 0.2417 indicates only a weak positive correlation between these two variables. Moreover, ignoring the lack of statistical significance, it is also fair to say that the economic significance of the other correlation coefficients is even smaller.

The assumption made in the spatial model in Section 4.2.1, that firms enter their cooperation partner's service area and compete, may appear too counter-intuitive to be realistic at first glance. Indeed, the collected data provide hints on the existence of such an ambivalent relationship. Two variables in the dataset shed more light on this issue. First, the firms were asked in the survey if they were planning to expand their delivery radius in future. It turned out that 44 percent of them do plan to expand, which is indicated by the variable "expansion" following. Second, the firms were asked if they planned to open new branches, which was confirmed by about 35 percent of them, and is indicated by the variable named "branches" following.[53] What is even more interesting are the correlations of these two variables with the variable representing whether they cooperate, called "cooperation."[54] The results showed that both variables are positively correlated with the cooperation variable. The correlation coefficient between the variables "expansion" and "cooperation" amounts to 0.1537 (p=0.0774 and n=133), and the coefficient for the variables "branches" and "cooperation" amounts to 0.1617 (p=0.0629 and n=133), which confirms that cooperation and expansion in fact tend to occur together, and that coopetition is a strategy adopted by postal providers. Again, in terms of statistical significance, the results should be interpreted cautiously, because of the size of the p-value in both cases.

To sum up, it can be deduced from these figures that cooperation is practiced and desired in the postal sector. Nonetheless, firms are also feeling competitive pressures in the market,

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[53] All firms answered both questions (n = 133). For both variables, firms who answered "maybe" have been counted among those who answered "yes" in order to obtain two binary coded variables.

[54] Again, the correlation coefficients are calculated with the Stata command *pwcorr* including the *sig* and *obs* options in order to display the p-values and number of observations.

which indicates there are different effects and tensions resulting from the activity in the conflicting area between cooperation and competition. In fact, the positive correlations of the variables "cooperation," "number of competitors," and "intensity of competition" with the variable "profit change" match the findings in previous studies that there are positive effects of both cooperative and competitive strategies on firm performance (Abdallah 2011). However, although it is very reasonable to assume so, the correlations are not sufficient to verify whether cooperative and competitive strategies simultaneously positively affect firm performance. Thus, the case studies presented in the subsequent section are used to shed more light on cooperative behavior and the effects resulting from it on German postal providers.

4.3.3   Evidence from Case Studies

Further evidence on the analyzed issue provided in this chapter stems from in-depth interviews conducted with postal providers. Below, I present seven cases focusing on the firms' cooperative behavior and competitive counter-effects. Of particular interest here is information on the firms' geographical coverage, whether they seek to increase it, and which cooperation strategies they adopt to do so. Moreover, to account for the counter-effect of cooperation, I present preliminary indications on the intensity of competition perceived. Section 4.3.3.1 provides a brief description of the cases and Section 4.3.3.2 summarizes the results of the case studies.

4.3.3.1 Case Descriptions

The firm in case A, which has more than 250 employees, regionally covers about 80 percent of the German federal state of Schleswig Holstein and cooperates occasionally with the market leader in the case of supra-regional post, which the firm cannot deliver by itself using its own network. Nonetheless, regional coverage goes beyond the German state where the firm is located and it is also able to serve other nationwide customers. This firm, however, is focused on providing its services to business clients from the medical industry and does not serve private customers because, according to own statements, supplying private customers leads to a complication of delivery routes and thus to inefficiency. Moreover, the firm does not seek to expand their own regional coverage. This firm highlights that their cooperation is

associated with coordination efforts and costs, which explains that it does not cooperate with selected firms, nor engage in cooperation within an organized network (e.g. Mail Alliance or P2-Network).

The cooperation strategy of firm B is very much akin to that of firm A with the difference that its regional coverage is restricted to the German federal state of Hamburg, where the firm is located. The firm has fewer than five employees and is active on a local level and has a very small number of processed items. The limitation of the delivery radius can definitely be attributed to the small size of this firm. Firm B has access to the network of the market leader through cooperation with a consolidator and, unlike firm A, endeavors to expand its delivery radius. According to statements from firm B, it feels no tension from the market leader and has no cooperative relationship with other postal providers. Lastly, it does not feel any competitive pressures from either of the postal providers operating in the German postal market.

Firm C has more than 250 employees, is larger than firms A and B, has a much more established network, and is very active in terms of selective cooperation with other firms and also cooperation in the framework of organized networks. It supplies about 80 to 85 percent of customers with postal services in Germany without the aid of the market leader. Its efforts to expand the geographical service area rely primarily on partnerships, investments, and cooperation. This firm is active in both of the large postal cooperation networks currently existing in Germany: Mail Alliance and P2. Its intention is in fact to establish a parallel delivery infrastructure so that they are completely independent from the market leader and supply their service throughout the country. This firm also claims that cooperation is currently the only way to establish a parallel network for alternative postal providers. Moreover, it states that it sees other postal providers with whom it cooperates as competitors and colleagues at the same time. They compete for the same customers, but also cooperate on the infrastructure level in order to ensure nationwide delivery. Lastly, the firm did not state whether it cooperates with the market leader.

Firm D resembles firm C in terms of cooperative behavior, but with fewer than five employees it is much smaller and has a much less developed network. It covers 100 percent of the region where it is located and is a member of the P2 network in order to ensure supraregional services. The firm is only able to cover a larger region with the aid of this organized network. Moreover, according to statements from firm D, it feels high competitive pressures

stemming from subsidiaries of the market leader. Nonetheless, this firm uses access to the market leaders' network without feeling any restrictions, which indicates an ambivalent relationship with the market leader.

Firm E has between five and ten employees and unfortunately did not give specific information on its regional coverage, but said that coverage varies. It has an incomplete network coverage which depends on which cooperative relationships are in place at the time. It has chosen selective cooperation as a major strategy for expanding regional coverage, but is also a partner of the Mail Alliance and cooperates indirectly with partners of the P2-Network. The firm emphasized that it is important to cooperate only with selected partners of these organized networks. Lastly, this firm cooperates particularly with publishing houses because they have the necessary transportation and delivery infrastructure. It emphasized there is primarily competition for customers in their own region and moreover asserts that it feels high competitive pressures stemming from the market leader.

Firm F has more than 250 employees and is comparatively large, operating nationwide as well as internationally. It tries to expand its own network coverage through organic growth. Despite a very well established network, this firm cooperates intensively with selected partners and has contracts in order to outsource operational functions to these partners. According to statements from firm F, it does not cooperate with any of its large competitors, especially not with the market leader DPAG. This firm claims it feels hard competitive pressures stemming from the market leader and also from other postal providers because the market is fiercely competitive.

Firm G, with fewer than five employees, very much resembles firms A and B, is also active only on a regional level, and uses the DPAG network in order to ensure the delivery of supra-regional sending. However, this firm does not provide its services to private customers, but only to public institutions, which implies that a large proportion of the items is collected and delivered within the same region. Although it aims to expand its own geographical coverage, the firm's efforts in this respect are rather low. According to statements from firm G, it does not feel hard competitive pressures from the market leader because of its strategic orientation. Lastly, the firm states that it has no further competitors in its own region and thus does not feel much competitive pressure.

4.3.3.2 Results

Table 19 summarizes information on the cases, the identified cooperation strategies, which of these strategies are adopted by the interviewed firms, their own assessment regarding their current regional coverage, and lastly whether they make an effort to expand coverage. Moreover, two variables on the competition situation and the firms' profit situations at the time of the survey are included in this table. The information included in this table derives from the written questionnaire and the in-depth interviews and plant visits. When information in questionnaires was not confirmed by the interviews, more weight was given to the information derived from the interviews or from observations during plant visits.

Table 19: Case Studies on Cooperation Behavior in the German Postal Market

Case	Size[a]	Cooperation Strategy				Regional Coverage	Effort to Expand?	Branch Planned?	Number of Competitors[b]	Intensity of Competition[c]	Profit Situation[d]
		Selective Cooperation	Network Cooperation	M&A	Access to Market Leader's Network						
A	Size > 250	No	No	Yes	Yes	80 percent in own German federal state Schleswig-Holstein and nationwide	No	Maybe	Unknown	1	4
B	Size < 5	No	No	No	Yes	Greater area of own German federal state Hamburg	Yes	Maybe	Unknown	1	3
C[e]	Size > 250	Yes	Yes	Yes	-	80-85 percent of customers for postal services in Germany	Maybe	Maybe	More than 5	5	1
D	Size < 5	Yes	Yes	-	Yes	Active only on local level; covers 100 percent of its own region	Yes	Maybe	5	5	1
E	5 ≤ Size < 10	Yes	Yes	-	-	Did not give specific information; underlined that it varies	Yes	No	0	-	2
F	Size > 250	Yes	-	Yes	No	Nationwide, international	Maybe	Maybe	More than 5	5	4
G	Size < 5	No	No	No	Yes	Local	Potentially	Potentially	0	2	2

a) Measured by the average number of employees at the time of the survey (2010); b) Firms were asked to give the number of their competitors in their region except for market leader; c) Measured on a scale from 1 (=very low) to 5 (=very high); d) At the time of the survey; measured on a scale from 1 (=unsatisfactory) to 5 (=very good); e) This firm did not provide information on its number of employees, the indicator used as a measure for the size, but data from the plant visit resulted that it has more than 250 employees.

It turned out that all interviewed firms practice some kind of cooperation. Results from the case studies show that cooperative behavior is influenced by competitive pressures which vary from case to case. Moreover, it also becomes obvious that the relationships between postal providers are ambivalently lying in the tension area between cooperation and competition. The results of the written questionnaire and the case studies revealed that different cooperative strategies are used by German postal providers in order to increase the geographical service area. In fact, the following four strategies could be identified:

- selective cooperation,
- cooperation within a network,
- mergers and acquisitions,
- access to the incumbent's network, the market leader.

Each cooperative strategy has particular advantages and disadvantages. The extent of the positive and negative effects on the firms' success varies for different cooperative strategies. It can be assumed that cooperation within a network yields a much greater effect on the firms' success than selective cooperation, because of a larger number of cooperative partners. Moreover, because it can be assumed that firms primarily compete with their direct neighbors for customers, the positive net effect of cooperation within a network exceeds the net effect of selective cooperation. Firms benefit from the large number of partners in a network, but they compete only with those who are located in their immediate surroundings.

In the case of merger and acquisition activities, it is assumed that there is primarily a positive effect because the firm is able to lower the costs but is not faced with a competitive effect because of the merger. Because the Hotelling optimality in terms of location, as described in Section 4.2.1, also applies to several different locations of one firm, it remains at the profit-maximizing level in the case of merger and acquisition activities, provided that the optimality was fulfilled previously.

In fact, the identified strategies are not necessarily alternatives. The case studies proved that postal providers usually mix strategies. To a certain extent, each postal provider has its own delivery network which is more or less large. The necessity to cooperate in order to increase geographical coverage depends on the one hand on the size of

this network and, on the other hand, on the entrepreneurial goals of the firm. The basic advantage of cooperation in network industries is that it enables firms to work on a greater volume level and thus exploit scale and scope economies.

Through cooperation, firms can expand their own geographical coverage and hence are able to provide services to other regions using the delivery network of the cooperation partner. A cooperation relationship can easily be built and certainly is suitable for increasing geographical coverage, but despite these advantages it is linked to coordination costs and may cause tension between the strategic partners because of interdependence and its operation in the conflicting area between cooperation and competition. By intuition, it can be assumed that cooperative behavior primarily has a positive effect on the firms' success; however, as shown by the evidence, it is very likely that cooperation may also negatively influence success.

The firms were asked in the interviews to state which of the following three groups represented the major threat to their own success in the market: the market leader, other postal service providers in the market, or new market entrants. Four of the seven firms stated that the major threat comes from the market leader and its subsidiaries, one stated that it depends on the region, and one firm stated that none of these firms represents a threat because it is active on a regional level. Three firms stated that there is actually competition between the alternative postal providers and one of them thinks that this group represents the major threat potential. New market entrants are not seen as a threat by any of the interviewed firms.

4.4   Concluding Remarks

The two suspected effects of cooperation were demonstrated with the spatial model proposed by Hotelling. This model has been used in order to demonstrate how firms benefit from cooperation, and how they expand their service area and enter other regional markets, which in turn leads to enhanced competition between cooperation partners, and in extreme cases even to market exits. The evidence from the written questionnaire and the case studies confirmed that cooperation is widespread in the German

postal market; however, only the case studies have shown the diversity of cooperation strategies adopted by small and medium-sized postal providers in order to increase their geographical service area.

This is often the case because postal networks have the benefit of more flexibility than other network industries, so that connections can be perpetually both generated and closed. This raises the prospect of competition on the infrastructure level in the postal sector. In fact, I found that cooperation yields a positive effect, helping firms to lower marginal or average transportation costs and to expand their service area, as stated in Hypothesis 1. Entry and operation on the local level seem not to be very profitable but are possible, and the results leave the impression that numerous firms would not exist without cooperation either with other postal providers or with the market leader who ensures nationwide delivery in any case.

Consequently, firms can only be competitive on the national level through cooperation. Although firms cooperate in order to maintain the infrastructure, they remain competitors and thus compete for customers. From this results a negative counter-effect, which entails an ambivalent relationship of the cooperation partners, as stated in Hypothesis 2. Although firms become more competitive, especially towards the market leader, this also intensifies the competition between the alternative postal providers as well so that it becomes likely that they will oust each other from the market.

In the strategy literature, it is assumed, principally on the basis of theoretical discussions, that firms engaging simultaneously in cooperative and competitive strategies perform better than firms concentrating on adopting either cooperative or competitive strategies. Unlike the conventional wisdom in strategy literature, my conclusion is that the negative effect described in Hypothesis 2 is likely to be induced by the positive effect described in Hypothesis 1 in this case. Moreover, although I demonstrated the probability of a non-cooperative relationship because of the prisoner's dilemma in the theoretical game discussion, the evidence showed that different cooperation strategies are widespread in the postal sector. These seemingly contradictory results can be explained by the fact that firms recently established their cooperation relationship and it may break hereafter. Despite this logic, only further research will produce a reliable answer to this question.

The assumptions made in this chapter entail some restrictions. First, it has not been considered in the analysis that the postal sector is characterized by the fact that firms are not necessarily providing a homogeneous service. In fact, the results of the written questionnaire and the in-depth interviews showed that German postal providers differ with respect to their primary business area, such as mail, parcels, etc., and also with respect to their product lines. Moreover, although I ignored the existence of different intermediate services of the postal network, such as collection, sorting, transportation, and delivery, and aggregated these operations into one service, the evidence has shown that there are firms in the market which specialize in selected operations and purchase the rest of the operations on the market. To deal with this heterogeneity, I focused on the licensees and assumed that they do not differ significantly from each other. Thus, it would be interesting to analyze what effects this specialization has on the cooperation behavior of postal providers. A further question this chapter does not answer and which could be interesting for further research refers to comparison of cooperation network and a non-cooperation network of equal size. In fact, I found that cooperation is a way for private postal providers to ensure wide geographical coverage without the aid of the market leader, but there is no evaluation of the economic benefit. Lastly, I did not discuss in detail the USO, which should ensure that every individual has access to postal services. The importance of the USO becomes even greater, if it is answered with the question of whether the alternative network, in this case the cooperation network, is able to replace the former monopolist's large network. This question is also proposed for further research.

5   Conclusions

The Europe-wide opening-up of postal markets to competition despite the long monopolistic tradition of this sector in many of these countries, and numerous contradictory studies whose authors detect natural monopoly features of the postal business, motivated me to deal with the topic of competition potential in the German postal market. The three conducted studies presented in this thesis provide a literature overview, theoretical analyses and initial empirical evidence for the German postal market. Because of the lack of data, the empirical evidence is based on data from a written survey and from in-depth interviews conducted during on-site visits to various postal firms.

Chapter 2 focused on both the analysis of natural monopoly and contestability theory and provided a review of empirical studies conducted in order to analyze these subjects for the postal sector. This chapter outlines the fact that scale, scope, and density economies play a significant role in the postal sector and that it is primarily the delivery function which has natural monopoly characteristics. This is because of the nature of the delivery function whereby several authors believe the remaining postal operations should open up to competition in order to be more efficient. In this chapter, I also discussed the difficulty of unbundling the delivery function because of the vertical integration of postal networks. Moreover, I presented the necessity to account for the contestability aspect if regulatory issues were addressed, and showed that there is a lack of studies providing empirical evidence on contestability.

Because the German postal market completely opened up to competition at the beginning of 2008 and a lot of market entries and exits have occurred since then, it was interesting to analyze how new private postal providers deal with the difficulties of the postal industry as discussed in Chapter 2, and also to analyze how they perform on the market. Thus, in Chapter 3, I focused on the analysis of the success and survival of new postal providers in relation to key success determinants. I used the data elevated within the framework of the written survey and the in-depth interviews for the analysis. I found that many success factors identified, such as quick and safe delivery, were linked to the confidential nature of the postal service. Moreover, I found that many firms are active in

additional business areas which significantly contribute to entrepreneurial success and allow for the subsidization of start-up time. I also found that scope economies represent an important success determinant and that providing delivery services is not beneficial. This finding fits the conclusion of previous studies that delivery function represents a natural monopoly. As the majority of postal services providers in Germany are small firms, this would imply that they can provide delivery services only at significantly higher average costs. This could explain the negative effect detected for the respective variable in the framework of the econometric investigation.

From analyses based on the self-collected data, in-depth interviews and plant visits, I concluded that small and medium-sized postal providers overcome the disadvantages of natural monopoly through specialization. A closer look at the industry revealed that regional and operational specialization is widespread in the German postal market, which proves that the unbundling of vertically integrated intermediate services in the postal network is practiced. Moreover, the results showed that working in niche markets, a result of specialization, is the reason why exploiting scale economies has not been identified as a decisive success determinant in this thesis, although it was previously found by many of the authors reviewed in Chapter 2. A further finding directly linked to this issue is that firms who specialize engage in different forms of cooperation in order to ensure the customer is provided with the entire service.

In my analysis in Chapter 3, I found that cooperation is among the major success determinants in the German postal market. Thus, in Chapter 4, I analyzed the issue of cooperation from the theoretical perspective using the spatial model proposed by Hotelling. I demonstrated the positive effect of cooperation in an industry characterized by the existence of scale and scope economies, as is the case of the postal sector, and showed how improved competitiveness of postal providers, which in this case is based on cooperation and thus the exploitation of scale and scope economies, leads to enhanced competition between cooperative partners and results in a negative effect on firm performance. Simultaneous engagement in cooperation and competition was coined "coopetition" in accordance with the literature dealing with the issues presented in this chapter. Using the collected data and information from the in-depth interviews, I provide the first evidence indicating that firms operate in the tension area between com-

petition and cooperation, and that cooperation yields both positive and negative effects on firm performance.

In sum, a closer analysis showed that despite the German market's opening up to competition, the monopolistic structures are still strikingly present in the market. Although the former monopolist DPAG lost market shares to competition, it seems it did not lose much market power. Nonetheless, overall private postal providers can succeed in the market despite the difficulties they face and regardless of the various innovative business models implemented. An interesting question in this context is whether specialized firms entered the national postal market as a whole. This question should be addressed in future research. More research is required in order to shed light on the contestability aspect in general, and on the role of the USO in a changing postal sector.

The postal sector is dynamic and rapidly changing because of the electronization of communication. One of the recent developments in the letter market is the initiation of the legally binding electronic letter. Electronic letters have been successfully adopted in three European countries: Finland, Switzerland and Germany.[55] Electronic letters differ from e-mail in the sense that they require registration with identification card. Time will tell if this innovation can successfully continue. The fact is the success of this concept would have a huge impact on postal service providers. One such impact applies to the cost structure of postal service providers since, as described in Chapter 3 and Chapter 4, the delivery costs represent the highest current cost pool. The delivery operation disappears when an electronic letter is sent.[56] A further impact is that the letter market is open to competitors from the information and communication technology markets.

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[55] The German electronic letter is called De-Mail, the Finnish version is called NetPosti, and the Swiss one is called Inca-Mail, all provided by the respective incumbent of the market.

[56] This does not apply to a hybrid service where the electronic letters are printed and placed in envelopes for delivery.

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Appendix

Table 20: Correlation Matrix

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
(1)	Age	1.0000																	
(2)	Size	0.1838	1.0000																
(3)	Size Squared	0.1589	0.9093	1.0000															
(4)	Collection	-0.1033	0.1122	0.0926	1.0000														
(5)	Sorting (in)	-0.1378	0.2897	0.2166	0.3775	1.0000													
(6)	Sorting (out)	-0.2377	0.2134	0.1621	0.5108	0.6902	1.0000												
(7)	Transportation	-0.0264	0.1594	0.1219	0.2812	0.3919	0.3458	1.0000											
(8)	Delivery	-0.2153	0.0282	0.0453	0.2643	0.3063	0.3017	0.1644	1.0000										
(9)	Letter Market	-0.2352	-0.2113	-0.2120	0.2651	0.1484	0.3757	0.0137	0.3008	1.0000									
(10)	Parcel Market	0.0483	-0.0453	-0.0422	-0.0525	-0.0506	-0.0775	-0.0223	0.0208	-0.0087	1.0000								
(11)	Other Market	0.2688	0.2559	0.2471	-0.2476	-0.2366	-0.3692	-0.0015	-0.2797	-0.6964	-0.1547	1.0000							
(12)	Delivery Radius 1	-0.0111	-0.2547	-0.1972	0.0063	-0.2110	-0.0956	-0.0285	0.0715	0.1106	-0.1266	-0.1354	1.0000						
(13)	Delivery Radius 2	0.0549	0.2438	0.2825	0.0401	0.2326	0.2138	0.1371	0.1253	0.0260	0.0598	-0.1312	-0.2679	1.0000					
(14)	Delivery Radius 3	-0.0387	-0.0052	-0.0537	0.0265	0.1292	0.0449	0.1170	0.2433	-0.0022	0.0525	0.0969	-0.5203	-0.1986	1.0000				
(15)	Delivery Radius 4	0.0508	0.1819	0.1223	0.0598	-0.0246	-0.0545	-0.1396	-0.3397	-0.1431	0.0892	0.0938	-0.3999	-0.1527	-0.2965	1.0000			
(16)	Cooperation	-0.1397	0.0494	-0.0227	0.2134	0.2576	0.2375	0.1407	0.3251	0.1711	-0.0900	-0.0743	-0.1762	0.0322	0.2006	0.0481	1.0000		
(17)	Founder	-0.2179	-0.0778	-0.0087	0.0958	0.0786	0.1626	0.0031	0.0847	0.1192	-0.0404	-0.1345	0.0337	-0.0494	0.0281	-0.0022	-0.0510	1.0000	
(18)	West	0.0606	0.0111	0.0307	0.0086	0.0021	-0.0660	-0.2434	0.0518	0.0336	-0.0521	-0.1488	0.0336	0.1681	-0.1762	0.0578	0.0305	-0.0313	1.0000

Correlation matrix for estimation sample (n=97)

Table 21: Results of Ordered Logistic Estimations

		Model 7	Model 8	Model 9
Variable	**Exp. sign[57]**	**Coef.**	**Coef.**	**Coef.**
Age	Pos.	-0.013 (-0.41)	-0.011 (-0.34)	-0.017 (-0.53)
Size	Pos.	-0.008 (-0.82)	-0.004 (-0.40)	0.001 ()0.08
Size squared	Neg.	0.004e-2 (1.07)	0.004e-2 (1.07)	0.002e-2 (0.55)
Collection	Neg./Pos.	0.855* (1.75)	0.810 (1.64)	0.956* (1.83)
Sorting (in)	Neg./Pos.	-0.434 (-0.78)	-0.474 (-0.82)	-0.311 (-0.52)
Sorting (out)	Neg./Pos.	0.206 (0.36)	-0.185 (-0.29)	-0.307 (-0.48)
Transportation	Neg./Pos.	0.357 (0.80)	0.492 (1.07)	0.407 (0.84)
Delivery	Neg.	-0.785* (-1.74)	-1.035** (-2.16)	-1.312** (-2.35)
Letter market	Neg./Pos.		-0.331 (-0.49)	-0.194 (-0.28)
Parcel market	Pos.		0.285 (0.54)	0.298 (0.54)
Other market	Pos.		-1.451** (-2.21)	-1.281* (-1.86)
Delivery radius 1	Pos.			0.795 (0.62)
Delivery radius 2	Pos.			1.060 (0.74)
Delivery radius 3	Neg.			0.850 (0.65)
Delivery radius 4	Neg.			0.134 (0.10)
Cooperation	Pos.			-0.449 (-1.05)
Founder	Pos.			0.429 (0.82)
West	Pos.			0.177 (0.35)
Const. (cut1)	0	-1.820*** (-2.82)	-2.738*** (-3.03)	-1.830 (-1.25)
Const. (cut2)	0	-0.821 (-1.33)	-1.678* (-1.93)	-0.744 (-0.51)
Const. (cut3)	0	0.968 (1.54)	0.166 (0.19)	1.179 (0.80)
Const. (cut4)	0	3.582*** (4.29)	2.832*** (2.79)	3.903** (2.48)
N		97	97	97
Pseudo R^2		0.032	0.058	0.073

Z statistics in parentheses

* p<0.1, ** p<0.05, ***p<0.01

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[57] The expected signs are explained at the end of Section 3.2.

Table 22: Brant Test: Estimated Coefficients

Variable	y>1	y>2	y>3	y>4
Age	-0.0631	-0.0034	-0.0016	-0.3270
Size	-0.0113	-0.0156	0.0008	1.1212
Size squared	0.0001	0.0001	0.7654	-0.0504
Collection	0.7929	1.3290	-0.6868	1.1534
Sorting (in)	0.0885	-1.0878	0.7084	4.0005
Sorting (out)	-0.8131	0.4928	0.3610	-2.1006
Transportation	0.8881	0.2681	-0.7732	-1.7713
Delivery	-0.4884	-1.1449	-1.3240	-2.7757
Const. (cut1)	2.0951	1.1188	-1.3239	-4.6740

Results refer to Model 7 (see Table 21); Displayed values are rounded

Table 23: Brant Test of Parallel Regression Assumption

Variable	Chi2	P<Chi2	df
All	-51.35	1.000	24
Age	6.70	0.082	3
Size	4.66	0.198	3
Size squared	2.21	0.530	3
Collection	1.58	0.665	3
Sorting (in)	8.54	0.036	3
Sorting (out)	9.02	0.029	3
Transportation	2.50	0.474	3
Delivery	3.24	0.356	3

Results refer to Model 7 (see Table 21); Displayed values are rounded

Table 24: Results of Binary Logistic Estimations

		Model 10	Model 11	Model 12
Variable	**Exp. sign[58]**	**Coef.**	**Coef.**	**Coef.**
Age	Pos.	-0.003 (-0.09)	0.001 (0.02)	-0.004 (-0.09)
Size	Pos.	-0.016 (-1.35)	-0.013 (-1.08)	-0.010 (-0.58)
Size squared	Neg.	0.006e-2 (1.11)	0.001e-2 (1.12)	0.001e-2 (0.67)
Collection	Neg./Pos.	1.329** (2.07)	1.413** (2.06)	1.736** (2.20)
Sorting (in)	Neg./Pos.	-1.088 (-1.49)	-1.359* (-1.69)	-1.235 (-1.45)
Sorting (out)	Neg./Pos.	0.493 (0.63)	0.168 (0.20)	0.031 (0.03)
Transportation	Neg./Pos.	0.268 (0.47)	0.513 (0.86)	0.286 (0.40)
Delivery	Neg.	-1.145* (-1.82)	-1.554** (2.17)	-3.292*** (-2.94)
Letter market	Neg./Pos.		-0.316 (-0.40)	-0.236 (-0.27)
Parcel market	Pos.		0.209 (0.29)	0.595 (0.71)
Other market	Pos.		-1.570** (-1.97)	-1.324 (-1.44)
Delivery radius 1	Pos.			3.178* (1.81)
Delivery radius 2	Pos.			3.759* (1.84)
Delivery radius 3	Neg.			2.148 (1.21)
Delivery radius 4	Neg.			0.531 (0.31)
Cooperation	Pos.			0.580 (0.95)
Founder	Pos.			1.038 (1.45)
West	Pos.			0.085 (0.12)
Const.	0	1.119 (1.49)	2.115* (1.94)	-0.270 (-0.14)
N		97	97	97
Pseudo R^2		0.100	0.145	0.260

t statistics in parentheses (robust standard errors)

* p<0.1, ** p<0.05, ***p<0.01

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[58] The expected signs are explained at the end of Section 3.2.