



The Evolution of Industry Structure - A Theoretical Analysis, with Special Regard to the EU Directive on Services

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DANKE!

1 Introduction

"The original directive on services represented two steps forward for Europe as a whole. But certain nations thought this was going too far and that we should only go one step forward."

Polish Prime Minister Kazimierz Marcinkiewicz (2005)

"The only way to hold our own is to provide better services and better customer service. Customers are Gods."

Jeff Bezos, American entrepreneur

1.1 The service industry: definition and development

Services accompany our daily lives. In all aspects of our society more or less specialized service firms have started to offer their services. They provide a wide range of services, e.g. maintenance, information or financial services, for private consumers or other companies. Consequently, in developed countries the relevance of the tertiary sector (the service sector) for the overall economy is fundamental nowadays¹.

However, in the field of industrial organization and especially in the analysis of the industry life cycle or the evolution of the industry structure, research has mainly focused on the goods industry and much less on services, although the tools of industrial organization fit very well to the service sector. Particularly the sector of labor-intensive services, on which we will mostly concentrate, suits very well to an economic analysis. Besides, there is also a lack of a clear definition of services in the literature. They are defined heterogeneously, depending on the focus of the research or study. To state e.g. a rather abstract, often cited economic definition, a service is an economic activity which does not result in ownership. However, services are also multiply defined for instance depending on what is owed to the customer - the effort (as in a concert) or the result (as in repair services), which is, for instance, the case in German law, which distinguishes between contracts of service² and contract for work and labor³. In our work we will implicitly use the broad economic definition.

In any case, the absence of ownership after the service has been provided is a main difference to physical products. The immateriality of services is the reason why the customer needs more trust in a service firm than in a firm from the goods' industry. He has to trust that they will provide the service with the promised quality, because he will only be able to judge the performance after the service has been provided. In our research we will not investigate what effect variations in provided service quality within a firm would have. Despite of this being a very interesting topic, it is not our focus. Generally, there are also other problems service suppliers face⁴, which we cannot consider, like the specification of capacity or the inability to "stock" services.

The general focus of our research lies in the changes in market or industry structure

¹In Europe almost 70% of the gross domestic product arises from services. Source: <http://epp.eurostat.ec.europa.eu>.

²"Dienstvertrag" in German (§ 611 BGB ff.).

³"Werkvertrag" in German (§ 631 BGB ff.).

⁴See Bieberstein (1998) [6].



Figure 1.1: The environment of a service firm

of a representative labor-intensive service industry and the implications for the overall society. But how can market structure change? To answer this question we have to look at the general environment a firm is facing in its industry. Thereby, it does not make a difference if the firm is in the goods or the service market. Figure 1.1⁵ sketches the environment of a (service) firm. We see that change for the firm may come for instance from the technology side through a technological innovation which displaces the current technology. Innovation thus changes the strategies of firms and, in turn, best-practice market structure. A typical example for such a technological innovation, which changed a whole service market, is the internet and the auction platform of eBay. Parallel with the triumph of the internet eBay became the dominant player in the auction market. However, this study will not feature technological changes and their influence on market structure. This has already been done extensively in the economic and business literature⁶. We will instead concentrate on the impact on market structure if legal and institutional settings change (Chapters 2 and 3).

Another appropriate tool for displaying the two-folded focus of this work and the evolution of an industry in general is the industry life cycle, which is sketched in figure 1.2. We have highlighted two regions of the industry life cycle - the shakeout and the maturity phase, which we will further analyze for a representative service market. The fourth chapter of this thesis will feature a representative service industry which is in its maturity phase and experiences a severe change in its environment - in our case the entry of many foreign firms due to the commencement of the EU directive on services.

⁵See Weigand 2005 [62].

⁶See e.g. Adner and Zemsky (2003) [1], Tushman and Anderson (1986) [58] or Christensen (1997) [16].

1 Introduction

The economic effects of the directive have also not been studied thoroughly yet. Based on open questions about the possible strategies of service firms in order to prepare for the directive on services, we will look at the reasons for a shakeout in a service industry (chapter 4), which is a comparable situation. We will especially investigate the case of Bertrand competition during the shakeout, which has not been done before in the economic literature. This is due to the fact that only goods industries were analyzed so far, which tend to start off in Cournot competition. Thus, in summary, our work

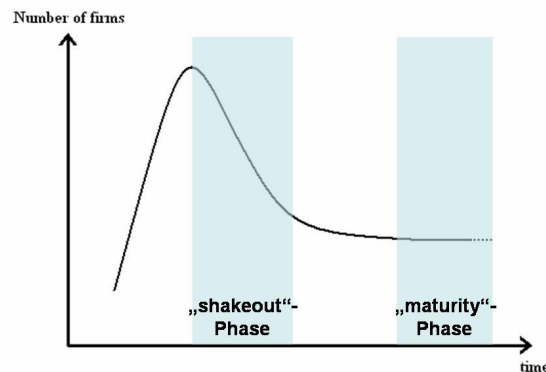


Figure 1.2: The life cycle of a service industry

comprises two very important periods in the industry life cycle of a service industry and fills the corresponding research gaps. We can thereby contribute to the literature in two ways. On the one hand, our research fills gaps in the general research on the economic implications of the EU directive on services and the shakeout, and on the other hand, it provides further insight into the market mechanisms of two main periods of industry evolution: the shakeout and the maturity phase.

1.2 How can Industrial Organization help?

Although services are so important in business and life, little research has been done in industrial organization concerning market structure or evolution of service markets. As said before, this is especially surprising as two models central to industrial organization each fit perfectly to different types of service markets. We will use these models - the differentiated Cournot [23] and the differentiated Bertrand [5] model with n firms - in order to investigate the changes in the market structure under the different settings described above.

Assigning Cournot competition - or a capacity game - to a service industry may at first

look a little bit odd, but if we go deeper into the dynamics of some service markets we will see that this is a very good approximation of the existing competitive behavior. Typically, Cournot competition in goods may describe a market for which the production capacity of all firms is relatively fixed and inflexible in the short run. It is therefore set first by the Cournot competitors. Then the firms capacity and resulting output choices determine the goods' price at given demand. In terms of labor-intensive services this would imply that the respective service firms first have to choose how many qualified employees they are able to hire - their "production capacity" - which in turn fixes how many of their services they are able to offer. This is the case in service industries where qualified employees are hard to find (or very costly), e.g. consulting services. In such industries, Cournot or quantity competition may be assumed. Specialized consultants - which tend to be rare - can charge high prices because the amount of services offered in the market is very low.

Bertrand or price competition may hold if the firms can easily hire and fire their employees, which implies that there are many of them on the market. This is the case in service industries where an employee does not need a lot of education or training, e.g. maintenance services such as cleaning.

In order to investigate the whole spectrum of labor-intensive service markets we will examine both, capacity and price competition, and compare the outcomes. One of our key findings, however, is that the type of competition does not change the outcome significantly.

1.3 Outline

The thesis presents three papers that are linked through the implications of increasing competition in service markets. It is organized in five main chapters. The present chapter 1 contains the main introduction. The next chapters (chapter 2 and 3) consist of two research papers about the economic implications of the EU directive on services. They are followed by chapter 4, which describes our research on the shakeout under Bertrand competition. Chapter 5 offers a conclusion, whereas the Appendix contains details of the modelling and simulations.

Each research paper (chapters 2, 3 and 4) is organized similarly. After having given a short abstract of the research right below the title of each paper, the first section al-

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ways remarks on the transition from the previous paper to the present one⁷. The next section introduces to the topic (2.1.1, 3.2.1 or 4.2.1), the existing literature (2.1.2, 3.2.2 or 4.2.2) and the main focus of the own analysis (2.1.3, 3.2.3 or 4.2.3).

The following section then presents the theory used to analyze the topic. It always comprises the general assumptions made in the research papers (2.2.1, 3.3.1 or 4.3.1) and sections about the cases of price (2.2.2, 3.3.3 or 4.3.2) and quantity competition (2.2.3, 3.3.4 or 4.3.3).

Subsequently, the next section presents the main findings of each research paper, while the last section concludes by remarking on the findings and the underlying assumptions.

⁷The first paper is an exemption, of course. It starts with the introduction right away.

2 The EU directive on services and its immediate effects

In this paper, we analyze how the EU's directive on services affects the competition of service firms in the common market. For that purpose our model features two countries - domestic and foreign - whose firms supply their services with different qualities and costs. Domestic firms provide services with better quality, but also face higher costs at home than firms in the foreign country. We analyze both price and quantity competition. When the directive becomes effective the firms have the opportunity to either supply their services temporarily or permanently. We find that foreign firms will choose to supply their services temporarily whereas domestic firms will be permanent suppliers in the foreign country. For the two types of competition - Bertrand and Cournot - and for either segmented or integrated markets we determine thresholds for the relative costs (foreign vs. domestic) beyond which the market opening through the directive is always desirable for the domestic country. We can also provide a threshold for the size of the foreign-country market beyond which an opening always implies higher profits for firms of the domestic country. In order to quantify these thresholds and the welfare effects the domestic country is set to be Germany whereas the other country is either set to be a smaller neighbor (Poland) or the rest of the European Union. For the first case we conclude that the welfare in Germany will decrease, whereas in the case of the rest of the European Union Germany will experience an increase in total welfare.

2.1 Introduction

2.1.1 General aspects

The service sector of the European economy is responsible for about 70% of the GDP and the total employment. In contrast to other industries, however, service providers still avoid offering their services across European borders due to the fear that they would experience huge losses on account of large time investments and legal problems¹, owing to the multitude of national barriers like operating licenses, different rules on insurances and so on. Therefore, the service industry is still very fragmented across Europe and each nation imposes many different regulations on its service firms. This situation stands in strong contrast to the Lisbon strategy of the EU, which has the goal to make the EU the most competitive and productive market in the world. And one of the inherent strengths of the EU is its huge domestic market, which has - due to the reasons outlined above - not unraveled its potential in the case of the service industry yet.

In this context, in 2004 the EU brought the directive on services [21] on its way, which after some time was the cause of great discussions in some nations of the EU. On the one hand, the supporters of the directive argued that the service sector - and the European economy accordingly - will experience an increase in momentum due to the huge cutback of bureaucracy, on the other hand the objectors argued that issues such as the protection of customers and workers or, in general, the quality standards of product and work were not considered thoroughly enough in the directive. In the course of the discussion, in February 2006 the European Parliament approved the Commission's first draft but demanded modifications. Thereafter, the suggested changes were mostly implemented by the Commission (April 2006) and after the involvement of the European Council and the European Council of the Heads of the States and Governments a joint position was found which was approved by the European parliament on the 15th of November 2006. However, the initial and already very ambitious plan of the Commission to pass the directive on to the national parliaments by the end of 2005 was not met.

The directive distinguishes between two major possibilities of border-crossing services. It regulates both the temporary and the permanent supply of service to a foreign country and it has to be applied to all kinds of services besides the ones which are designated for social, cultural or educational purposes (E.g. the school and university system. See Herdegen [34]). Additionally, the directive does not regulate sectors of the service industry which have been harmonized before, e.g. the financial sector, or which are sensitive

¹See Commission in 2002 [20].

sectors in the sense that commercial interests fall behind political or social interests (See the Commission (2006) [22]), like e.g. the gambling sector.

When the directive applies to a specific service industry it tries to regulate it horizontally. This means that it regulates all steps of the entrepreneurial process - starting from the formation of a company to the governance of the post-contractual responsibilities. The core of the directive lies in its effort to reduce the administrative procedures a service provider has to undertake in order to be allowed to supply its service in a foreign country. Therefore, in its initial draft the directive featured the "country of origin" principle, which said that service firms could supply their services temporarily in the foreign country on the grounds of the regulation they were facing in their home country. Consequently, the destination country of the service would not have been allowed to regulate or monitor the market behavior of the foreign firm. This principle caused much of the immediate resentments the initial draft was facing, because countries like Germany and France feared a "race to the bottom" effect concerning social and quality standards. Subsequently, the "country of destination" principle was developed, which states that the market behavior for both the temporary and permanent supply of services should mostly follow the regulations of the country of destination. Due to these changes the directive's most powerful tool is now the regulation of the licensing of foreign service firms. If this is enough in order to fulfill the high goals of the Lisbon strategy² remains questionable.

2.1.2 Existing literature

In its 2005 study on the directive on services the Speyer based German Research Institute for Public Administration [8] split the economic effect of the directive into two parts. The first part - the competition effect - refers to the fact that different national regulations concerning the supply of services are a source of transaction costs, which constrain competition within the European Union and therefore, decrease the total welfare. The other effect - the structural effect - deals, on the one hand, with changes in the regional allocation of economic activity and, on the other hand, with the changes in the quality of the services. The study predicts the also geographically division within the EU between high-quality and low-quality suppliers. It also predicts generally lower prices than before the opening, but higher prices for the higher-quality services due to lower market volume. The present research aims to examine the structural effect and, thereby, check predictions of the Speyer study.

Another study, by the Copenhagen Economics Group in 2005 [54], analyzes empirically

²As stated before, one of the goals is to become the most competitive, productive and dynamic economy by 2010.

the economic implications of national barriers in the European service market. It concentrates on the negative economic effects of these barriers and concludes that the directive will give rise to lower prices and higher output of services.

For our analysis of the structural effect we make use of standard oligopoly theory. In particular, we will model competition as either Cournot [23] or Bertrand [5]³.

We will investigate a two-country setting with - among other things - differing market sizes and differing numbers of firms⁴. Concerning the market segmentation of two countries we will distinguish in our analysis between segmented and integrated markets⁵.

2.1.3 Main focus of the analysis

This paper looks at the EU directive's implications for a high-quality, high-cost country, whose firms, on the one hand, will face tougher competition in their domestic market, but, on the other hand, will have a larger market to offer their (labor-intensive) services, after the directive becomes effective. Eight different scenarios of the opening will be examined. First of all, we will divide our investigation into two main parts: The industry exhibits either Cournot or Bertrand competition. Furthermore, we will have a look what happens if the firms are either able to perfectly separate the two markets concerning quantity supplied and price charged, or are unable to do so, e.g. if they have to set the same price in each country (integrated markets). This differentiation is important as e.g. some services can not be transported and firms offering these services face segmented markets. On the contrary, some services can be consumed by the customers in each country without facing relatively high transaction costs - then, firms face integrated markets⁶.

³Singh and Vives (1984) [56] examined both models with differentiated goods in a duopoly based on a model by Dixit (1979) [24]. They conclude that with a linear demand structure Bertrand competition is more efficient than Cournot competition (in consumer or total surplus terms), and that with nonlinear demand and under certain assumptions to ensure the existence of unique Bertrand and Cournot equilibria Bertrand prices (quantities) are smaller (larger) than Cournot prices (quantities) if the goods are substitutes (complements). Häckner (2000) [33] showed that this statement is sensitive to the duopoly assumption, so that in an oligopoly with more than two firms, prices may be higher under Bertrand competition than under Cournot competition. In our Bertrand model we use a similar model as Oxenstierna [50] with $n_A + n_B$ firms supplying differentiated services.

⁴Similar models have been used widely in the literature on international trade, particularly in the international trade section, e.g. about strategic trade policies, which try to determine the optimal tariff or subsidiary policy a country should pursue (See e.g. Cheng [15]).

⁵Colonescu and Schmitt [19] investigated the implications of markets which move from segmented to integrated markets. Their infinitely repeated Cournot duopoly game with one firm in each country, however, concentrates on anticompetitive effects.

⁶For instance, the medical service of correcting the visual acuity by laser (or plastic surgery in general). There, the transportation costs of a customer are much lower than the actual surgery. Thus, this service market is integrated.

In summary, we will analyze the impact of market opening on prices, quantities and firm profits in each country along three dimensions: the type of competition (i.e., Bertrand vs. Cournot), the time horizon of services supplied (temporary vs. permanent), and the degree of market integration (separation vs. integration). The combination of the three dimensions leaves us with eight distinct cases. The case of Bertrand competition may be the most interesting since a large part of the service sector competes on prices rather than on quantity⁷.

We assume two countries A and B - both members of the European Union - with different numbers of firms n_A and n_B , which are suppliers in the same representative, labor-intensive service market. Firms in country A (domestic) provide a higher quality of service than firms in country B (foreign). Their unit costs, c_A , are also higher than the respective unit costs in B, c_B . The variable costs are assumed to be directly associated to the wages in each country. However, the quality of the product is firm-specific in the sense that it is impossible to improve the quality in the short-run via higher costs/wages. This is a realistic assumption because the quality of the service depends very much on the experience of the firm and their leading employees, which, in turn, is related to their initial training. The quality of initial training, however, is a country-specific given. Thus, firms from A will have a higher quality than firms from B at least in the short-run, even if they supply their services permanently in B with lower unit costs c_B . The last aspect could also be seen as "know-how transfer" of an A-firm to its employees in B.

It will be particularly interesting to see at which unit cost ratio the market opening will be favorable for the firms of the larger country. Further, we will explore which form of expansion - temporary or permanent - the domestic and foreign firms should choose.

We will use country-specific data of Germany for our models' parameters in order to calculate the effects of the directive for Germany. In most cases, the second country will be set to be Germany's direct neighbor Poland. The main conclusion, however, is based upon the findings when the second country is set to be the rest of the European Union.

2.1.4 Outline

This chapter is organized as follows: Section 2.2 introduces the underlying oligopoly models and their assumptions. We will investigate the outcome under different assumptions of the segmentation of the markets and different types of supply to the markets. In Section 2.3 we will compare the results from Section 2.2 and discuss the effects of the

⁷We will also discuss this in detail in Section 4.2.3.

directive for the European service market. Section 2.4 offers a conclusion and remarks on the assumptions made in this paper.

2.2 Theory

2.2.1 General assumptions

There are only two countries: country A, in which n_A firms supply their services with quality θ_A and cost c_A , and country B with n_B firms with quality θ_B and cost c_B . The quality in each country depends, among other things, on the training of the employees and is exogenously given as $\theta_A < \theta_B$ ⁸. Thus, the quality of firms in A is in the short run always greater than the quality of firms in B, whereas the unit costs in A can be assumed to be higher than in B: $c_A > c_B$.

Further, we assume that each firm i only offers one kind of service and that each firm has perfect information about the prices, quantities and profits of the other firms in both countries and that all players are rational. Each firm i faces a cost function:

$$C_i^{A,B}(q_i) = c_i^{A,B} q_i \quad (2.1)$$

where $c_i^{A,B}$ are the marginal costs of firm i from (A,B) and q_i the amount of services it supplies.

Offering only temporary supply of service in the foreign country raises the respective unit costs to $\delta_{AB} \cdot c_A$ for firms from A or $\delta_{BA} \cdot c_B$ for firms from B. The factors δ_{AB} and δ_{BA} are both set to be greater than one in order to include transaction costs. For the "country of destination" principle of the directive, which is now effective, it will be assumed that $\delta_{AB} < \delta_{BA}$ as the requirements on the market behavior are expected to be much higher in country A than in country B. If the "country of origin" principle had been chosen, the factors δ would have been almost equal as they would have only involved transportation costs: $\delta_{AB} \approx \delta_{BA}$.

If the firms offer permanent supply of services in the foreign country instead, they face the respective unit costs of the foreign country independent of their own origin. However, the quality offered does not change as it is firm-specific and a know-how transfer is assumed. We also assume that there is a fixed cost $R_{A,B}$ for providing permanent services in a foreign country (for instance, building a branch office, or applying for certain permits). One basic feature of the service industry - and an important distinction to the goods' industry - is the fact that the "production" of a service is not separable. Therefore, we

⁸ $0 < \theta \leq 1$.

can assume that there is a clear distinction between temporary and permanent supply of service and that firms are faced with the binary decision to either build a branch or not. In order to simplify the analysis we assume identical firms in each country.

2.2.2 Bertrand competition

In order to analyze the differences between the situation before ($t=0$) and after the opening ($t=1$), we have to take a brief look at the situation before the opening. In country A (B) the demand for the service in period $t=0$ is given by:

$$q_i^{A(B)} = \alpha_i^{A(B)} - \beta \theta_i^{A(B)} p_i^{A(B)} + \frac{\beta}{n_{A(B)}} \cdot \sum_{j \neq i}^{n_{A(B)}} \theta_j^{A(B)} p_j^{A(B)}$$

where $\alpha_i^{A,B}$ is the maximum quantity firm i can sell in country A or B or in other words the market size for firm i in A or B. β serves as a scaling variable, which is set to be equal to one for all of our calculations (See Appendix B). Firm profits are given by

$$\pi_i^{A(B)} = \left(p_i^{A(B)} - c_i^{A(B)} \right) q_i^{A(B)} - F_i^{A(B)}$$

where $F_i^{A(B)}$ is the fixed cost of production. As we assume identical firms, we can maximize profits for a representative firm. The profit maximizing quantity and price are

$$q_{t=0}^{A(B)} = \frac{n_{A(B)} \cdot \alpha_{A(B)} - \beta \theta_{A(B)} c_{A(B)}}{n_{A(B)} + 1} = \frac{K_{A(B)} - \beta \theta_{A(B)} c_{A(B)}}{n_{A(B)} + 1} \quad (2.2)$$

$$p_{t=0}^{A(B)} = \frac{K_{A(B)} + \beta n_{A(B)} \theta_{A(B)} c_{A(B)}}{\beta \theta_{A(B)} (n_{A(B)} + 1)} \quad (2.3)$$

Let $K_{A(B)} = \sum_{j=1}^{n_{A(B)}} \alpha_j^{A(B)}$ be the total market size in country A (B), which is assumed to remain unchanged, independent of the opening of the market, because we assumed mature service markets in both countries. Maximized profits are:

$$\pi_{t=0}^{A(B)} = \frac{q_{A(B)}^2}{\beta \theta_{A(B)}} - F_{A(B)} \quad (2.4)$$

We now investigate the situation after the market opening ($t=1$). First we distinguish between segmented and integrated markets. Next, we examine the two extreme cases of both A- and B-firms offering either temporary or permanent supply of service. Finally,

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we look at the case of opposed strategies in order to determine the dominant supply strategy of each firm.

2.2.2.1 Segmented markets

In segmented markets firm i from (A,B) faces the following demand in country A after the opening:

$$q_i^{A,(A,B)} = \alpha_i^A - \beta \theta_i^{(A,B)} p_i^{A,(A,B)} + \frac{\beta}{n_A + n_B} \cdot \left(\sum_{\substack{j=1 \\ j \neq i}}^{n_A} \theta_j^A p_j^{A,A} + \sum_{\substack{j=n_A+1 \\ j \neq i}}^{n_A+n_B} \theta_j^B p_j^{A,B} \right) \quad (2.5)$$

In country B the demand for services of firm i from (A,B) becomes in $t=1$:

$$q_i^{B,(A,B)} = \alpha_i^B - \beta \theta_i^{(A,B)} p_i^{B,(A,B)} + \frac{\beta}{n_A + n_B} \cdot \left(\sum_{\substack{j=1 \\ j \neq i}}^{n_A} \theta_j^A p_j^{B,A} + \sum_{\substack{j=n_A+1 \\ j \neq i}}^{n_A+n_B} \theta_j^B p_j^{B,B} \right)$$

where $p_i^{A,(A,B)}$ ($p_i^{B,(A,B)}$) is the price of firm i from (A,B) in country A (B).

2.2.2.1.1 Temporary supply of services If firms only offer their services temporarily in the foreign country, they face higher unit costs due to transaction costs. We also assume that they face twice their normal fixed costs. These facts are included into the profit function of firm i from A or B:

$$\pi_i^A = \left(p_i^{A,A} - c_i^A \right) q_i^{A,A} + \left(p_i^{B,A} - \delta_{AB} c_i^A \right) q_i^{B,A} - 2 * F_A \quad (2.6)$$

$$\pi_i^B = \left(p_i^{A,B} - \delta_{BA} c_i^B \right) q_i^{A,B} + \left(p_i^{B,B} - c_i^B \right) q_i^{B,B} - 2 * F_B \quad (2.7)$$

Maximizing the profit at $d\pi_i^A \equiv 0$ is equivalent to $\frac{\partial}{\partial p_i^{A,A}} \left(p_i^{A,A} - c_i^A \right) q_i^{A,A} \equiv 0$ and $\frac{\partial}{\partial p_i^{B,A}} \left(p_i^{B,A} - \delta_{AB} c_i^A \right) q_i^{B,A} \equiv 0$. By assuming identical firms this leads us to the following profit maximizing quantities and prices:

$$q_{A,A} = \frac{K_A - \beta \theta_{ACA}}{n_A + n_B + 1} - \beta \xi \frac{\theta_{ACA} - \delta_{BA} \theta_{BCB}}{n_A + n_B + 1} \quad (2.8)$$

$$q_{A,B} = \frac{K_A - \beta \delta_{BA} \theta_{BCB}}{n_A + n_B + 1} - \beta \xi \frac{n_A \delta_{BA} \theta_{BCB} - \theta_{ACA}}{n_B \quad n_A + n_B + 1} \quad (2.9)$$

$$q_{B,A} = \frac{K_B - \beta\delta_{AB}\theta_{ACA}}{n_A + n_B + 1} - \beta\xi \frac{\delta_{AB}\theta_{ACA} - \theta_{BCB}}{n_A + n_B + 1} \quad (2.10)$$

$$q_{B,B} = \frac{K_B - \beta\theta_{BCB}}{n_A + n_B + 1} - \beta\xi \frac{n_A \theta_{BCB} - \delta_{AB}\theta_{ACA}}{n_A + n_B + 1} \quad (2.11)$$

$$p_{A,A} = \frac{K_A}{(n_A + n_B + 1) \beta\theta_A} + \xi \frac{(2n_A + n_B + 1)\theta_{ACA} + n_B\delta_{BA}\theta_{BCB}}{n_B(n_A + n_B + 1)\theta_A} \quad (2.12)$$

$$p_{A,B} = \frac{K_A}{(n_A + n_B + 1) \beta\theta_B} + \xi \frac{n_A\theta_{ACA} + (n_A + 2n_B + 1)\delta_{BA}\theta_{BCB}}{n_B(n_A + n_B + 1)\theta_B} \quad (2.13)$$

$$p_{B,A} = \frac{K_B}{(n_A + n_B + 1) \beta\theta_A} + \xi \frac{(2n_A + n_B + 1)\delta_{AB}\theta_{ACA} + n_B\theta_{BCB}}{n_B(n_A + n_B + 1)\theta_A} \quad (2.14)$$

$$p_{B,B} = \frac{K_B}{(n_A + n_B + 1) \beta\theta_B} + \xi \frac{n_A\delta_{AB}\theta_{ACB} + (n_A + 2n_B + 1)\theta_{BCB}}{n_B(n_A + n_B + 1)\theta_B} \quad (2.15)$$

where $\xi = \frac{n_B(n_A+n_B)}{2n_A+2n_B+1}$. Consequently, the profits of the firms in A and B simplify to:

$$\pi_{t=1}^A = \frac{q_{A,A}^2}{\beta \theta_A} + \frac{q_{B,A}^2}{\beta \theta_A} - 2F_A \quad (2.16)$$

$$\pi_{t=1}^B = \frac{q_{A,B}^2}{\beta \theta_B} + \frac{q_{B,B}^2}{\beta \theta_B} - 2F_B \quad (2.17)$$

If we look at the profit function of firms in A, we see the expected behavior. They depend positively on the total market sizes of A and B, the quality θ_B^9 , the unit cost c_B and the transaction factor δ_{BA} of firms from B, whereas they depend negatively on the quality θ_A , the unit cost c_A and the transaction factor δ_{AB} . Another interesting aspect is the fact that entry into country B will be deterred if $F_A > \frac{q_{B,A}^2}{\beta \theta_A}$.

At what ratio of the costs in B and A ($x^t = \frac{c_B}{c_A}$) is the market opening favorable for firms of country A? To answer this question, we have to compare profits after and before market opening. The difference of after- and before-profits is given by:

$$\begin{aligned} \Delta\pi_A(x^t) &= \frac{1}{\beta\theta_A} \left[\left(\frac{K_A - \beta\theta_{ACA} - \beta\xi c_A(\theta_A - \delta_{BA}\theta_B x^t)}{n_A + n_B + 1} \right)^2 + \right. \\ &\quad \left. \left(\frac{K_B - \beta\delta_{AB}\theta_{ACA} - \beta\xi c_A(\delta_{AB}\theta_A - \theta_B x^t)}{n_A + n_B + 1} \right)^2 - \left(\frac{K_A - \beta \theta_{ACA}}{n_A + 1} \right)^2 - \beta\theta F_A \right] \\ &\equiv 0 \end{aligned} \quad (2.18)$$

⁹The higher θ the worse the quality.

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The opening will be profitable for firms from A as long as $\Delta\pi_A(x^t) = \pi_{t=1}^A - \pi_{t=0}^A > 0$. Thus, $\Delta\pi_A(x^t) = \pi_{t=1}^A - \pi_{t=0}^A = 0$ must hold to make A-firms at least indifferent to market opening. Solving (2.18) for x^t yields:

$$\begin{aligned}
x_{1,2}^t &= -\frac{\delta_{BA}K_A + K_B - \beta(1 + \xi)(\delta_{BA} + \delta_{AB})\theta_{ACA}}{\beta\xi(1 + \delta_{BA}^2)\theta_{BCA}} \\
&\pm \left[\left(\frac{\delta_{BA}K_A + K_B - \beta(1 + \xi)(\delta_{BA} + \delta_{AB})\theta_{ACA}}{\beta\xi(1 + \delta_{BA}^2)\theta_{BCA}} \right)^2 \right. \\
&+ \frac{n_B(2 + 2n_A + n_B)(K_A - \beta\theta_{ACA})^2}{\beta^2(n_A + 1)^2\xi^2(1 + \delta_{BA}^2)\theta_B^2c_A^2} \\
&\left. - \frac{(K_B - \beta(\xi + 1)\delta_{AB}\theta_{ACA})^2}{\beta^2\xi^2(1 + \delta_{BA}^2)\theta_B^2c_A^2} + \frac{(n_A + n_B + 1)^2\theta_A F_A}{\beta\xi^2(1 + \delta_{BA}^2)\theta_B^2c_A^2} \right]^{1/2} \quad (2.19)
\end{aligned}$$

Only x_1^t is reasonable, because $x_2^t < 0$. As $\Delta\pi_A(x^t)$ depends positively¹⁰ on x^t , the following Lemma is straightforward:

Lemma 1a: If $\frac{c_B}{c_A} > x_1^t \Leftrightarrow \Delta\pi_A\left(\frac{c_B}{c_A}\right) > 0 \Leftrightarrow$ The opening of the market is positive for firms from A.

This means that if the costs of firms from B are x_1^t times higher than the costs of firms from A, the profit of firms from A will be higher than before the opening. Related to Lemma 1a is Lemma 2a:

Lemma 2a: There exists a limit for the ratio of the costs $x_1^{t,\infty}$, which is reached with a large number of firms n_B from B. For infinitely large n_B we have $\Delta\pi_A(\tilde{x}) > 0 \forall \tilde{x} > x_1^{t,\infty}$ with

$$\begin{aligned}
x_1^{t,\infty} &= \frac{\delta_{AB} + \delta_{BA}}{1 + \delta_{BA}^2} \cdot \frac{\theta_A}{\theta_B} + \\
&\sqrt{-\frac{(\delta_{BA}\delta_{AB} - 1)^2}{(1 + \delta_{BA}^2)^2} \cdot \frac{\theta_A^2}{\theta_B^2} + \frac{4}{1 + \delta_{BA}^2} \left(\frac{\theta_A F_A}{\beta\theta_B^2 c_A^2} + \frac{(K_A - \beta\theta_{ACA})^2}{\beta^2(n_A + 1)^2\theta_B^2 c_A^2} \right)} \quad (2.20)
\end{aligned}$$

Hence, if the cost of services from A is so low, that $\frac{c_B}{c_A} > x_1^{t,\infty}$, the firms in A have higher profits than before the opening, irrespective of the number of firms from B. There also exists another important threshold, which is independent of the costs in B:

*Corollary 1a*¹¹: There exists a certain total market size of B beyond which an opening

¹⁰ $\frac{\partial \Delta\pi_A(x)}{\partial x} > 0$.

¹¹ See Appendix A.

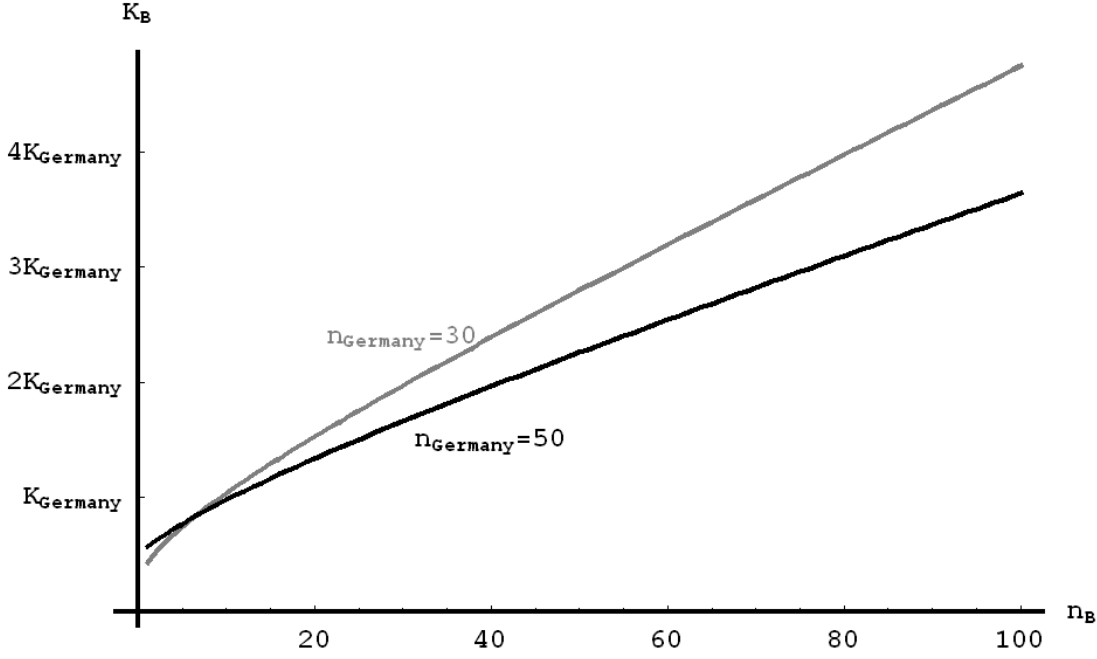


Figure 2.1: The market size of the foreign country B for which an opening of the service market would always be profitable for German firms against the number of firms from country B. All firms compete on *price* and supply their services *temporarily*.

of the markets would always be favorable for firms in A. This market size is given by:

$$\hat{K}_B^t = \beta(1 + \xi)\delta_{AB}\theta_{ACA} + \left[\frac{n_B(2 + 2n_A + n_B)}{(n_A + 1)^2} (K_A - \beta\theta_{ACA})^2 + \beta\theta_A(n_A + n_B + 1)^2 F_A + 2\beta\xi\theta_{ACA}(K_A - \beta(1 + \xi/2)\theta_{ACA}) \right]^{1/2} \quad (2.21)$$

The two Lemmata and the Corollary are the major conditions on the cost of the firms from A or on the total market size of country B, respectively, for testing if the opening of the market has a favorable influence on the profits of firms from A. By taking reasonable values and assuming A to be Germany¹² we obtain the following figures:

Figure 2.1 shows the threshold of the market size of country B beyond which an opening of the service market would always be profitable for German firms against the number of firms from B. It demonstrates that if country B is taken to be the whole European Union (without Germany, Bulgaria and Romania), and the number of firms in the market in

¹²See Appendix B for details.

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Germany is already very high, the opening of the service market will be favorable for firms from Germany (i.e., their profits will be higher after the opening as compared to the situation before the opening)¹³.

Next we will investigate what happens if firms offer their services permanently in the foreign country by establishing a branch there.

2.2.2.1.2 Permanent supply of services If firms supply their services permanently in the foreign country, the directive on services rules that they have to follow the regulations of the destination country ("country of destination"-principle). Thus, they are facing the variable costs - mostly wages due to collective wage agreements - of the destination country. As they build a branch in the foreign country, their fixed costs are changing as compared to the supply of temporary services. These changed costs are reflected in the profit function of the firms:

$$\pi_i^A = (p_i^{A,A} - c_i^A) q_i^{A,A} + (p_i^{B,A} - c_i^B) q_i^{B,A} - F_A - F_B - R_B \quad (2.22)$$

$$\pi_i^B = (p_i^{A,B} - c_i^A) q_i^{A,B} + (p_i^{B,B} - c_i^B) q_i^{B,B} - F_A - F_B - R_A \quad (2.23)$$

Again, we maximize the profit in each market, assuming identical firms. This leads us to the following profit maximizing quantities and prices¹⁴:

$$q_{A,A} = \frac{K_A - \beta\theta_{ACA}}{(n_A + n_B + 1)} - \beta\xi c_A \frac{\theta_A - \theta_B}{n_A + n_B + 1} \quad (2.24)$$

$$q_{A,B} = \frac{K_A - \beta\theta_{BCA}}{(n_A + n_B + 1)} - \beta\xi \frac{n_A}{n_B} c_A \frac{\theta_B - \theta_A}{n_A + n_B + 1} \quad (2.25)$$

$$q_{B,A} = \frac{K_B - \beta\theta_{ACB}}{(n_A + n_B + 1)} - \beta\xi c_B \frac{\theta_A - \theta_B}{n_A + n_B + 1} \quad (2.26)$$

$$q_{B,B} = \frac{K_B - \beta\theta_{BCB}}{(n_A + n_B + 1)} - \beta\xi \frac{n_A}{n_B} c_B \frac{\theta_B - \theta_A}{n_A + n_B + 1} \quad (2.27)$$

¹³Figure C.1 in Appendix C displays the effect that, if country B is smaller (e.g. Poland) but has much more firms than Germany, German firms must have a much better cost structure in order to have higher profits after the opening.

¹⁴ $\xi = \frac{n_B(n_A + n_B)}{2n_A + 2n_B + 1}$.

$$p_{A,A} = \frac{K_A}{(n_A + n_B + 1) \beta \theta_A} + \xi c_A \frac{(2n_A + n_B + 1)\theta_A + n_B \theta_B}{n_B(n_A + n_B + 1)\theta_A} \quad (2.28)$$

$$p_{A,B} = \frac{K_A}{(n_A + n_B + 1) \beta \theta_B} + \xi c_A \frac{n_A \theta_A + (n_A + 2n_B + 1)\theta_B}{n_B(n_A + n_B + 1)\theta_B} \quad (2.29)$$

$$p_{B,A} = \frac{K_B}{(n_A + n_B + 1) \beta \theta_A} + \xi c_B \frac{(2n_A + n_B + 1)\theta_A + n_B \theta_B}{n_B(n_A + n_B + 1)\theta_A} \quad (2.30)$$

$$p_{B,B} = \frac{K_B}{(n_A + n_B + 1) \beta \theta_B} + \xi c_B \frac{n_A \theta_A + (n_A + 2n_B + 1)\theta_B}{n_B(n_A + n_B + 1)\theta_B} \quad (2.31)$$

Similarly, the profits of the firms in A and B simplify to:

$$\pi_{t=1}^A = \frac{q_{A,A}^2}{\beta \theta_A} + \frac{q_{B,A}^2}{\beta \theta_A} - F_A - F_B - R_B \quad (2.32)$$

$$\pi_{t=1}^B = \frac{q_{A,B}^2}{\beta \theta_B} + \frac{q_{B,B}^2}{\beta \theta_B} - F_A - F_B - R_A \quad (2.33)$$

As before, the profits of A-firms depend positively on the total market sizes of A and B and the quality θ_B of firms from B. But the interesting new result is that the impact of unit costs on profits is now ambivalent. However, with a rising number of firms from B the profit depends only positively on the unit costs in A and B:

$$\begin{aligned} \frac{\partial \pi_{t=1}^A}{\partial c_{A(B)}} &> 0 \\ &\Downarrow \\ (1 + 1/\xi)\theta_A &< \theta_B \xrightarrow{n_B \rightarrow \infty} \theta_A < \theta_B \end{aligned} \quad (2.34)$$

Entry of firms from A will be deterred if $F_B + R_B > \frac{q_{B,A}^2}{\beta \theta_A}$.

As before, we can calculate the ratio of the costs $x^p = \frac{c_B}{c_A}$ for which the market opening becomes favorable for firms in country A. This is the same as asking for which x^p is $\Delta \pi_A(x^p) = \pi_{t=1}^A - \pi_{t=0}^A > 0$:

$$\begin{aligned} \Delta \pi_A(x^p) = \frac{1}{\beta \theta_A} &\left[\left(\frac{K_A - \beta \theta_{AcA} - \beta \xi c_A (\theta_A - \theta_B)}{n_A + n_B + 1} \right)^2 + \right. \\ &\left. \left(\frac{K_B - \beta \theta_A x^p c_A - \beta \xi x^p c_A (\theta_A - \theta_B)}{n_A + n_B + 1} \right)^2 - \left(\frac{K_A - \beta \theta_{AcA}}{n_A + 1} \right)^2 - \beta \theta (F_B + R_B) \right] \end{aligned} \quad (2.35)$$

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Thus, we have to solve $\Delta\pi_A(x^p) = 0$ for x^p which yields:

$$\begin{aligned}
x_{1,2}^p &= \frac{K_B}{\beta c_A((1+\xi)\theta_A - \xi\theta_B)} \\
&\pm \left[\frac{(n_A + n_B + 1)^2 \theta_A (F_B + R_B)}{\beta c_A^2((1+\xi)\theta_A - \xi\theta_B)^2} \right. \\
&+ \frac{n_B(2 + 2n_A + n_B)(K_A - \beta\theta_{ACA})^2}{\beta^2(n_A + 1)^2 c_A^2((1+\xi)\theta_A - \xi\theta_B)^2} \\
&\left. + \frac{\xi c_A(\theta_A - \theta_B)(2K_A - \beta c_A((2+\xi)\theta_A - \xi\theta_B))}{\beta c_A^2((1+\xi)\theta_A - \xi\theta_B)^2} \right]^{1/2} \quad (2.36)
\end{aligned}$$

Again, only x_1^p is reasonable. As before, $\Delta\pi_A(x^p)$ depends positively on x^p , therefore, Lemma 1 also applies:

Lemma 1b: If $\frac{c_B}{c_A} > x_1^p \Leftrightarrow \Delta\pi_A\left(\frac{c_B}{c_A}\right) > 0 \Leftrightarrow$ The opening of the market is positive for firms from A.

This means - equivalently to Lemma 1a - that, if the costs of firms from B are x_1^p times higher than the costs of firms from A, the profit of the A-firms will be higher than before the opening.

Lemma 2b: There exists a limit for the ratio of the costs $x_1^{p,\infty}$, which is reached with a large number of firms n_B from B. For infinitely large n_B we have $\Delta\pi_A(\tilde{x}) > 0 \forall \tilde{x} > x_1^{p,\infty}$.

$$x_1^{p,\infty} = \sqrt{4 \frac{\theta_A(F_B+R_B)}{\beta c_A^2(\theta_A-\theta_B)^2} + 4 \frac{(K_A-\beta\theta_{ACA})^2}{\beta^2(n_A+1)^2 c_A^2(\theta_A-\theta_B)^2}} - 1 \quad (2.37)$$

Thus, if the costs of services from A are so much lower than for its counterparts from B, that $\frac{c_B}{c_A} > x_1^{p,\infty}$, the number of suppliers from B can be arbitrarily high, firms in A will nevertheless have higher profits than before the opening.

Corollary 1b: There exists a certain total market size of B beyond which an opening of the markets would always be favorable for firms in A. This market size is given by:

$$\begin{aligned}
\hat{K}_B^p &= \left[\beta \xi c_A(\theta_A - \theta_B)(2K_A + \beta c_A(\xi\theta_B - (2+\xi)\theta_A)) + \right. \\
&\left. \frac{n_B(2 + 2n_A + n_B)}{(n_A + 1)^2} (K_A - \beta\theta_{ACA})^2 + \beta\theta_A(n_A + n_B + 1)^2 (F_B + R_B) \right]^{1/2} \quad (2.38)
\end{aligned}$$

We will now take the same values as before in order to calculate the thresholds. Figure 2.2 shows the threshold of the market size of country B beyond which an opening of the service market would always be profitable for firms from Germany against the number of

firms from B. Figure 2.2 is quite similar to Figure 2.1. However, Figure C.2 in Appendix

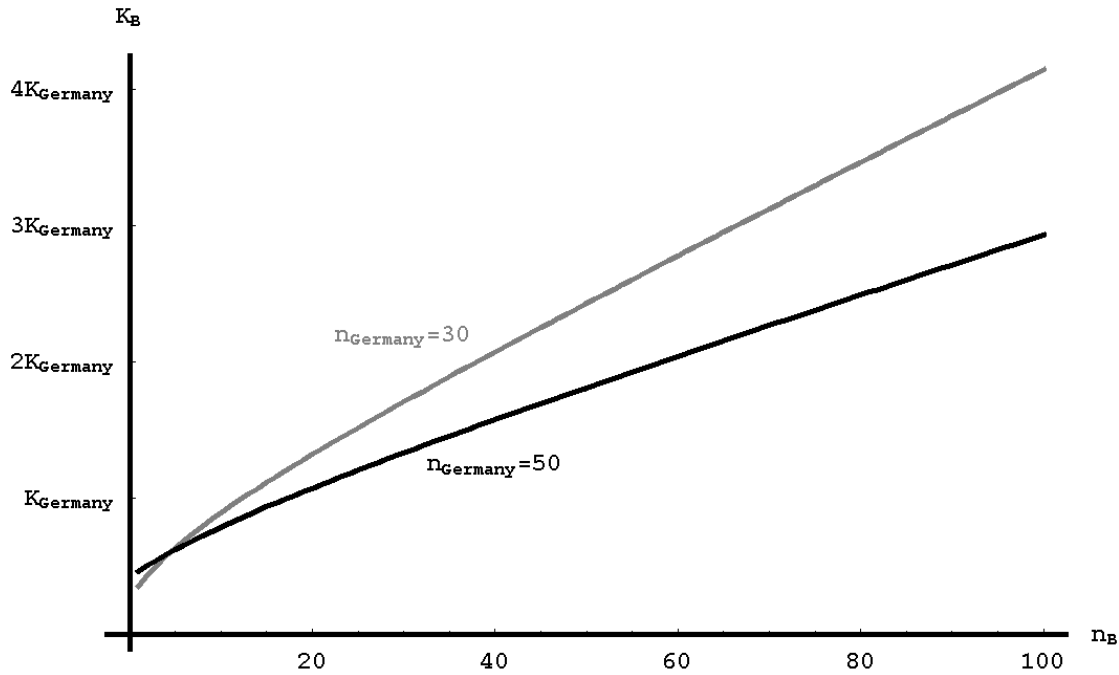


Figure 2.2: The market size of country B for which an opening of the service market would always be profitable for German firms against the number of firms from country B. All firms compete on *price* and supply their services *permanently*.

C shows that in the case of permanent supply of service the threshold for the ratio of the costs is much higher as compared to the case of temporary supply of services, which is reasonable because A- and B-firms now share the same unit costs in each country and none of them enjoys a significant cost advantage over each other.

2.2.2.1.3 Opposed strategies The above analysis applies in a similar vein if A- and B-firms have different strategies of supplying their services. If, for example, B-firms offer their services temporarily while A-firms offer theirs permanently, the respective quantities change by replacing $\theta_B c_A$ in (2.24) and (2.25) with $\theta_B \delta_{BACB}$, whereas (2.26) and (2.27) remain unchanged. If $c_A > \delta_{BACB}$ holds, then the total quantity A-firms are selling in country A will decrease whereas the quantity B-firms are selling in A will increase compared to the case where both firms offer their services permanently. Thus, B-firms will then prefer to offer their services temporarily.

If, on the contrary, B-firms offer their services permanently while A-firms offer theirs temporarily, we will obtain the quantities as in (2.8) and (2.9) with $\theta_B \delta_{BACB}$ replaced

		B	B
		temp	perm
A	temp	(1,2)	(1,1)
A	perm	(2,2)	(2,1)

Table 2.1: Exemplary pay-offs for firms from A and B after choosing temporary (*temp*) or permanent (*perm*) supply of service

by θ_{BCA} ¹⁵. This would make B-firms worse off as compared to the case where both A- and B-firms offer their services temporarily. Hence, it is a dominant strategy for B-firms to offer their services temporarily¹⁶.

This leads us to the question which strategy A-firms are going to choose knowing that B-firms will offer their services temporarily. This is the same as asking if the quantities as given by (2.8) and (2.10) are bigger than those of (2.24) and (2.26) transformed via $\theta_{BCA} \rightarrow \theta_B \delta_{BACB}$ because B-firms will be temporary suppliers. Transforming (2.24) results in (2.8), so the decision which kind of service to offer is determined through (2.10) and (2.26). As $c_B < \delta_{ABCA}$ holds in our setting¹⁷ the values of (2.26) exceed the values of (2.10). Thus, A-firms will prefer to build a branch in B.

Therefore, in the case of segmented markets we have a Nash equilibrium if A-firms choose permanent supply of service¹⁸ and B-firms temporary supply of service. Table 2.1 exemplifies the situation explained above.

In the next section we will investigate the possibility that firms are not able to treat the two markets separately anymore, i.e., the two markets of countries A and B are integrated.

2.2.2.2 Integrated markets

Now, the firms are not able to have different pricing strategies for both markets anymore. Thus, they set a uniform price in both countries A and B. Hence, firm *i* from (A,B) faces

¹⁵(2.10) and (2.11) remain unchanged.

¹⁶Assuming, of course, that $c_A > \delta_{BACB}$ holds.

¹⁷As $c_B < c_A$ and $\delta_{AB} > 1$.

¹⁸In this case and for the rest of the analysis we assume that R_B , which includes e.g. fees for government permits, etc, does not erode the higher profits from offering permanent supply of service.

the following demand in country A:

$$q_i^{A,(A,B)} = \alpha_i^A - \beta \theta_i^{(A,B)} p_i^{(A,B)} + \frac{\beta}{n_A + n_B} \cdot \left(\sum_{\substack{j=1 \\ j \neq i}}^{n_A} \theta_j^A p_j^A + \sum_{\substack{j=n_A+1 \\ j \neq i}}^{n_A+n_B} \theta_j^B p_j^B \right) \quad (2.39)$$

Equivalently, in country B the demand for services of firm i from (A,B) is:

$$q_i^{B,(A,B)} = \alpha_i^B - \beta \theta_i^{(A,B)} p_i^{(A,B)} + \frac{\beta}{n_A + n_B} \cdot \left(\sum_{\substack{j=1 \\ j \neq i}}^{n_A} \theta_j^A p_j^A + \sum_{\substack{j=n_A+1 \\ j \neq i}}^{n_A+n_B} \theta_j^B p_j^B \right)$$

where $p_i^{(A,B)}$ is the price of firm i from (A,B).

2.2.2.2.1 Temporary supply of services As argued before, firms face higher unit costs due to transaction costs. Of course, this also holds for integrated markets and hence, we find for the profits of the firms:

$$\pi_i^A = (p_i^A - c_i^A) q_i^{A,A} + (p_i^A - \delta_{AB} c_i^A) q_i^{B,A} - 2 * F_A \quad (2.40)$$

$$\pi_i^B = (p_i^B - \delta_{BA} c_i^B) q_i^{A,B} + (p_i^B - c_i^B) q_i^{B,B} - 2 * F_B \quad (2.41)$$

However, maximizing the profit is now a little bit easier, because the firms only maximize over one price so that $\frac{\partial \pi^{A(B)}}{\partial p_i^{A(B)}} \equiv 0$. By assuming identical firms we obtain the following profit maximizing quantities and prices:

$$q_{A,A} = \frac{(2n_A + 2n_B + 1)K_A - K_B - (n_A + n_B)\beta(1 + \delta_{AB})\theta_{ACA}}{2(n_A + n_B)(n_A + n_B + 1)} - \beta n_B \xi_2 ((1 + \delta_{AB})\theta_{ACA} - (1 + \delta_{BA})\theta_{BCB}) \quad (2.42)$$

$$q_{A,B} = \frac{(2n_A + 2n_B + 1)K_A - K_B - (n_A + n_B)\beta(1 + \delta_{BA})\theta_{BCB}}{2(n_A + n_B)(n_A + n_B + 1)} - \beta n_A \xi_2 ((1 + \delta_{BA})\theta_{BCB} - (1 + \delta_{AB})\theta_{ACA}) \quad (2.43)$$

$$q_{B,A} = \frac{(2n_A + 2n_B + 1)K_B - K_A - (n_A + n_B)\beta(1 + \delta_{AB})\theta_{ACA}}{2(n_A + n_B)(n_A + n_B + 1)} - \beta n_B \xi_2 ((1 + \delta_{AB})\theta_{ACA} - (1 + \delta_{BA})\theta_{BCB}) \quad (2.44)$$

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$$\begin{aligned}
q_{B,B} &= \frac{(2n_A + 2n_B + 1)K_B - K_A - (n_A + n_B)\beta(1 + \delta_{BA})\theta_{BCB}}{2(n_A + n_B)(n_A + n_B + 1)} \\
&\quad - \beta n_A \xi_2 ((1 + \delta_{BA})\theta_{BCB} - (1 + \delta_{AB})\theta_{ACA})
\end{aligned} \tag{2.45}$$

$$\begin{aligned}
p_A &= \frac{K_A + K_B}{2(n_A + n_B + 1) \beta \theta_A} \\
&\quad + \frac{\xi_2}{\theta_A} ((2n_A + n_B + 1)(1 + \delta_{AB})\theta_{ACA} + n_B(1 + \delta_{BA})\theta_{BCB})
\end{aligned} \tag{2.46}$$

$$\begin{aligned}
p_B &= \frac{K_A + K_B}{2(n_A + n_B + 1) \beta \theta_B} \\
&\quad + \frac{\xi_2}{\theta_B} (n_A(1 + \delta_{AB})\theta_{ACA} + (n_A + 2n_B + 1)(1 + \delta_{BA})\theta_{BCB})
\end{aligned} \tag{2.47}$$

where $\xi_2 = \frac{n_A + n_B}{2(n_A + n_B + 1)(2n_A + 2n_B + 1)}$. The profits of the firms have the same form as in equations (2.16) and (2.17). However, due to the different form of the quantities they behave differently concerning changes in the basic variables K_A and K_B . A change in one of them triggers an ambivalent response. If, K_A increases for instance, the first element of the profit of A-firms $\frac{q_{A,A}^2}{\beta\theta_A}$ also increases, whereas the second element $\frac{q_{B,A}^2}{\beta\theta_A}$ decreases. This happens because an increase in K_A triggers a price increase which affects profits in country A positively due to the increase in total market size, but as country B faces the same price increase without a change in the respective total market size K_B , the effect on profit in country B is negative. Equation (2.48) sums up these effects:

$$\frac{\partial \pi_{t=1}^A}{\partial K_A} = \frac{2}{\beta\theta_A} \left[\frac{2n_A + 2n_B + 1}{2(n_A + n_B)(n_A + n_B + 1)} q_{A,A} - \frac{q_{B,A}}{2(n_A + n_B)(n_A + n_B + 1)} \right] \tag{2.48}$$

The profits behave as expected concerning particular variables such as quality, costs or transaction cost factor: The profits of firms from a country go up, if one of these variables deteriorates for firms from the other country, and the profits decrease, if the same happens with their own variables.

Again, we want to ask, for what ratio of costs $x^{nt} = \frac{c_B}{c_A}$ does the opening of the markets

become favorable for A-firms or for which x^{nt} is $\Delta\pi_A(x^{nt}) = 0$:

$$\begin{aligned}
 x_{1,2}^{nt} &= -\frac{K_A + K_B - \beta(1 + \xi)(1 + \delta_{AB})\theta_{AC}c_A}{\beta\xi(1 + \delta_{BA})\theta_{BC}c_A} \\
 &\pm \left[\frac{-(n_A + 1)^2(K_A - K_B)^2 + 2(n_A + n_B)^2(K_A - \beta\theta_{AC}c_A)^2}{4\beta^2\xi_2^2(n_A + 1)^2(n_A + n_B)^2n_B^2(1 + \delta_{BA})^2\theta_B^2c_A^2} \right. \\
 &\left. + \frac{2(n_A + 1)^2(n_A + n_B)^2\beta\theta_{AF}F_A}{4\beta^2\xi_2^2(n_A + 1)^2(n_A + n_B)^2n_B^2(1 + \delta_{BA})^2\theta_B^2c_A^2} \right]^{1/2} \quad (2.49)
 \end{aligned}$$

We drop x_2^{nt} , which is negative, and continue only with x_1^{nt} . As before, Lemma 1 applies accordingly.

Lemma 2c: There exists a limit for the ratio of the costs $x_1^{nt,\infty}$, which is reached with a large number of firms n_B from B. For infinitely large n_B we have $\Delta\pi_A(\tilde{x}) > 0 \forall \tilde{x} > x_1^{nt,\infty}$.

$$x_1^{nt,\infty} = \frac{(1 + \delta_{AB})\theta_A}{(1 + \delta_{BA})\theta_B} + \sqrt{\frac{8\beta\theta_{AF}F_A}{\beta^2(1 + \delta_{BA})^2\theta_B^2c_A^2} + 8\frac{(K_A - \beta\theta_{AC}c_A)^2}{\beta^2(n_A + 1)^2(1 + \delta_{BA})^2\theta_B^2c_A^2}} \quad (2.50)$$

Corollary 1c: There exists a certain total market size of B beyond which an opening of the markets would always be favorable for firms in A. This market size is given by:

$$\begin{aligned}
 \hat{K}_B^{nt} &= \frac{(2n_A + 2n_B + 1)K_A + \beta(n_A + n_B)^2(1 + \xi)(1 + \delta_{AB})\theta_{AC}c_A}{(n_A + n_B + 1)^2 + (n_A + n_B)^2} + \\
 &(n_A + n_B)(n_A + n_B + 1) \left[-\left(\frac{2K_A - \beta(1 + \xi)(1 + \delta_{AB})\theta_{AC}c_A}{(n_A + n_B + 1)^2 + (n_A + n_B)^2} \right)^2 + \right. \\
 &\left. \frac{2(K_A - \beta\theta_{AC}c_A)^2}{(n_A + 1)^2((n_A + n_B + 1)^2 + (n_A + n_B)^2)} + \frac{2\beta\theta_{AF}F_A}{(n_A + n_B + 1)^2 + (n_A + n_B)^2} \right]^{1/2} \quad (2.51)
 \end{aligned}$$

Calculating with the same values as before, we obtain Figure C.3 and Figure C.4, which are both part of Appendix C. They exhibit the same effects as discussed before. A detailed comparison of the results will follow in Section 2.3.

2.2.2.2 Permanent supply of services If firms build a branch in the foreign country to offer their services permanently, the same arguments as in Section 2.2.2.1 apply and the firms' profits are:

$$\pi_i^A = (p_i^A - c_i^A) q_i^{A,A} + (p_i^A - c_i^B) q_i^{B,A} - F_A - F_B - R_B \quad (2.52)$$

$$\pi_i^B = (p_i^B - c_i^A) q_i^{A,B} + (p_i^B - c_i^B) q_i^{B,B} - F_A - F_B - R_A \quad (2.53)$$

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By assuming identical firms the following profit maximizing quantities and prices can be found:

$$\begin{aligned}
 q_{A,A} &= \frac{(2n_A + 2n_B + 1)K_A - K_B - (n_A + n_B)\beta\theta_A(c_A + c_B)}{2(n_A + n_B)(n_A + n_B + 1)} \\
 &\quad - \beta n_B \xi_2(c_A + c_B)(\theta_A - \theta_B)
 \end{aligned} \tag{2.54}$$

$$\begin{aligned}
 q_{A,B} &= \frac{(2n_A + 2n_B + 1)K_A - K_B - (n_A + n_B)\beta\theta_B(c_A + c_B)}{2(n_A + n_B)(n_A + n_B + 1)} \\
 &\quad - \beta n_A \xi_2(c_A + c_B)(\theta_B - \theta_A)
 \end{aligned} \tag{2.55}$$

$$\begin{aligned}
 q_{B,A} &= \frac{(2n_A + 2n_B + 1)K_B - K_A - (n_A + n_B)\beta\theta_A(c_A + c_B)}{2(n_A + n_B)(n_A + n_B + 1)} \\
 &\quad - \beta n_B \xi_2(c_A + c_B)(\theta_A - \theta_B)
 \end{aligned} \tag{2.56}$$

$$\begin{aligned}
 q_{B,B} &= \frac{(2n_A + 2n_B + 1)K_B - K_A - (n_A + n_B)\beta\theta_B(c_A + c_B)}{2(n_A + n_B)(n_A + n_B + 1)} \\
 &\quad - \beta n_A \xi_2(c_A + c_B)(\theta_B - \theta_A)
 \end{aligned} \tag{2.57}$$

$$\begin{aligned}
 p_A &= \frac{K_A + K_B}{2(n_A + n_B + 1) \beta\theta_A} \\
 &\quad + \frac{\xi_2(c_A + c_B)}{\theta_A}((2n_A + n_B + 1)\theta_A + n_B\theta_B)
 \end{aligned} \tag{2.58}$$

$$\begin{aligned}
 p_B &= \frac{K_A + K_B}{2(n_A + n_B + 1) \beta\theta_B} \\
 &\quad + \frac{\xi_2(c_A + c_B)}{\theta_B}(n_A\theta_A + (n_A + 2n_B + 1)\theta_B)
 \end{aligned} \tag{2.59}$$

Profit responses to changes in the basic variables are quite similar. Because markets are not segmented, we again find two opposing effects on profits if the total market sizes K_A and K_B change. And because the firms face the unit costs of the respective country, the dependence of the profit on the unit costs c_A and c_B is also ambivalent in line with

Section 2.2.2.1 for permanent supply of services. Concerning the ratio of costs we find:

$$\begin{aligned}
x_{1,2}^{np} &= \frac{K_A + K_B - \beta c_A((1 + \xi)\theta_A - \xi\theta_B)}{\beta c_A((1 + \xi)\theta_A - \xi\theta_B)} \\
&\pm (n_A + n_B + 1) \cdot \left[- \left(\frac{K_A - K_B}{\beta(n_A + n_B)c_A((1 + \xi)\theta_A - \xi\theta_B)} \right)^2 \right. \\
&\left. + \frac{2(K_A - \beta\theta_A c_A)^2}{\beta^2(n_A + 1)^2 c_A^2((1 + \xi)\theta_A - \xi\theta_B)^2} + \frac{2\theta_A(F_B + R_B)}{\beta c_A^2((1 + \xi)\theta_A - \xi\theta_B)^2} \right]^{1/2} \quad (2.60)
\end{aligned}$$

After dropping x_2^{np} , we note that Lemma 1 also applies here.

Lemma 2d: There exists a limit for the ratio of the costs $x_1^{np,\infty}$, which is reached with a large number of firms n_B from B. For infinitely large n_B we have $\Delta\pi_A(\tilde{x}) > 0 \forall \tilde{x} > x_1^{np,\infty}$.

$$x_1^{np,\infty} = -1 + \sqrt{\frac{8\theta_A(F_B + R_B)}{\beta c_A^2(\theta_A - \theta_B)^2} + 8 \frac{(K_A - \beta\theta_A c_A)^2}{\beta^2(n_A + 1)^2 c_A^2(\theta_A - \theta_B)^2}} \quad (2.61)$$

Corollary 1d: There exists a certain total market size of B beyond which an opening of the markets would always be favorable for firms in A. This market size is given by:

$$\begin{aligned}
\hat{K}_B^{np} &= \frac{(2n_A + 2n_B + 1)K_A + \beta(n_A + n_B)^2 c_A((1 + \xi)\theta_A - \xi\theta_B)}{(n_A + n_B + 1)^2 + (n_A + n_B)^2} + \\
&(n_A + n_B)(n_A + n_B + 1) \left[- \left(\frac{2K_A - \beta c_A((1 + \xi)\theta_A - \xi\theta_B)}{(n_A + n_B + 1)^2 + (n_A + n_B)^2} \right)^2 + \right. \\
&\left. \frac{2(K_A - \beta\theta_A c_A)^2}{(n_A + 1)^2((n_A + n_B + 1)^2 + (n_A + n_B)^2)} + \frac{2\beta\theta_A(F_B + R_B)}{(n_A + n_B + 1)^2 + (n_A + n_B)^2} \right]^{1/2} \quad (2.62)
\end{aligned}$$

Taking the same values as before we obtain Figures C.5 and C.6, which are both part of Appendix C.

2.2.2.2.3 Opposed strategies Like in the case of segmented markets, we will investigate which strategy each firm will choose in order to maximize profits. By analyzing in a first step that B-firms supply temporarily and A-firms permanently we find with a similar argumentation as before that B-firms will prefer to offer their services temporarily if $c_A > \delta_{BACB}$. Again, it is a dominant strategy for B-firms to supply their services only temporarily.

For A-firms the same result as before emerges: It is a dominant strategy for A-firms to supply their services permanently if $c_B < \delta_{ABCA}$. Hence, we can say that in price com-

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petition independent of the segmentation of the markets A-firms will always supply their services permanently, i.e., building a branch in country B, whereas B-firms will choose to be temporary suppliers.

After having investigated the outcomes under price competition, we will now focus on firms that compete on quantities, because their capacity is relatively fixed, which is the case for e.g. very specialized service firms.

2.2.3 Cournot competition

Again, we have the periods before and after the opening ($t=0$ and $t=1$) of the service market. In $t=0$ we have the following situation in both countries:

$$p_i^{A(B)} = \gamma_i^{A(B)} - \chi \cdot \sum_{j=1}^{n_{A(B)}} \theta_j^{A(B)} q_j^{A(B)}$$

$$\pi_i^{A(B)} = \left(p_i^{A(B)} - c_i^{A(B)} \right) q_i^{A(B)} - F_i^{A(B)}$$

where γ_i^A is the maximum price the consumers in A are willing to pay for product i and χ serves as a scaling variable.

Assuming identical firms and profit maximization we obtain the following outcomes for quantity, price and profit of the firms in period $t=0$ for country A (B):

$$q_{t=0}^{A(B)} = \frac{\gamma_{A(B)} - c_{A(B)}}{\chi \theta_{A(B)} (n_{A(B)} + 1)} \quad (2.63)$$

$$p_{t=0}^{A(B)} = \frac{\gamma_{A(B)} + n_{A(B)} c_{A(B)}}{n_{A(B)} + 1} \quad (2.64)$$

$$\pi_{t=0}^{A(B)} = \beta \theta_{A(B)} \cdot q_{A(B)}^2 - F_{A(B)} \quad (2.65)$$

In the next sections we will investigate the situation after the opening ($t=1$). Because the approach is quite similar to Section 2.2.2, we will skip a few steps in-between. Again we will first have a look at the situation where firms are able to sell different quantities in the two countries.

2.2.3.1 Segmented markets

In $t=1$ firms from B enter the market in A and vice versa. Therefore, the new inverse demand functions in A and B become:

$$p_i^{A(B)} = \gamma_i^{A(B)} - \chi \cdot \left(\sum_{j=1}^{n_A} \theta_j^A q_j^{A(B),A} + \sum_{j=n_A+1}^{n_A+n_B} \theta_j^B q_j^{A(B),B} \right) \quad (2.66)$$

2.2.3.1.1 Temporary supply of services As the firms offer their services only temporarily, they face transaction costs. Therefore, the firm's profit functions are similar to (2.6) and (2.7)¹⁹. Profit maximization for identical firms yields

$$q_{A,A} = \frac{\gamma_A - c_A}{(n_A + n_B + 1)\chi\theta_A} - \zeta \frac{c_A - \delta_{BACB}}{\chi\theta_A} \quad (2.67)$$

$$q_{A,B} = \frac{\gamma_A - \delta_{BACB}}{(n_A + n_B + 1)\chi\theta_B} - \zeta \frac{n_A \delta_{BACB} - c_A}{n_B \chi\theta_B} \quad (2.68)$$

$$q_{B,A} = \frac{\gamma_B - \delta_{ABCA}}{(n_A + n_B + 1)\chi\theta_A} - \zeta \frac{\delta_{ABCA} - c_B}{\chi\theta_A} \quad (2.69)$$

$$q_{B,B} = \frac{\gamma_B - c_B}{(n_A + n_B + 1)\chi\theta_B} - \zeta \frac{n_A c_B - \delta_{ABCA}}{n_B \chi\theta_B} \quad (2.70)$$

$$p_A = \frac{\gamma_A + n_A c_A + n_B \delta_{BACB}}{n_A + n_B + 1} \quad (2.71)$$

$$p_B = \frac{\gamma_B + n_A \delta_{ABCA} + n_B c_B}{n_A + n_B + 1} \quad (2.72)$$

where $\zeta = n_B/(n_A + n_B + 1)$. The profits become

$$\pi_{t=1}^A = \beta \theta_A \cdot q_{A,A}^2 + \beta \theta_A \cdot q_{B,A}^2 - 2F_A \quad (2.73)$$

$$\pi_{t=1}^B = \beta \theta_B \cdot q_{A,B}^2 + \beta \theta_B \cdot q_{B,B}^2 - 2F_B \quad (2.74)$$

Interestingly, the maximized profit of firms from A (B) does not depend on the quality of firms from B (A) anymore. Concerning the other variables it behaves as expected.

¹⁹The different prices $p^{A,A(B)}$ and $p^{B,A(B)}$ in (2.6) and (2.7) have to be replaced with p^A and p^B .

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Again, we consider the ratio of the costs. Here, we have for $y^t = \frac{c_B}{c_A}$:

$$\begin{aligned}
y_{1,2}^t &= -\frac{\gamma_B + \delta_{BA}\gamma_A - (n_B + 1)(\delta_{AB} + \delta_{BA})c_A}{n_B(1 + \delta_{BA}^2)c_A} \\
&\pm \left[-\left(\frac{\gamma_B + \delta_{BA}\gamma_A - (n_B + 1)(\delta_{AB} + \delta_{BA})c_A}{n_B(1 + \delta_{BA}^2)c_A} \right)^2 + \frac{\chi\theta_A F_A}{\zeta^2(1 + \delta_{BA}^2)c_A^2} \right. \\
&+ \frac{(n_B + 2)(\gamma_A^2 - n_A^2 c_A^2) + 2(n_A\gamma_A - (n_B + 1)c_A)(\gamma_A + n_A c_A)}{(n_A + 1)^2 n_B(1 + \delta_{BA}^2)c_A^2} \\
&\left. - \frac{(\gamma_B - (n_B + 1)\delta_{AB}c_A)^2}{n_B^2(1 + \delta_{BA}^2)c_A^2} \right]^{1/2} \tag{2.75}
\end{aligned}$$

Economically, only y_1^t makes sense, because y_2^t is always negative.

Lemma 1e: If $\frac{c_B}{c_A} > y_1^t \Leftrightarrow \Delta\pi_A\left(\frac{c_B}{c_A}\right) > 0 \Leftrightarrow$ The opening of the market is positive for firms from A.

If the unit costs of firms from B are y_1^t times higher than the unit costs of firms from A, the profit of firms from A will be higher than before the opening.

Lemma 2e: There exists a limit for the ratio of the unit costs $y_1^{t,\infty}$, which is reached with a large number of firms n_B from B. For infinitely large n_B we have $\Delta\pi_A(\tilde{y}) > 0 \forall \tilde{y} > y_1^{t,\infty}$.

$$\begin{aligned}
y_1^{t,\infty} &= \frac{\delta_{AB} + \delta_{BA}}{1 + \delta_{BA}^2} + \\
&\sqrt{\left(\frac{\delta_{AB} + \delta_{BA}}{1 + \delta_{BA}^2} \right)^2 - \frac{\delta_{AB}^2}{1 + \delta_{BA}} + \frac{\chi\theta_A F_A}{(1 + \delta_{BA}^2)c_A^2} + \frac{(\gamma_A + n_A c_A)(\gamma_A - (n_A + 2)c_A)}{(n_A + 1)^2(1 + \delta_{BA}^2)c_A^2}} \tag{2.76}
\end{aligned}$$

Corollary 1e: There exists a certain maximum price of services of firms from B beyond which an opening of the markets would always be favorable for firms in A. This price is given by:

$$\begin{aligned}
\hat{\gamma}_B^t &= (n_B + 1)\delta_{AB}c_A + \left[\frac{n_B^2 \chi\theta_A F_A}{\zeta^2} + \right. \\
&\left. n_B(\gamma_A + n_A c_A) \frac{2(\gamma_A - c_A)(n_A + 1) + n_B(\gamma_A - (n_A + 2)c_A)}{(n_A + 1)^2} \right]^{1/2} \tag{2.77}
\end{aligned}$$

Using the same values as before²⁰ as before we first notice that the quantity which firms from A sell in country B would be negative and hence, it is set to be zero. However, this already implies that for these values (Germany - Poland) the opening cannot be positive for firms from A. Figures C.7 and C.8 in Appendix C show the conditions concerning γ

²⁰ $\gamma = K/\beta$.

and c_B/c_A for which the profit difference would be positive²¹.

2.2.3.1.2 Permanent supply of services In order to avoid redundancies, we just report the findings for the case of permanent supply of services:

$$q_{A,A} = \frac{\gamma_A - c_A}{(n_A + n_B + 1)\chi\theta_A} \quad (2.78)$$

$$q_{A,B} = \frac{\gamma_A - c_A}{(n_A + n_B + 1)\chi\theta_B} \quad (2.79)$$

$$q_{B,A} = \frac{\gamma_B - c_B}{(n_A + n_B + 1)\chi\theta_A} \quad (2.80)$$

$$q_{B,B} = \frac{\gamma_B - c_B}{(n_A + n_B + 1)\chi\theta_B} \quad (2.81)$$

$$p_A = \frac{\gamma_A + (n_A + n_B)c_A}{n_A + n_B + 1} \quad (2.82)$$

$$p_B = \frac{\gamma_B + (n_A + n_B)c_B}{n_A + n_B + 1} \quad (2.83)$$

The ratio for which $\Delta\pi_A = 0$ is:

$$\begin{aligned} \Delta\pi_A(y^p) &= 0 \\ &\Downarrow \\ y_{1,2}^p &= \frac{\gamma_B}{c_A} \pm \left[\frac{n_B(2n_A+n_B+2)}{(n_A+1)^2} \cdot \left(\frac{\gamma_A-c_A}{c_A} \right)^2 + \frac{\chi(n_A+n_B+1)^2\theta_A(F_B+R_B)}{c_A^2} \right]^{1/2} \end{aligned} \quad (2.84)$$

Economically, y_2^p does not make sense, because with $c_B/c_A > y_2^p$ follows $\Delta\pi_A(c_B/c_A) < 0$. But when inserting $\hat{c}_B = y_1^p \cdot c_A$ in (2.80) we see that $q_{B,A}$ will become negative (which is then set to be zero). Thus, A-firms are only left with $q_{A,A}$, which is smaller than (2.63). Hence, there does not exist a cost ratio for which an opening with permanent supply would yield a positive change in profits for A-firms.

An equivalent to Lemma 2 does also not exist. There is no upper bound for the ratio of the unit costs when the number of firms from B is very high ($y^{p,\infty} = \infty$).

Corollary 1f: There exists a certain maximum price of services of firms from B beyond which an opening of the markets would always be favorable for firms in A. This price is

²¹E.g. if the unit costs in Poland were seven times higher than in Germany the opening of the market would yield higher profits for firms in Germany than before.

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given by:

$$\hat{\gamma}_B^p = c_B + \sqrt{\chi(n_A + n_B + 1)^2 \theta_A (F_B + R_B) + \frac{n_B(2n_A + n_B + 2)}{(n_A + 1)^2} (\gamma_A - c_A)^2} \quad (2.85)$$

Hence, if we assume permanent supply of services the difference in profits for firms from A will become positive after the opening only if the foreign market's γ_B increases up to $\hat{\gamma}_B^p$ (or higher). Figure C.9 demonstrates this for the case of Germany and Poland.

2.2.3.1.3 Opposed strategies If firms have different strategies the outcomes calculated above change. If A-firms build a branch in country B, whereas B-firms only supply temporarily, the quantities are determined by (2.67) and (2.68) for country A and by (2.80) and (2.81) for country B. Thus, B-firms are better off as compared to the case where both A- and B-firms build branches²². If we look at the case where A-firms are temporary suppliers and B-firms build branches we observe the same effect as before: B-firms would prefer to be temporary suppliers as this yields higher profits. Thus, as in the Bertrand case for segmented markets, temporary supply is the dominant strategy for B-firms if $c_A > \delta_{BACB}$ ²³.

Using the same analysis for A-firms we see that their dominant strategy is permanent supply of services²⁴. Hence, for segmented markets, we have the same Nash equilibrium as before: B-firms offer temporary²⁵ and A-firms permanent supply of service.

2.2.3.2 Integrated markets

As firms are now only able to supply the same quantity to each market, the inverse demand function for integrated markets is:

$$p_i^{A(B)} = \gamma_i^{A(B)} - \chi \cdot \left(\sum_{j=1}^{n_{A(B)}} \theta_j^A q_j^A + \sum_{j=n_A+1}^{n_A+n_B} \theta_j^B q_j^B \right) \quad (2.86)$$

²²If $c_A > \delta_{BACB}$ holds.

²³Permanent supply would be the dominant strategy if $c_A < \delta_{BACB}$.

²⁴If $c_B < \delta_{ABCA}$ holds.

²⁵If $c_A > \delta_{BACB}$.

2.2.3.2.1 Temporary supply of services Here, we have:

$$q_A = \frac{\gamma_A + \gamma_B + n_B(1 + \delta_{BA})c_B - (n_B + 1)(1 + \delta_{AB})c_A}{2(n_A + n_B + 1)\chi\theta_A} \quad (2.87)$$

$$q_B = \frac{\gamma_A + \gamma_B - (n_A + 1)(1 + \delta_{BA})c_B + n_A(1 + \delta_{AB})c_A}{2(n_A + n_B + 1)\chi\theta_B} \quad (2.88)$$

$$p_A = \frac{(n_A + n_B)(\gamma_A - \gamma_B) + 2\gamma_A + n_A(1 + \delta_{AB})c_A + n_B(1 + \delta_{BA})c_B}{2(n_A + n_B + 1)} \quad (2.89)$$

$$p_B = \frac{(n_A + n_B)(\gamma_B - \gamma_A) + 2\gamma_B + n_A(1 + \delta_{AB})c_A + n_B(1 + \delta_{BA})c_B}{2(n_A + n_B + 1)} \quad (2.90)$$

We first notice that, if both markets are very different in their possible maximum prices γ , one of the prices in A or B will become negative. This happens because firms adopt their quantity strategy to the bigger market and do not consider the other market. In our model we set the price to zero if it becomes negative which means that firms do not supply this market anymore. The ratio for which $\Delta\pi_A = 0$ is:

$$y_{1,2}^{nt} = -\frac{\gamma_A + \gamma_B - (n_B + 1)(1 + \delta_{AB})c_A}{n_B(1 + \delta_{BA})c_A} \pm \frac{n_A + n_B + 1}{n_B(n_A + 1)(1 + \delta_{BA})c_A} \cdot \sqrt{2(\gamma_A - c_A)^2 + 2(n_A + 1)^2\chi\theta_A F_A} \quad (2.91)$$

Lemmata 1 and 2 apply accordingly:

$$y_1^{nt,\infty} = \frac{1 + \delta_{AB}}{1 + \delta_{BA}} + \frac{1}{(n_A + 1)(1 + \delta_{BA})c_A} \cdot \sqrt{2(\gamma_A - c_A)^2 + 2(n_A + 1)^2\chi\theta_A F_A} \quad (2.92)$$

Corollary 1g: There exists a certain maximum price of services of firms from B beyond which an opening of the markets would always be favorable for firms in A. This price is given by:

$$\hat{\gamma}_B^{nt} = -\gamma_A + (n_B + 1)(1 + \delta_{AB})c_A + \frac{n_A + n_B + 1}{n_A + 1} \cdot \sqrt{2(\gamma_A - c_A)^2 + 2\chi(n_A + 1)^2\theta_A F_A} \quad (2.93)$$

Inserting our values for Germany and Poland we first note that the price in Poland would become negative and hence, will be set to zero. Looking at Figure 2.3 we see that only if the unit costs in Poland were more than seven times higher than in Germany, firms from Germany would definitely benefit from the opening. Figure C.10 in Appendix C

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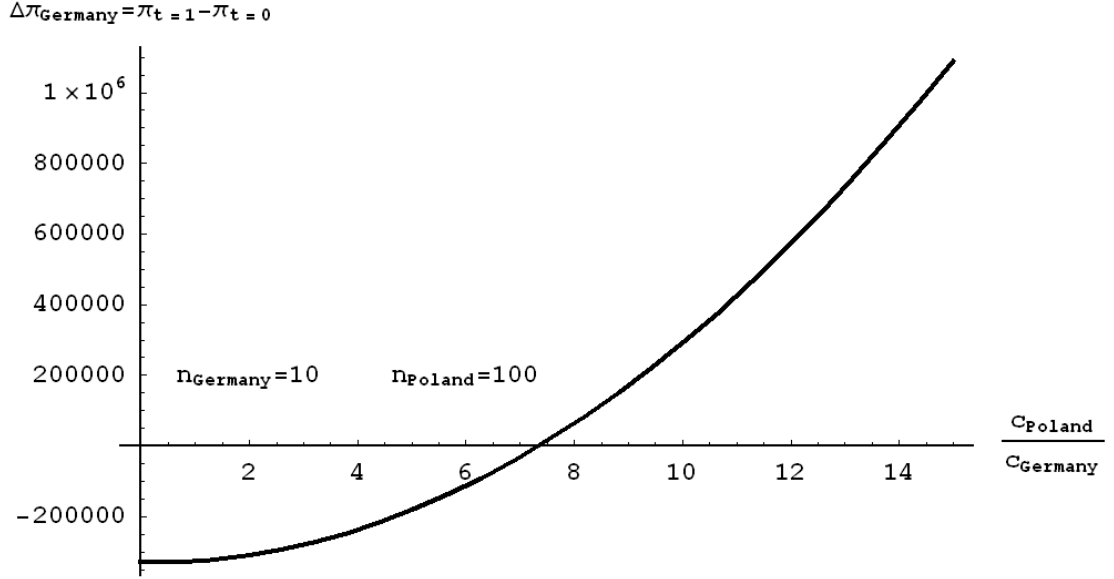


Figure 2.3: Temporary supply of services in integrated Cournot markets: The difference in firms' profits in Germany before and after the opening against the ratio of costs in Poland and Germany

presents the implications of Corollary 1g.

2.2.3.2.2 Permanent supply of services For permanent supply of services we have:

$$q_A = \frac{\gamma_A + \gamma_B - c_A - c_B}{2(n_A + n_B + 1)\chi\theta_A} \quad (2.94)$$

$$q_B = \frac{\gamma_A + \gamma_B - c_A - c_B}{2(n_A + n_B + 1)\chi\theta_B} \quad (2.95)$$

$$p_A = \frac{(n_A + n_B)(\gamma_A - \gamma_B + c_A + c_B) + 2\gamma_A}{2(n_A + n_B + 1)} \quad (2.96)$$

$$p_B = \frac{(n_A + n_B)(\gamma_B - \gamma_A + c_A + c_B) + 2\gamma_B}{2(n_A + n_B + 1)} \quad (2.97)$$

$\Delta\pi_A(y^{pt}) = 0$ yields:

$$y_{1,2}^{pt} = \frac{\gamma_A + \gamma_B - c_A}{c_A} \pm \frac{n_A + n_B + 1}{(n_A + 1)c_A} \cdot \sqrt{2(\gamma_A - c_A)^2 + 2(n_A + 1)^2\chi\theta_A(F_B + R_B)} \quad (2.98)$$

But alike the case of segmented markets and permanent supply of services Lemma 1 and 2 do not apply, because $\hat{c}_B = y_1^{pt} \cdot c_A$ implies $q_A < 0$ and $q_B < 0$.

Corollary 1h: There exists a certain maximum price of services of firms from B beyond which an opening of the markets would always be favorable for firms in A. This price is given by:

$$\hat{\gamma}_B^{np} = -\gamma_A + c_A + c_B + (n_A + n_B + 1) \cdot \sqrt{2\chi\theta_A(F_B + R_B) + 2\left(\frac{\gamma_A - c_A}{n_A + 1}\right)^2} \quad (2.99)$$

Figure C.11 in Appendix C clarifies that in the case of Germany-Poland no cost ratio c_B/c_A would yield a benefit of the opening for firms from Germany, whereas Figure C.12 shows the implications of Corollary 1h.

2.2.3.2.3 Opposed strategies Using the same line of reasoning as above²⁶ we can conclude that also for the case of integrated markets the dominant strategy for firms from B is to be temporary suppliers²⁷ and for firms from A to be permanent suppliers²⁸.

Hence, independent of both kinds of competition (price or quantity competition) and segmented versus integrated markets firms from B will prefer to supply their services temporarily if $c_A > \delta_{BACB}$, and firms from A will prefer to be permanent suppliers if R_B does not erode the higher profits from building a branch in country B (and of course if $c_B < \delta_{ABCA}$ holds).

2.2.4 Ratio of qualities

If we give up the assumption of given service qualities we can derive a threshold ratio of qualities, for which the opening would yield a positive change in profits for firms from A²⁹. As the profits of the firms in Cournot competition are independent of the quality of their rivals³⁰, these ratios can only be derived for the case of Bertrand competition. They exhibit a similar run and behavior as the ratio of costs, meaning that German firms would need a much higher quality compared to the Polish firms in order to experience a boost in profits after the opening.

²⁶I.e. replacing e.g. $\delta_{ABCA} \rightarrow c_B$ in (2.87) and (2.88).

²⁷Again if $c_A > \delta_{BACB}$.

²⁸Also if $c_B < \delta_{ABCA}$.

²⁹This is in analogy to deriving the ratio of costs previously. The quality ratios are shown in Appendix D.

³⁰For details, insert the quantities as given by equations (2.67) and (2.69) into the profit function given by equation (2.73), or refer to equation (4.33) of Chapter 4.

2.3 Comparison and Discussion

2.3.1 Type of supply

As shown in the previous sections, two conditions define the type of service A- and B-firms will offer in their respective foreign country:

Condition 1: If $c_A < \delta_{BACB}$ firms from country B will offer their services permanently in country A.

Condition 2: If $c_B < \delta_{ABCA}$ firms from country A will offer their services permanently in country B.

Both conditions have in common that if the domestic unit costs times the transaction costs³¹ are higher than the foreign unit costs, it will yield higher profits for the domestic firm to build a branch in the foreign country³².

If we use our typical values for Germany and Poland, the first condition is not met whereas the second one holds. Thus, German firms will build branches in Poland and Polish firms will supply Germany only temporarily.

2.3.2 Bertrand competition

Comparing the results from the previous sections let us first look at the case of Bertrand competition. As Figure 2.4 indicates, the opening of the service market is much better for firms from country B (Poland) than for A-firms³³ because their profits are higher after the opening whereas the profits of A-firms are lower than before. This holds up to a ratio of costs of about 10 (for temporary service) and $\frac{c_B}{c_A} \approx 80$ (for permanent service). As the actual cost ratio³⁴ of these countries is about 0.2, we can conclude that firms from Poland (Germany) would be better (worse) off after the opening.

Our findings that B-firms will be temporary suppliers and German firms will supply their services permanently is reversed for the most part of Figure 2.4 as the basic assumptions $c_B < \delta_{ABCA}$ and $c_A > \delta_{BACB}$ ³⁵ do not hold for most of the chart. With a rising cost ratio (or, in other words, with decreasing competitiveness of B-firms) the foremost positive effect for Polish firms diminishes and, eventually, turns negative. This is generally

³¹Which incur due to the temporary supply to the foreign country.

³²These are of course similar aspects as in Ricardo's theory of comparative advantage.

³³For clarity reasons we will refrain from plotting opposed strategies in the following figures.

³⁴See Appendix B.

³⁵See Section 2.3.1.

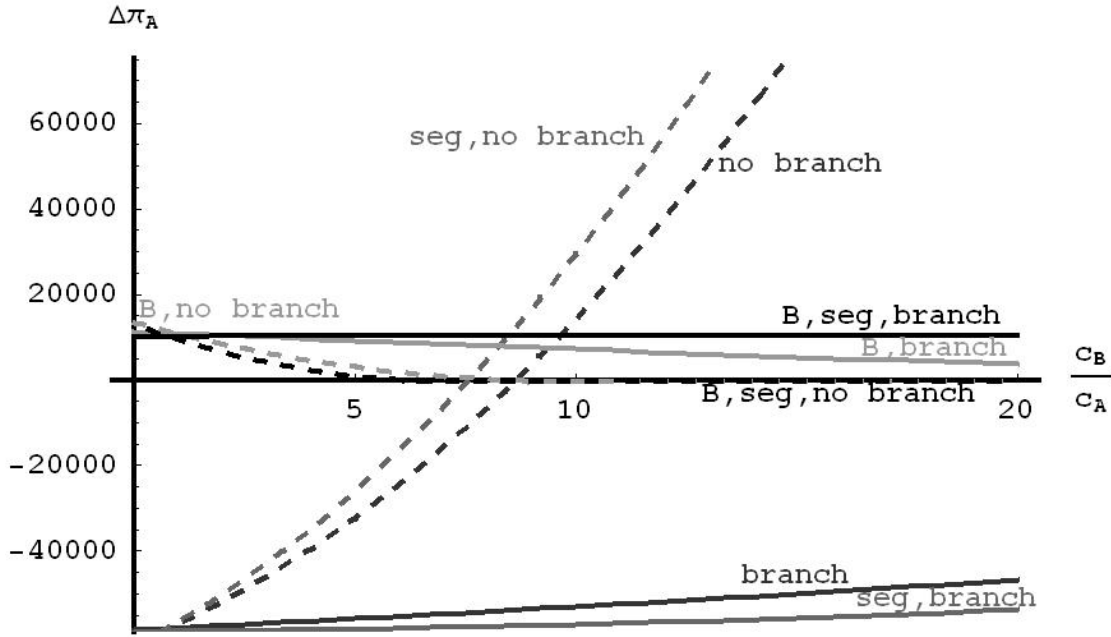


Figure 2.4: Bertrand competition: The change in profits after the opening against the cost ratio $\frac{c_{Poland}}{c_{Germany}}$ for firms from Germany and Poland (B) in segmented (seg) and integrated markets supplying either temporarily ($no\ branch$) or permanently ($branch$) for $n_A = n_B = 10$

not the case for firms in segmented markets which have build a branch in the other country, so that they can also benefit from the relatively lower costs there³⁶. Firms from Germany that offer their services permanently need a very high ratio of costs in order to experience a positive net effect of the opening on account of the fact that they do not have a cost advantage over firms from B, because both face the same unit costs in each country. Concerning the segmentation of the market, it becomes obvious that it has always an opposite influence on A- and B-firms on account of the fact that their decisions are strategic: if the segmentation of the market has a positive influence on the German firms' output, for instance, then Polish firms have to adapt and reduce their output. Generally, A-firms need a very high ratio of costs in order to experience a positive effect on profit³⁷, which is quite unrealistic. Figure E.1 in Appendix E illustrates the net effect of the opening for German and Polish firms for the relevant range of $0 \leq \frac{c_B}{c_A} \leq 2$. There, the intersection, where both assumptions pointed out above loose their validity, becomes more obvious.

³⁶As $\frac{c_B}{c_A} > 1$ for most of the chart.

³⁷This is due to the relatively small market size of country B.

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	Absolute Size	Size relative to Germany	Size relative to EU-24*
Segmented & Temporary	3806.89	169.53%	44.50%
Integrated & Temporary	3786.74	168.64%	44.26%
Segmented & Permanent	3611.58	160.84%	42.22%
Integrated & Permanent	3590.71	159.91%	41.97%

Table 2.2: Required market size of country B which independently of the costs in A yields higher profits for firms of country A ($n_A = n_B = 10$) - *the EU-24 are the 25 member states without Germany, Bulgaria and Romania

If country B exceeds a certain size, the change in profits for firms from country A will always be positive according to Corollaries 1a-1h (independent of the costs in B). These thresholds are listed in Table 2.2. If we assume that there are ten firms ($n_B = 10$) in the market of country B the opening of the markets will always have a positive net effect for firms in Germany if the other country's market size is 1.69 times larger than the German market (with $n_{Germany} = 10$). If we set the European Union (without Germany, Bulgaria and Romania) as country B³⁸ the profit difference will be positive for firms from Germany - actually only half of the EU-24 (EU-25 without Germany, Bulgaria and Romania) would be sufficient.

How do quantities and prices evolve in the two markets after the opening? Figures 2.5 and E.2 in Appendix E show that for the case of country A (Germany) the quantities are always higher than before the opening, irrespective of the number of B-firms in the market. In country B (Poland) however, they only reach the pre-opening level if both

Country	Quantity	Price	Consumer Surplus
Country A	↑	↓	↑
Country B	↓	↑	↓

Table 2.3: Bertrand competition: Comparison of the situation before and after the opening in two countries regarding quantity, price and consumer surplus

markets are EU segmented. Concerning the prices in Germany and Poland we see in Figures E.3 and E.4³⁹ that consumers are again better off in Germany after the opening, because prices in Germany from B- and A-firms are lower than the price of the A-firms before the

³⁸Again with only $n_B = 10$ firms in the market, which is for the European Union quite a small number.

With $n_B = 50$ firms the respective market size would have to be around 1.45 the size of the EU-24 (EU-25 without Germany, Bulgaria and Romania).

³⁹In Appendix E.

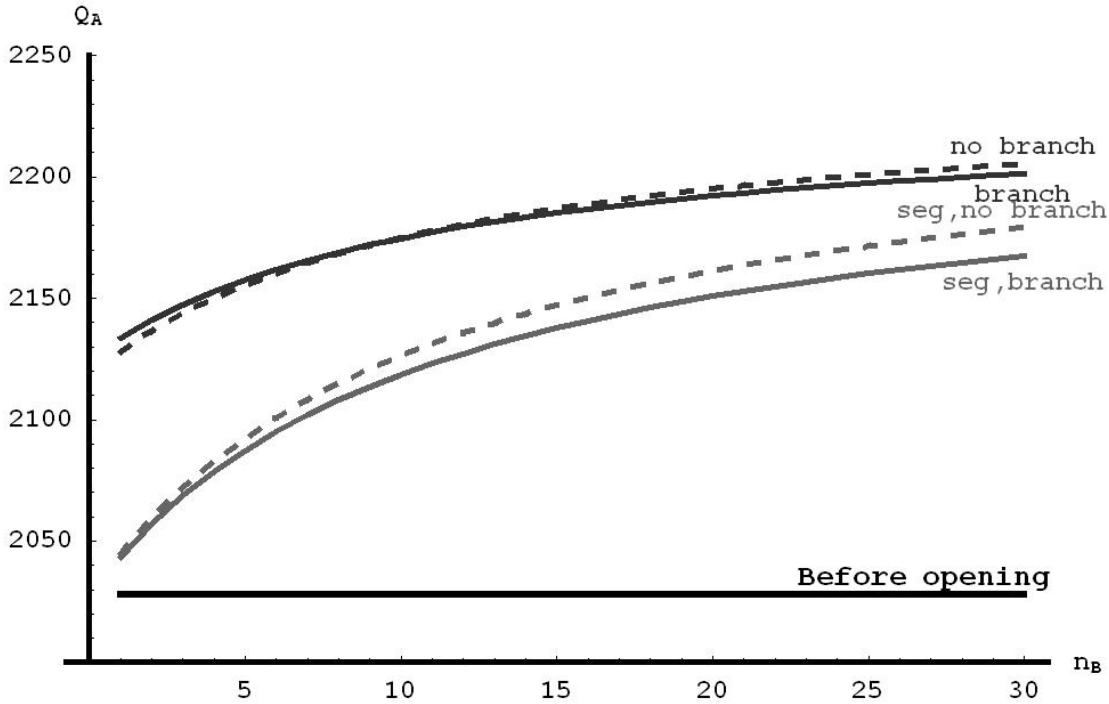


Figure 2.5: Bertrand competition: Quantity offered in country A before (*Thick black line*) and after the opening against the number of firms from country B in segmented (*seg*) and integrated markets by either temporarily (*no branch*) or permanently (*branch*) supplying firms with $n_A = 10$

opening. For most of the analyzed cases, however, consumers in Poland will be worse off as prices tend to be higher than before the opening. Our theoretical analysis therefore refutes the claim of the Copenhagen Economics study [54]⁴⁰ that every nation will be better off after the opening. Table 2.3 summarizes the effects.

2.3.3 Cournot competition

If firms compete on quantities a slightly different picture emerges. For a very small ratio of costs, we may conclude from Figure 2.6 what we have already concluded in the sections on opposed strategies: A-firms will prefer to supply permanently whereas B-firms will be temporary suppliers. However, with increasing ratio c_B/c_A the two basic conditions $c_A > \delta_{BACB}$ and $c_B < \delta_{ABCA}$ do not hold anymore and the picture changes. B-firms will now supply permanently in order to take advantage of the relatively lower unit costs in A whereas A-firms will start supplying temporarily. Generally, German or A-firms will

⁴⁰See Section 2.1.2.

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always experience a negative profit change with permanent supply of services - independent of the cost ratio between Polish and German firms, whereas after a certain cost ratio (in the German-Polish case if it were around $\frac{c_B}{c_A} \approx 3 - 5$) the opening will have a positive net effect if they supply temporarily. Market segmentation, however, plays

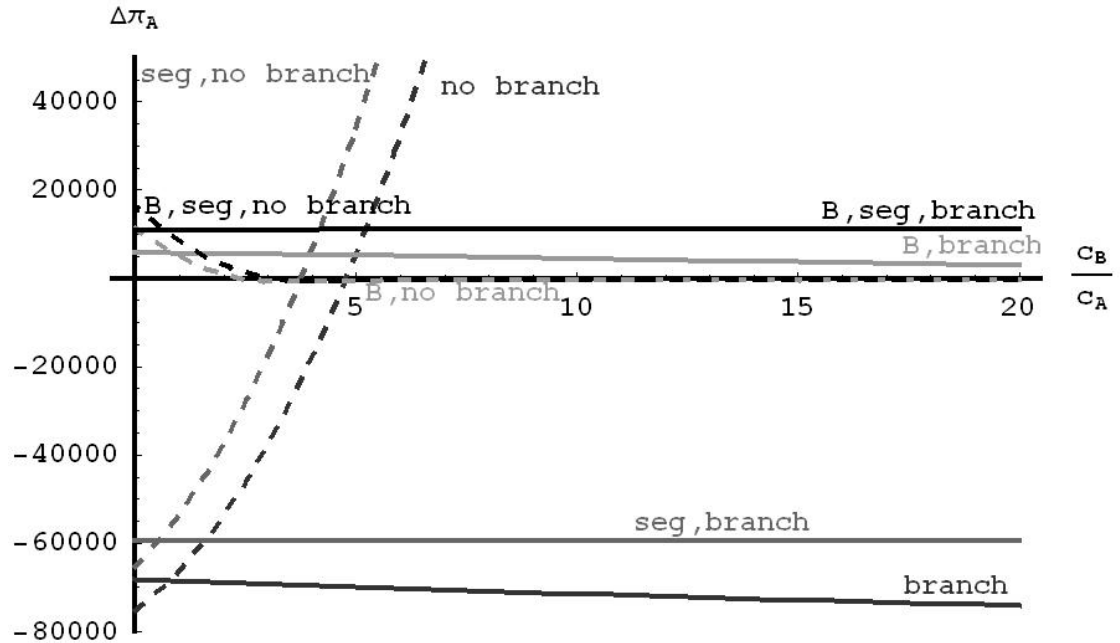


Figure 2.6: Cournot competition: The change in profits after the opening against the cost ratio $\frac{c_{Poland}}{c_{Germany}}$ for firms from Germany and Poland (B) in segmented (seg) and integrated markets supplying either temporarily ($no\ branch$) or permanently ($branch$) for $n_A = n_B = 10$

for both countries a rather minor role, because although segmentation always increases the profits of the firms⁴¹ its effect is not crucial in the sense that it separates the curves considerably⁴². In sum, we may conclude that with the actual cost ratio of about 0.2 Polish (German) firms under Cournot competition will have higher (lower) profits after the opening, as well.

If we look at the thresholds for the maximum prices listed in Table 2.4 we observe very similar findings as compared to the market sizes in the Bertrand case. Equivalently, we find that half of the EU would suffice for German firms in order to experience a positive change in profits after the opening.

⁴¹If markets are segmented price discrimination is possible and firms have more market power.

⁴²An exemption might be the case of permanently supplying firms where the two curves have a slightly different slope.

	Absolute Magnitude	Magnitude rel. to Germany	Magnitude rel. to EU-24*
Segmented & Temporary	4195.61	186.85%	49.04%
Integrated & Temporary	4498.15	200.32%	52.58%
Segmented & Permanent	3629.74	161.65%	42.43%
Integrated & Permanent	3797.15	169.10%	44.39%

Table 2.4: Required maximum prices of country B which independently of the costs in A yield higher profits for firms of country A ($n_A = n_B = 10$) - *the EU-24 are the 25 member states without Germany, Bulgaria and Romania

Concerning the evolution of the quantities and prices in the Cournot case we observe a totally different picture than under Bertrand competition. Figures E.5 and E.6 in Appendix E show that the supplied quantity in country A decreases, whereas it increases in country B which is contrary to the Bertrand case. The prices in both countries⁴³ depend strongly on the segmentation of the markets. If the markets in both countries are segmented the price is either almost as low as before the opening (in country B) or even lower (in country A). If the markets are not segmented however and the firms are induced to offer the same quantity in both markets the price in country A will be much higher and the firms will refrain from offering their services in country B at all ($p_B = 0$)⁴⁴. This means that country B will only be supplied in the case of segmented

Country	Quantity	Price	Consumer Surplus
Country A	↓	↓	↕
Country B - branch	↑	↓	↑
Country B - no branch	↑	↑	↕

Table 2.5: Cournot competition: Comparison of the situation before and after the opening in two countries with segmented markets regarding quantity, price, consumer and producer surplus

markets and consumers in B will only have the chance to be better off if markets are segmented because otherwise they would have to consume in A to a much higher price. Table 2.5 summarizes the effects for segmented markets.

Generally, we find that in Germany Bertrand prices are lower than Cournot prices for the case of no market segmentation, whereas they are about the same in the case of market segmentation. Concerning the quantity provided in Germany, it is just the other way

⁴³See Figures E.7 and E.8 in Appendix E.

⁴⁴Which is also the reason for the higher price in A because the firms are selling a lower quantity as in the case of segmented markets.

around.

In Poland the picture is clearer. The supply is higher in the Cournot case whereas the price is higher in the Bertrand case. Thus, Cournot competition is more desirable in Poland's view.

2.3.4 Welfare aspects

What are the implications of the opening for welfare? In order to analyze this question we need to calculate the change in producer surplus at first, which is nothing else than the aggregated change in the domestic (or foreign) firms' profits minus the fixed costs. Then, the consumer surplus in the domestic (foreign) country has to be calculated. In our case of Germany and Poland we saw that for Bertrand competition with reasonable values for the ratio of the costs the firms from A will be worse off after the opening whereas firms from B are better off. However, as Table 2.3 illustrates, the consumer

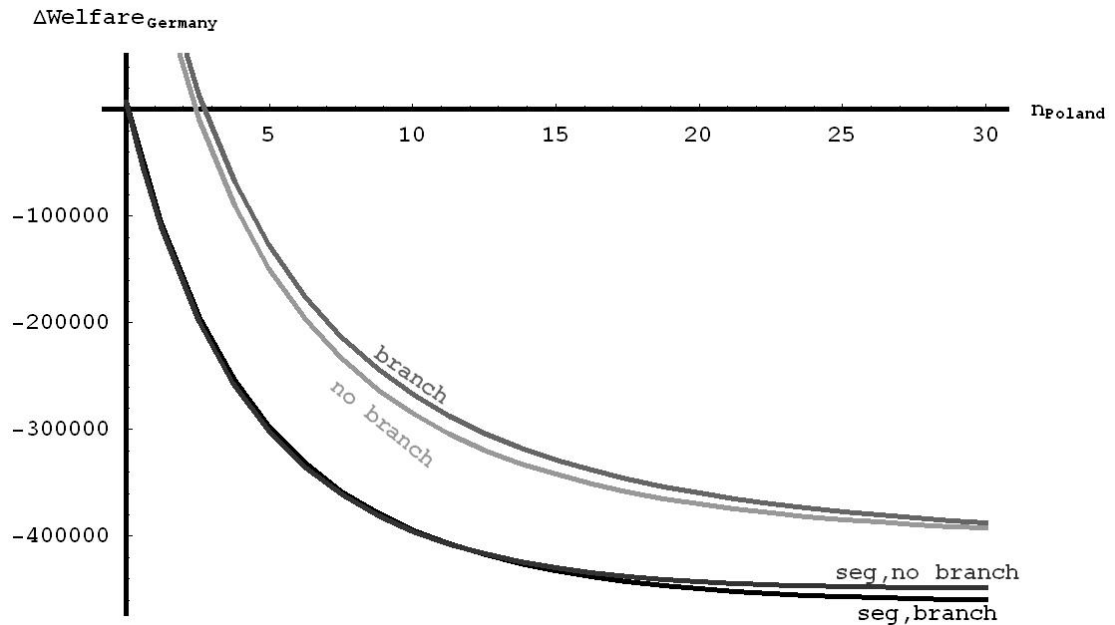


Figure 2.7: Bertrand competition: Welfare differences in Germany against n_{Poland} in segmented (*seg*) and integrated markets supplying either temporarily (*no branch*) or permanently (*branch*) with $n_{Germany} = 10$

surplus increases in country A and decreases in country B. Using a definition of the change of consumer surplus, which includes the different qualities⁴⁵, we can calculate the

⁴⁵One-Half-Rule: Consumer Surplus Difference = $\frac{1}{2}(\theta_A p_{i=0}^A - \frac{n_A \theta_A p_{i=1}^{AA} + n_B \theta_B p_{i=1}^{AB}}{n_A + n_B}) \cdot (n_A \cdot q_{i=0}^A + n_A \cdot q_{i=1}^{AA} + n_B \cdot q_{i=1}^{AB})$ for Bertrand and $\frac{1}{2}(p_{i=0}^A - p_{i=1}^A) \cdot (n_A \theta_A \cdot q_{i=0}^A + n_A \theta_A \cdot q_{i=1}^{AA} + n_B \theta_B \cdot q_{i=1}^{AB})$ for Cournot.

following welfare differences against the number of firms in Poland displayed in Figure 2.7⁴⁶. Here we see that the overall welfare change in country A will be negative after the opening for all higher numbers of firms from Poland. This implicitly means that the loss in producer surplus outweighs the rise in consumer surplus. If the markets are not segmented the change in welfare will be higher as prices will be lower for all numbers of firms from Poland. Generally, the opening will trigger a loss in welfare for Germany and a boost in welfare for Poland. This is due to the negative change in producer surplus in Germany, which exceeds the positive change in consumer surplus, whereas in Poland it is just the other way around.

But what happens if the second country is not a "Poland" but the rest of the European Union? In Figure 2.8 we see that the welfare difference is positive for Germany up to

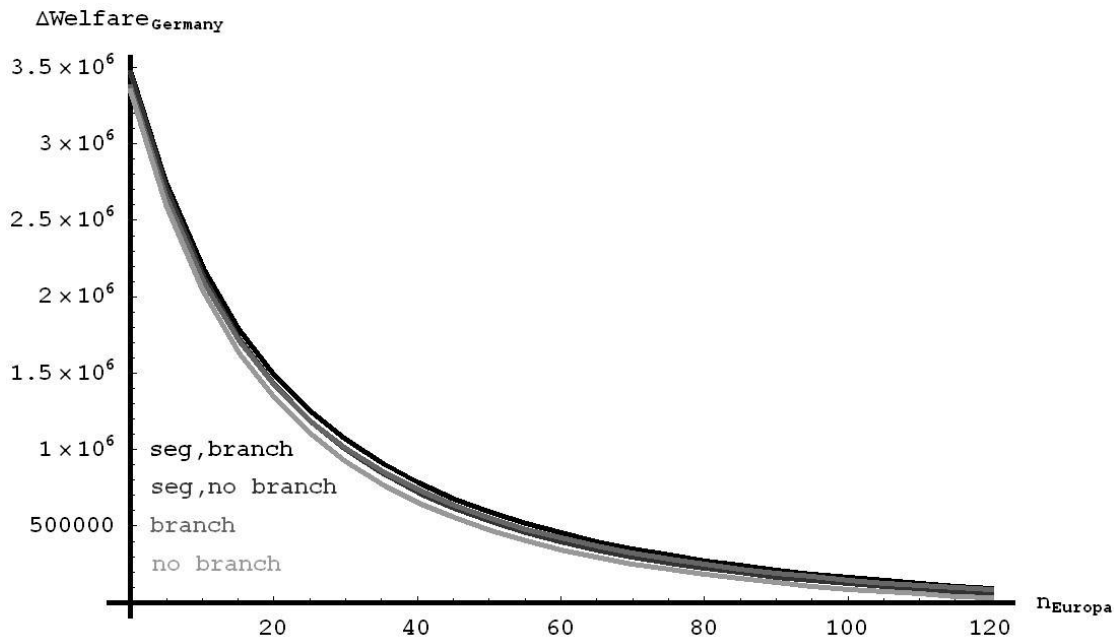


Figure 2.8: Bertrand competition: Welfare differences in Germany against n_{Europe} in segmented (*seg*) and integrated markets supplying either temporarily (*no branch*) or permanently (*branch*) with $n_{Germany} = 30$

a very high number of European firms. This is due to the positive consumer surplus, whereas the firms' profits do not fall as sharply as in the Poland case due to the size of the European Union (without Germany, Bulgaria and Romania). Thus, for Bertrand

See Oxenstierna (1998) [50].

⁴⁶The welfare change in Poland against the number of Polish firms is shown for the Bertrand case in Figure E.9 in Appendix E.

2 The EU directive on services and its immediate effects

competition the opening of the European service market yields a positive welfare effect for Germany. However, this is a static view and therefore incomplete. For instance, it does not incorporate a possible long-term change in market structure or the possibility of a firm to completely relocate its branch to the foreign country.

Evaluating the welfare difference in the Cournot case we end up with Figure 2.9⁴⁷. Here, we have a different picture. Although the welfare differences are negative as in

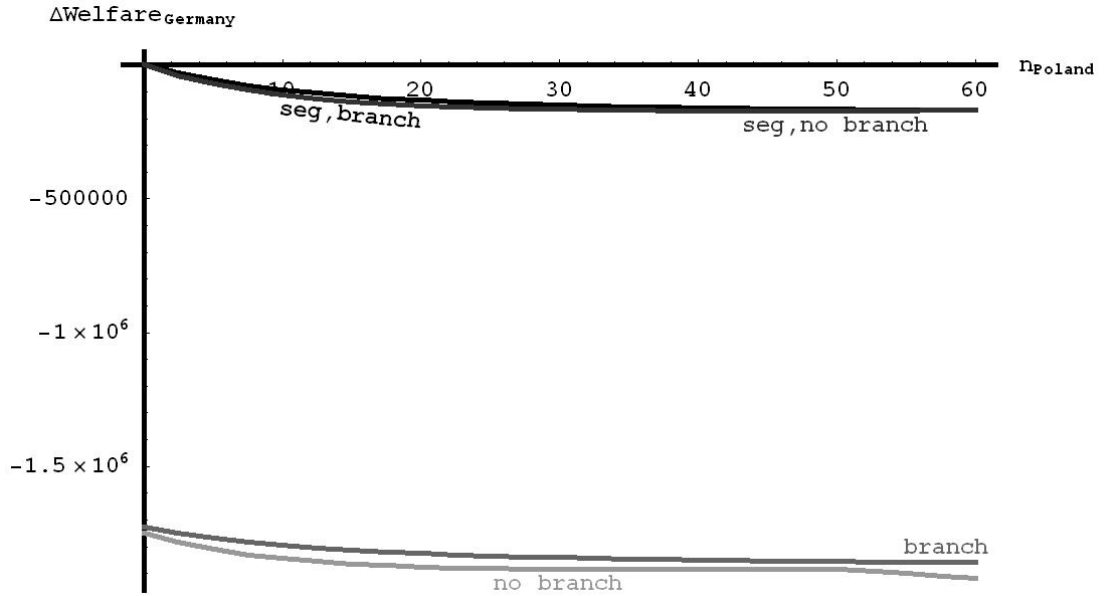


Figure 2.9: Cournot competition: Welfare differences in Germany against n_{Poland} in segmented (*seg*) and integrated markets supplying either temporarily (*no branch*) or permanently (*branch*) with $n_{\text{Germany}} = 10$

the Bertrand case, in a Cournot environment the welfare effect for segmented markets will be higher than for integrated markets. This is at first glance counterintuitive as it decreases consumer surplus. But as we have seen before, in the case of countries like Germany and Poland, firms from both countries will stop supplying Poland if markets are not segmented. Therefore, the calculated welfare effects for integrated markets should not be taken too seriously⁴⁸. In any case, the welfare difference for Germany (Poland) is negative (positive) also under Cournot competition.

⁴⁷The welfare change in Poland against the number of Polish firms is shown for the Cournot case in Figure E.10 in Appendix E.

⁴⁸Taking two similar countries, where a supply stop does not happen, leads to the results that the change in welfare for integrated markets are again above the segmented ones like in the Bertrand case.

If country B is set to be the rest of the European Union, however, we have a positive welfare effect for Germany⁴⁹ like in the Bertrand case.

Therefore, we can conclude that the opening of the whole European service market yields a positive welfare effect for Germany at least in the short-run. This result holds independently of the kind of competition. However, continued restraint on wage increases as it was the case in the past few years would improve Germany's position even further - especially as European countries like Poland have experienced a boost in wages over the past few years.

The evolution of the market structure due to the possible exit of domestic firms and its effect on welfare, however, are not investigated here. This might lead to a negative effect in the long-run. Such an analysis should be the focus of future research.

2.4 Conclusion

In this chapter, we investigated the economic effects, which the directive on services of the European Commission may have on the domestic (labor-intensive) service market of a country. The underlying model featured two countries A and B which in $t = 0$ were effectively closed to each others' service firms. The costs and quality of the services were assumed to be higher in country A than in country B. In $t = 1$ the directive came into force and the markets opened. We analyzed how the situation for both A- and B-firms changed depending on how they entered the market - temporarily or permanently - and how general welfare was affected. under both price and quantity competition.

Depending on the basic characteristics of the two countries and the representative service it is possible for A-firms in Bertrand competition to experience a positive change in profits from the opening if the relation of costs between B-firms and them exceeds a certain threshold. Equivalently⁵⁰, the profit difference is also positive, if the quality is not exogenously set and the ratio of the quality exceeds a specific threshold. Thus, if both can be manipulated, firms from A will try to achieve much lower cost or much higher quality in order to avoid a possible erosion of their profits. B-firms, on the contrary, have no incentive to further lower their costs or improve their quality due to their initial cost advantage. This supports the results of the study carried out 2005 by the German Research Institute for Public Administration in Speyer[8], which predicts a split of the European service market in a high- and a low-quality market due to the directive

⁴⁹See Figure E.11 in Appendix E.

⁵⁰See Section 2.2.4.

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on services.

Concerning the different regulations in the directive about temporary and permanent supply of our representative services we could show that firms from the low-cost country will prefer to be temporary suppliers whereas the firms from the high-quality country will prefer to build branches in B in order to become permanent suppliers and profit from the lower unit costs. This outcome is independent of the kind of competition and holds if $c_A > \delta_{BACB}$ and $c_B < \delta_{ABCA}$ ⁵¹. The theory also suggested that at a certain market size of country B the opening yields a positive change in profit for firms from A independently of the cost ratio of the two countries. This market size threshold increases strongly with the number of firms in B.

On these grounds we could argue that an opening of the service market would bear a positive welfare effect for Germany, if country B is set to be the rest of the European Union - independent of the kind of competition or the kind of supply of the firms. Even if that meant that the number of firms were rather high, it would probably still bear a positive change in welfare for Germany as on the one hand the consumer surplus would rise and on the other hand not all firms from B - the EU - would probably enter the German market as this might reduce their profits⁵². Thus, our analysis supports the view that the directive on services by the European Commission yields a positive effect for Germany.

However, these findings might only hold in the short run. As our analysis was static in the sense that it did not investigate time steps after the opening we cannot analyze how market structure in the domestic and foreign country will evolve in the long run. If, for instance, A-firms have to leave the market because their relative costs are too high, country A will experience a loss in welfare. The same effect would occur if A-firms built branches in B and closed theirs in A in order to supply A only temporarily. The quality differences might also diminish over time, if firms from B are able to adapt themselves to offer higher quality. Introducing further dynamics into the model is therefore a very reasonable task. This problem will be the topic of further research which will also feature a more detailed investigation of the welfare effects including the possibilities of taxation

⁵¹Therefore, the transportation or transaction cost factor δ_{BA} of the specific service needs to be not too high or δ_{AB} needs to be not too low, respectively.

⁵²As stated in Section 2.2.2.1 entry deterrence of a representative B-firm will happen if $F_A + R_A > \frac{q_{A,B}^2}{\beta \theta_B}$ for permanent supply of services or $F_B > \frac{q_{A,B}^2}{\beta \theta_B}$ in the case of temporary supply of services.

by the government.

Our findings are also based upon the characteristics of a specific service. Therefore, they will not hold for services with different transaction costs, for instance. Other simplifications in our model are of course the assumptions of complete information and constant unit costs, which can be relaxed but which will probably not lead to significantly different results.

The key insights of our investigation can be used in further steps of the analysis of the effects of the directive on services: We have shown that A-firms will at first⁵³ rather build branches whereas B-firms' dominant strategy is to be temporary suppliers. We could also conclude that the opening will probably lead to greater differences in costs or quality.

⁵³If a complete relocation of branch in A is not an option.

3 The EU directive on services' long term implications

In this paper we analyze the EU service directive's long term implications for a country in terms of market structure and total welfare. Our model features two countries - domestic and foreign - whose firms supply their services with different qualities and costs. Both Cournot and Bertrand competition in a labor-intensive service market are analyzed. By choosing where to locate their branch(es) the firms decide how they are supplying - temporarily or permanently - each country. Their decision is based on the wages paid in each country as determined by demand for labor which in turn depends on the number of branches in that country. We also consider taxation, which can be shown to change the direction as compared to existing research.

Assuming a Germany and the rest of the European Union as the two countries we derive a long-run equilibrium, in which the German firms earn profits almost as high as before the opening, wages are much lower than before the opening, and the welfare effect is almost negligible. However, in the shorter run Germany goes through a slump in welfare due to low government and producer surplus. This implies for economic policy to make wages more flexible in order to reduce the negative effects in the short run.

3.1 Long-term changes through the EU directive on services

After having investigated the implications of the directive, we are left with a few questions, which we already mentioned in the previous Section 2.4. The next chapter will address most of these issues and offer a dynamic model which features wage changes in

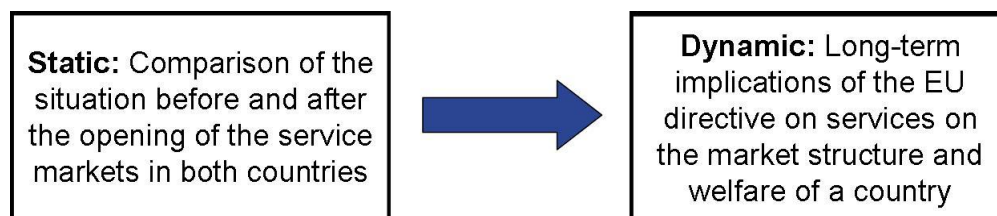


Figure 3.1: Transition from a static to a dynamic view

both countries. A change in provided quality of the services will not be part of the model, as this is an effect which has to be considered only in the very long-run.

The basic difference in the following investigation compared to our analysis of the directive in the previous chapter is that firms are now able to totally relocate themselves including closing their domestic branch and opening one in the other country¹. Thereby, they would supply their home country only temporarily. Additionally, they would not need employees in their home country anymore. This would lead to lower demand for labor in that country which in turn would put pressure on the wages of the employees. This indirect effect of relocating the branch is complementary to the flow of firms because in our model, the wages in both countries are the main indicators for the firms where they should open a branch².

Another factor which depends on the number of branches in the country is the tax income of the government. Therefore, we will also introduce taxation on profits and sales.

In order to be able to calculate all these partly contradictory effects, we built a dynamic, iterative model which we will introduce in the following chapter. It calculates in each time step where firms will locate and how this changes the demand for labor and the corresponding wages. We will see that this leads to other findings than before and to interesting political recommendations.

¹We did not consider this in the previous chapter because we only looked at two periods - before and after the opening. And it is not realistic that firms will move completely to the other country right after the opening due to ties with their domestic country such as e.g. existing wage agreements.

²This is due to the fact that in a labor-intensive service sector wages are the main part of the arising costs.

3.2 Introduction

3.2.1 General aspects

When the European Commission (EC) launched its ambitious project to harmonize the European service sector through the directive on services [21] it did not anticipate the tremendous public response³. Based on an initial study by the EC [20] the goal of the directive was to remove the barriers which hindered service companies to offer their services in other European countries. The initial draft met harsh criticism by labor unions, social institutions and industry associations⁴, fearing a "race to the bottom" concerning wages and labor standards, although the possibility of each member state to set minimum wages⁵ was not addressed by the directive⁶. Many solutions were proposed⁷ until the European parliament approved a version on the 15th of November 2006 which was worked out in April 2006 by the EC⁸ and approved by the European council in July 2006.

As in previous drafts, the directive distinguishes between temporary and permanent supply of service to another European country. For both types, it focuses on the reduction of regulatory procedures⁹ a service provider has to cope with in order to be allowed to supply its services in the foreign country. This simplification of the licensing of foreign service firms and the general existence of a directive mean a big improvement for the firms as the fear of judicial problems was one of the main reasons of their reluctance of offering services in other European countries [20]. The key note of the directive is the "country of destination"-principle. It states that the firms' conduct in the respective country market, especially for permanent supply of services, should follow the regulations of the country of destination of the service. The "country of origin"-principle, which was the basis of the first draft of the Commission for temporary supply of service and which caused the rejection of the directive by many stakeholders, has been mostly abandoned¹⁰.

³A recapitulation of the process is given e.g. in the European Employment Review [27], by the Economist Intelligence Unit [25] or in the European Industrial Relations Review [28], whereas an overview over the juridical implications is given in Korte [45].

⁴For an example refer to the International Fire and Security News [36].

⁵Through the law concerning the posting of employees abroad.

⁶Although the efficiency of minimum wages or its equivalents is a highly disputed question (see e.g. Funk and Lesch [29]). In our analysis we will have to use a "minimum wage" in order to calculate the labor supply curve (see Section 3.3.2).

⁷See e.g. the editorial comment in [26].

⁸In February 2006, the European parliament had only accepted the directive with modifications and passed it back to the EC.

⁹The installation of an electronic system and a centralized contact for all formalities concerning authorization are the tools to derive this goal.

¹⁰For a summary which elements of both principles finally got into the directive: see Korte [43].

3 The EU directive on services' long term implications

The directive governs all kinds of services besides specific sectors which were harmonized before or where commercial interests fall behind political or social interests [22].

Although the directive has received high attention in the media and in political circles, its economic implications have not been discussed thoroughly in the economic literature yet (see Section 3.2.2). The goal of this paper is to fill this gap and contribute to the academic discussion by analyzing the long-term implications of the directive for a country's service market and welfare. From our theoretical analysis we will derive some recommendations for economic policy how to benefit from the directive.

3.2.2 Existing literature

Although there is an established literature on both competition in services and the EU directive on services, none has yet fully investigated the implications of the directive¹¹. One strand of research about service markets concentrates on the financial sector. The focus is, among other things, on market power¹², market efficiency (Casu and Girardone [13]), and financial stability¹³. Due to the deregulation of the financial services sector in the EU and the effects of the Economic and Monetary Union competition has increased especially among international banks, sparking off consolidation in the sector. Studies have looked at the competitiveness of banks¹⁴, including the costs of branching (Cerasi et al. [14]), and strategic investments in banking services¹⁵, among other things. However, this research is of little use for our case of competition in labor-intensive service markets¹⁶.

The directive on services has been a major topic of research in law¹⁷. The economic implications, however, are evidently not considered in this context.

The study of Hupkes and Maks [35] comes close to an economic analysis but they focus more on the differences in market regulation in both countries. Their finding of sub-optimal market functioning in both countries might be viewed as an argument for the launch of the directive on services in order to increase competition in both countries¹⁸.

¹¹A static analysis of the effects of the directive has been carried out by Kirchheim and Weigand [38].

¹²See e.g. de Guevara et al. [32].

¹³See e.g. Allen and Gale [3].

¹⁴See e.g. Claessens and Laeven [18].

¹⁵The possibility to limit competition in the banking market ("arm's length financial markets") through investments in bank-firm relationships is analyzed in Yafeh and Yosha [64].

¹⁶The financial sector is also due to its peculiarity not covered by the directive on services.

¹⁷For instance, the overlap of the directive with §49 f. EG (the free rendering of services) is discussed in Korte [44].

¹⁸Another interesting analysis in this field is the investigation of Castelli and Leporelli [12] concerning the implications of different national regulations on global service industries like e.g. the telecommu-

An interesting model for services like medical, legal or other "repair" services¹⁹ and its implications has been offered by Wolinsky [63]. As it is not transferable to other services it could not serve as the basis for our investigation.

The international trade literature offers various theoretical insights, which come relatively near to our analysis or parts of it. For example Munch [49] investigates firms' locational choices in a two-country model with different degrees of unionized labor markets. Lahiri and Ono [47] study oligopoly pricing and the effects on welfare in a two-country Heckscher-Ohlin trade model. Venables [60] models international trade as a two-stage game between firms in two countries and distinguishes also between segmented and integrated markets²⁰. However, their findings cannot be transferred in order to understand the implications of the service directive.

3.2.3 Main focus of the analysis

This paper focuses on the long-term effects of the EU Directive on Services on a country's service industry. We use a two-country model, in which service firms from one country (A) offer high-quality services but face initially high costs in A, whereas the service firms from the other country (B) have initially lower costs and lower quality²¹. The quality standard of their services is set and cannot be changed, as we assume that the quality depends on the experience of the firm (or its leading employees who will always stay with their company) and not on its location or the cost of the service. This assumption is not too rigorous as the quality of a service depends highly on the training of the leading employees, which is in turn country-specific and unchangeable. The executive management determines quality and standards of reaching this quality. They pass it on to the employees who eventually carry out the service. Thus, a firm keeps its quality independent of the location of their branch and their costs. This is a specific feature of the service industry.

When the directive becomes effective these firms compete either over price or the volume of services in both countries. We will also distinguish between perfectly segmented markets and integrated markets. Generally, we will concentrate on Bertrand competition, as price competition is widespread among service firms.

nication industry.

¹⁹They all have in common that the seller of this service is at the same time the expert who determines how much of the service is needed.

²⁰Other research in international economics focused mainly on optimal tariffs (See e.g. Cheng [15]) or taxation (See e.g. Schulze and Koch [53]).

²¹Firms from A and B offer the same kind of labor-intensive service and are competitors.

3 The EU directive on services' long term implications

After the opening the firms have three options. They can either keep the only branch in their home country, open a branch in the foreign country, as well, or relocate their branch to the foreign country. Their decision will be based on the costs in each country, which are in labor-intensive service markets more or less the wages they have to pay for their employees. These wages in turn depend on the demand for labor in that country which is proportional to the amount of services supplied from that country. Thus, we have an iteration process in which the number of branches in each country, the amount of services supplied from the country and the wages change each time step.

By using country-specific data from Germany, Poland and the rest of the EU we can calculate the implications of the directive for these countries concerning market structure and total surplus. Naturally, our own best interest lies especially in the implications for the high-quality, high-cost country Germany.

3.2.4 Outline

The paper is organized as follows. Section 3.3 introduces the theoretical basis of our analysis. The section is divided into four subsections. In Section 3.4 we will compare the theoretical results, discuss the implications of the directive on the European service market and its effect on the total surplus in the short and long-run. Section 3.5 concludes by discussing the assumptions underlying our analysis.

3.3 Theory

3.3.1 General assumptions

We assume that there are only two countries: country A, in which n_A firms supply their services with quality $0 < \theta_A \leq 1$ and cost c_A , and country B with n_B firms with quality $0 < \theta_B \leq 1$ and cost c_B . The quality in each country is set as $\theta_A < \theta_B$, meaning that the quality of firms in A is always better than the quality of firms in B, because it depends on the training of the leading employees and is therefore country-specific and unchangeable. The unit costs/wages are set to be higher in A than in B ($c_A > c_B$) and are also country-specific due to local collective wage agreements. Thus, a firm, which opens a branch in the foreign country, has to pay the foreign wages.

To keep things simple, we assume that each firm i only supplies one kind of service and that their information about them and their competitors is perfect. They face a cost function with constant unit costs, which are raised if they offer their service in the foreign country without having a branch there. These transaction costs are represented by the constant factors $\delta_{AB} > 0$ ²² and $\delta_{BA} > 0$ ²³. Due to the "country of destination" principle of the directive, which is now effective, we will assume that $\delta_{AB} < \delta_{BA}$ ²⁴. A key difference between the goods and the service industry is the inseparability of the "production" of a service. We are thus able to make this clear distinction between temporary and permanent supply of service²⁵. We will ignore fixed costs and the costs which arise by moving or building a branch in one country.

The government can levy taxes on the firms. We assume that the producer surplus (or the profits of the firms) flows back to the country of their origin, i.e. the owners of firms are located in the respective home country of the firms. We further assume that the firm's decision where to maintain a branch will be based on the relevant unit costs of the country and not its respective taxes.

Finally, we assume that the firms are direct competitors in our representative service market and that there are no switching costs for consumers by changing the service firm.

²²Service has to be transported from country A to B.

²³Service has to be transported from country B to A.

²⁴Which means that a firm from country B faces higher problems in A than a firm from A in B, e.g. due to more complicated working standards in A.

²⁵I.e. the distinction between building a branch or not.

3.3.2 Basic model

Our basic model derives equilibrium quantities and prices for Bertrand and Cournot competition in segmented and integrated markets. The equilibrium relationships define the fundamental state of the market. At the firm level the equilibrium relationships only differ on the cost side as we assumed equal qualities within both groups of firms. We then let the firms decide in certain periods - details are given below - where to locate their branch(es). The choice of location thus determines what costs they are facing and how they supply the two markets. By choosing the location of their branch(es) they implicitly decide which countries' workforce is mainly used. The more services they want to supply from a certain country the more employees they need in that country. This will increase labor demand and raise wages (at given labor supply). However, by introducing friction, we will restrain the flexibility of wages and thereby slow down the relocation of the firms. This friction is in reality observed for instance due to the existence of labor unions and employers' associations.

There are two possible points of departure for the firms' decision where to locate their branch(es). On the one hand, they can decide on the grounds of higher profits, meaning that they compare profits across different locations. Then the fixed costs would also play a role. On the other hand, they may only consider at the relevant unit costs and locate where they are the lowest. This might be more reasonable, as they are easier to observe (they are more or less the wage of a service employee) and in most cases aligned to the fixed costs in the sense that lower wages in a country mostly also imply lower general costs. Besides, by moving or building a branch firms face sunk costs, which we do not explicitly consider here, but which create a barrier to mobility so that firms only move if they expect lower costs for a longer period of time. Thus, it makes sense to consider unit costs as the critical factor for changing location. Hence, the unit costs were implemented as the ground of the decision into our calculations:

Condition 1: If $c_{i,t}^A < \delta_{BA} c_{i,t}^B$ firm i chooses to have a branch in country A at period t .

Condition 2: If $c_{i,t}^B < \delta_{AB} c_{i,t}^A$ firm i chooses to have a branch in country B at period t .

These conditions share the idea that if domestic unit costs times transaction costs²⁶ are higher than the unit costs in the foreign country, it will yield higher profits for firm i over time to build a branch in the foreign country. In our model, these costs are split into a main part C_t which is determined through general wage negotiation (see below) and a firm-specific, random part, which reflects the fact that some firms have lower costs than

²⁶Which incur with temporary supply to the foreign country.

others:

$$c_{i,t}^{A(B)} = C_t^{A(B)}(1 + 1/2 \cdot v_i) \quad (3.1)$$

where $v_i \in [0, 1]$ is an independent and identically distributed variable.

In order to track the decisions of the firms we introduce a state function $g_{i,t}$, which records the location of the branches over time:

$$g_{i,t} = \begin{cases} \{1, \pi, 0\} & \text{if firm } i \text{ from A only has a branch in country A in period } t \\ \{1, \pi, \pi\} & \text{if firm } i \text{ from A has a branch in country A and B in period } t \\ \{1, 0, \pi\} & \text{if firm } i \text{ from A only has a branch in country B in period } t \end{cases} \quad (3.2)$$

$$g_{i,t} = \begin{cases} \{0, \pi, 0\} & \text{if firm } i \text{ from B only has a branch in country A in period } t \\ \{0, \pi, \pi\} & \text{if firm } i \text{ from B has a branch in country A and B in period } t \\ \{0, 0, \pi\} & \text{if firm } i \text{ from B only has a branch in country B in period } t \end{cases} \quad (3.3)$$

At $t = 0$ we start with the initial situation that for all firms from A $g_i = \{1, \pi, 0\}$, whereas for all firms from B $g_i = \{0, 0, \pi\}$, i.e., firms start competing with branches only in their respective home countries.

Our model already inherits a dynamic aspect, because the wages paid in each country depend on the amount of services which are supplied out of this country. By assumption, the wage of an employee equals the unit costs, the unit costs itself depend on the total amount of services from the country, which itself depends on how many branches are located in that country. Thus, if one firm relocates its branch it will change the costs in both countries.

Concerning the change in wages or general costs C_t^A and C_t^B of the two countries, we make use of a simple model of labor supply. Figure 3.2 displays the basic assumption that the change in wages with respect to the amount of services is set to be equal in country A and B. In other words, the general preference functions of employees in both countries have the same slope and are simply shifted due to the different costs of living in A or B. In our further calculations we use the same values as in paper 1 and set y^A (the minimal wage) to be equal to the average amount the government in Germany assigns to an unemployed worker²⁷. Thus, we are able to calculate the slope of the two labor supply curves and their point of intersection with the wage-axis. If we set the slope of the curves to be b and label the intersections of the curves with the wage-axis y^A and y^B

²⁷The government assignment in Germany is effectively a "minimum wage". Employees will not work below this level. Concerning the values refer to appendix F.

3 The EU directive on services' long term implications

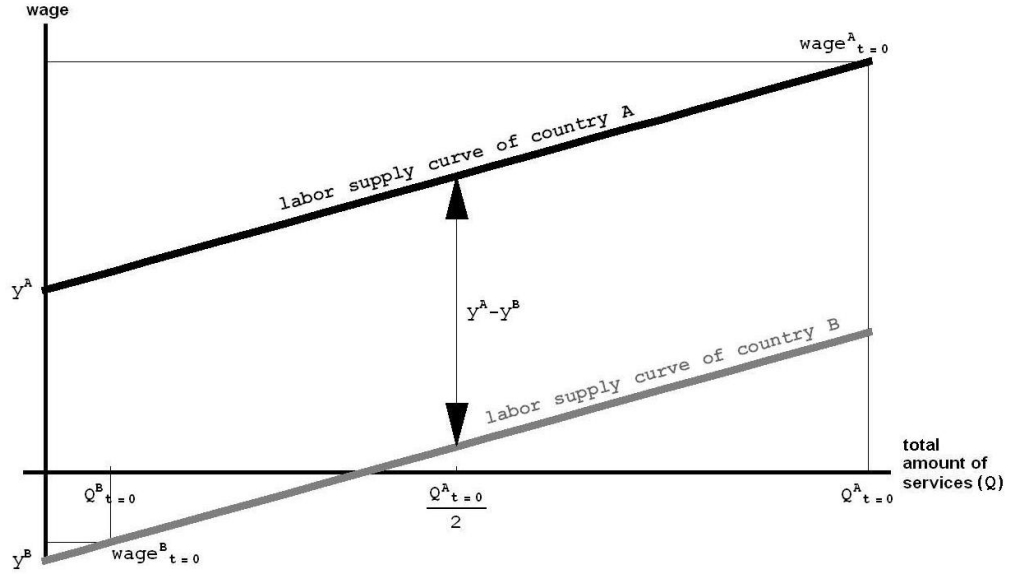


Figure 3.2: Sketch of the labor supply curves of countries A and B

we can derive the labor supply curves of both countries:

$$C_{t=0}^A = w_{t=0}^A = y^A + b \cdot Q_{t=0}^A$$

$$C_{t=0}^B = w_{t=0}^B = y^B + b \cdot Q_{t=0}^B$$

$$\Leftrightarrow b = \frac{w_{t=0}^A - y^A}{Q_{t=0}^A} \quad (3.4)$$

$$\Leftrightarrow y^B = w_{t=0}^B - (w_{t=0}^A - y^A) \frac{Q_{t=0}^B}{Q_{t=0}^A} \quad (3.5)$$

$$w_t^A = \frac{w_{t=0}^A + y^A(Q_{t=0}^A - Q_t^A)}{Q_{t=0}^A} \quad (3.6)$$

$$w_t^B = \frac{w_{t=0}^B - (y^A - w_{t=0}^A)(Q_{t=0}^B - Q_t^B)}{Q_{t=0}^A} \quad (3.7)$$

where $w_{t=0}^{A,B}$ and y^A are given²⁸ and $Q_{t=0}^{A,B} = n_{A,B} \cdot q_{t=0}^{A,B}$ with $q_{t=0}^{A,B}$ from (3.10) or (3.34), respectively.

However, as the flexibility of the wages is restricted, $C_t^A \neq w_t^A$ for most t . In reality, wages do not move as freely as suggested by the neoclassical theory and the wage supply curve. One reason for these frictions is, of course, collective bargaining Labor Unions

²⁸See Appendix F.

and employer associations. In our model, there is collective bargaining in each period and wages are adjusted depending on the actual position of the labor supply curve. Wages are changed in discrete steps. These steps are determined through the distance between actual wage and the wage implied by the labor supply curve times the wage coefficients λ_L and λ_H , which reflect the wage flexibility to either decrease or increase wages, respectively. C_t^A and C_t^B are therefore determined as follows:

$$C_{t+1}^A = \begin{cases} C_t^A - \lambda_L^A(C_t^A - w_t^A) & \text{if } C_t^A > w_t^A \\ C_t^A + \lambda_H^A(w_t^A - C_t^A) & \text{if } C_t^A < w_t^A \end{cases} \quad (3.8)$$

$$C_{t+1}^B = \begin{cases} C_t^B - \lambda_L^B(C_t^B - w_t^B) & \text{if } C_t^B > w_t^B \\ C_t^B + \lambda_H^B(w_t^B - C_t^B) & \text{if } C_t^B < w_t^B \end{cases} \quad (3.9)$$

λ_L^A is assumed to be lower than λ_H^A as it is easier to raise wages than to cut them due to labor unions and the public opinion, which might be even more important to a service firm. For most calculations²⁹ we assume that $\lambda_L^A = \lambda_L^B$ and $\lambda_H^A = \lambda_H^B$.

With every time step t the environment of the firms changes. Using Mathematica [48] we programmed a code³⁰, which calculates the market state for each time step. Thereby, the program checks at each time step whether the unit costs in both countries differ in a way that it is profitable for some firms to switch branch location. However, in order to implement the typical time lag of these decisions not every firm is able to make a decision in the respective period. The firms which are able to decide on their location are chosen randomly each period. The decision is given by functions (3.2) and (3.3).

In the next step the program calculates how many services originate from each of the two countries. These figures imply the number of employees needed from that country and determine the wage via the labor supply curve (3.6) and (3.7). With (3.8) and (3.9) the costs of the firms in the next period are calculated. With these new costs/wages the program goes on to the next time step and repeats its process until a previously defined maximum number of periods t_{max} is reached.

In our analysis we also introduce a tax imposing government, which levies taxes on both sales and profits. The tax rates remain fixed over the given time horizon, as we do not want to investigate the effects of taxation here. However, this is an interesting subject for further research.

We will first determine the market equilibrium under Bertrand competition (subsection

²⁹If not stated otherwise.

³⁰See Appendix G.

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3.3.3), then under Cournot competition (subsection 3.3.4) and finally compare them (subsection 3.4.3).

3.3.3 Bertrand competition

In order to calculate labor supply as given by (3.6) and (3.7) we start from the situation before the opening. For country A (B) we have in period $t=0$:

$$q_{i,t=0}^{A(B)} = \alpha^{A(B)} - \beta\theta^{A(B)}(1 + \tau_{A(B)})p_{i,t=0}^{A(B)} + \frac{\beta(1 + \tau_{A(B)})}{n_{A(B)}} \cdot \sum_{j \neq i}^{n_{A(B)}} \theta^{A(B)} p_{j,t=0}^{A(B)}$$

$$\pi_{i,t=0}^{A(B)} = (1 - r_{A(B)}) \left(p_{i,t=0}^{A(B)} - c_{i,t=0}^{A(B)} \right) q_{i,t=0}^{A(B)}$$

where $\alpha^{A(B)}$ is the market size for a firm in A or B, $\theta_{A(B)}$ is the designated quality of firms from A or B, $\tau_{A(B)}$ is the sales tax rate and $r_{A(B)}$ is the tax rate on profits. β served as a scaling variable, which is set to be equal to one for all of our calculations (See Appendix F).

Quantity, price and profit of a representative firm in country A are then given by the following equations:

$$q_{i,t=0}^A = \frac{K_A}{n_A + 1} + \frac{\beta(1 + \tau_A)\theta_A(n_A \sum_{j=1}^{n_A} c_j^A - (n_A + 1)^2 c_i^A)}{(2n_A + 1)(n_A + 1)} \quad (3.10)$$

$$p_{i,t=0}^A = \frac{(2n_A + 1)K_A + n_A\beta(1 + \tau_A)\theta_A(\sum_{j=1}^{n_A} c_j^A + (n_A + 1)c_i^A)}{\beta(1 + \tau_A)\theta_A(2n_A + 1)(n_A + 1)} \quad (3.11)$$

$$\pi_{i,t=0}^A = (1 - r_A) \frac{(q_{i,t=0}^A)^2}{\beta(1 + \tau_A)\theta_A} \quad (3.12)$$

We define $K_{A(B)} = \sum_{j=1}^{n_{A(B)}} \alpha^{A(B)}$ as the total market size of country A (B), which is assumed to remain unchanged, irrespective of the market opening.

We will analyze the two cases of market segmentation and market integration. First, we examine perfectly segmented markets.

3.3.3.1 Segmented markets

The demand functions in country A (B) for firms from (A,B) are:

$$q_{i,t}^{A(B),(A,B)} = \alpha^{A(B)} - \beta(1 + \tau_{A(B)})\theta^{(A,B)}p_{i,t}^{A(B),(A,B)} + \frac{\beta(1 + \tau_{A(B)})}{n_A + n_B} \cdot \left(\sum_{\substack{j=1 \\ j \neq i}}^{n_A} \theta^A p_{j,t}^{A(B),A} + \sum_{\substack{j=n_A+1 \\ j \neq i}}^{n_A+n_B} \theta^B p_{j,t}^{A(B),B} \right)$$

The indices i and t denote individual firms ($i=1, \dots, n$) and time periods ($t=0, \dots, T$), respectively. The profits of firms from A and B are

$$\begin{aligned} \pi_{i,t}^A &= (1 - r_{A,i,t}) (p_{i,t}^{A,A} - \kappa_{i,t}^A) q_{i,t}^{A,A} + (1 - r_{B,i,t}) (p_{i,t}^{B,A} - \kappa_{i,t}^B) q_{i,t}^{B,A} \\ \pi_{i,t}^B &= (1 - r_{A,i,t}) (p_{i,t}^{A,B} - \kappa_{i,t}^A) q_{i,t}^{A,B} + (1 - r_{B,i,t}) (p_{i,t}^{B,B} - \kappa_{i,t}^B) q_{i,t}^{B,B} \end{aligned}$$

where $r_{A(B),i,t}$ depends on the location of the branches of firm i

$$r_{A,i,t} = \begin{cases} r_B & \text{if firm } i\text{'s only branch is in country B} \\ r_A & \text{otherwise} \end{cases} \quad (3.13)$$

$$r_{B,i,t} = \begin{cases} r_A & \text{if firm } i\text{'s only branch is in country A} \\ r_B & \text{otherwise} \end{cases} \quad (3.14)$$

and $\kappa_{i,t}^{A(B)}$ are the unit costs firm i is facing at time t for supplying service to country A (B):

$$\kappa_{i,t}^A = \begin{cases} c_{i,t}^A & \text{if firm } i \text{ has a branch in country A} \\ \delta_{BA} c_{i,t}^B & \text{otherwise} \end{cases} \quad (3.15)$$

$$\kappa_{i,t}^B = \begin{cases} c_{i,t}^B & \text{if firm } i \text{ has a branch in country B} \\ \delta_{AB} c_{i,t}^A & \text{otherwise} \end{cases} \quad (3.16)$$

Maximizing the firm profits with respect to price we obtain the following quantities and prices:

$$q_{i,t}^{A,A} = \frac{K_A}{n_A + n_B + 1} + \beta(1 + \tau_A) \left(\xi \sum_{j=1}^{n_A+n_B} \theta_j \kappa_{j,t}^A - \frac{(n_A + n_B + 1)\theta_A}{2n_A + 2n_B + 1} \kappa_{i,t}^A \right) \quad (3.17)$$

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$$q_{i,t}^{A,B} = \frac{K_A}{n_A + n_B + 1} + \beta(1 + \tau_A) \left(\xi \sum_{j=1}^{n_A+n_B} \theta_j \kappa_{j,t}^A - \frac{(n_A + n_B + 1)\theta_B}{2n_A + 2n_B + 1} \kappa_{i,t}^A \right) \quad (3.18)$$

$$q_{i,t}^{B,A} = \frac{K_B}{n_A + n_B + 1} + \beta(1 + \tau_B) \left(\xi \sum_{j=1}^{n_A+n_B} \theta_j \kappa_{j,t}^B - \frac{(n_A + n_B + 1)\theta_A}{2n_A + 2n_B + 1} \kappa_{i,t}^B \right) \quad (3.19)$$

$$q_{i,t}^{B,B} = \frac{K_B}{n_A + n_B + 1} + \beta(1 + \tau_B) \left(\xi \sum_{j=1}^{n_A+n_B} \theta_j \kappa_{j,t}^B - \frac{(n_A + n_B + 1)\theta_B}{2n_A + 2n_B + 1} \kappa_{i,t}^B \right) \quad (3.20)$$

$$p_{i,t}^{A,A} = \frac{K_A/(\beta(1 + \tau_A)\theta_A)}{n_A + n_B + 1} + \frac{\xi}{\theta_A} \sum_{j=1}^{n_A+n_B} \theta_j \kappa_{j,t}^A + \xi(n_A + n_B + 1) \kappa_{i,t}^A \quad (3.21)$$

$$p_{i,t}^{A,B} = \frac{K_A/(\beta(1 + \tau_A)\theta_B)}{n_A + n_B + 1} + \frac{\xi}{\theta_B} \sum_{j=1}^{n_A+n_B} \theta_j \kappa_{j,t}^A + \xi(n_A + n_B + 1) \kappa_{i,t}^A \quad (3.22)$$

$$p_{i,t}^{B,A} = \frac{K_B/(\beta(1 + \tau_B)\theta_A)}{n_A + n_B + 1} + \frac{\xi}{\theta_A} \sum_{j=1}^{n_A+n_B} \theta_j \kappa_{j,t}^B + \xi(n_A + n_B + 1) \kappa_{i,t}^B \quad (3.23)$$

$$p_{i,t}^{B,B} = \frac{K_B/(\beta(1 + \tau_B)\theta_B)}{n_A + n_B + 1} + \frac{\xi}{\theta_B} \sum_{j=1}^{n_A+n_B} \theta_j \kappa_{j,t}^B + \xi(n_A + n_B + 1) \kappa_{i,t}^B \quad (3.24)$$

with

$$\xi = \frac{n_A + n_B}{(2n_A + 2n_B + 1)(n_A + n_B + 1)}$$

and

$$\theta_j = \begin{cases} \theta_A & \text{if } j \leq n_A \\ \theta_B & \text{otherwise} \end{cases} \quad (3.25)$$

Thus, the maximized profits are given by

$$\pi_{i,t}^A = \frac{(1 - r_{A,i,t}) \left(q_{i,t}^{A,A} \right)^2 / (1 + \tau_A) + (1 - r_{B,i,t}) \left(q_{i,t}^{B,A} \right)^2 / (1 + \tau_B)}{\beta\theta_A} \quad (3.26)$$

$$\pi_{i,t}^B = \frac{(1 - r_{A,i,t}) \left(q_{i,t}^{A,B} \right)^2 / (1 + \tau_A) + (1 - r_{B,i,t}) \left(q_{i,t}^{B,B} \right)^2 / (1 + \tau_B)}{\beta\theta_B} \quad (3.27)$$

Based on (3.25) to (3.27) we are able to calculate the development of market structure in the two countries over time as sketched in Section 3.3.2. The parameter values we

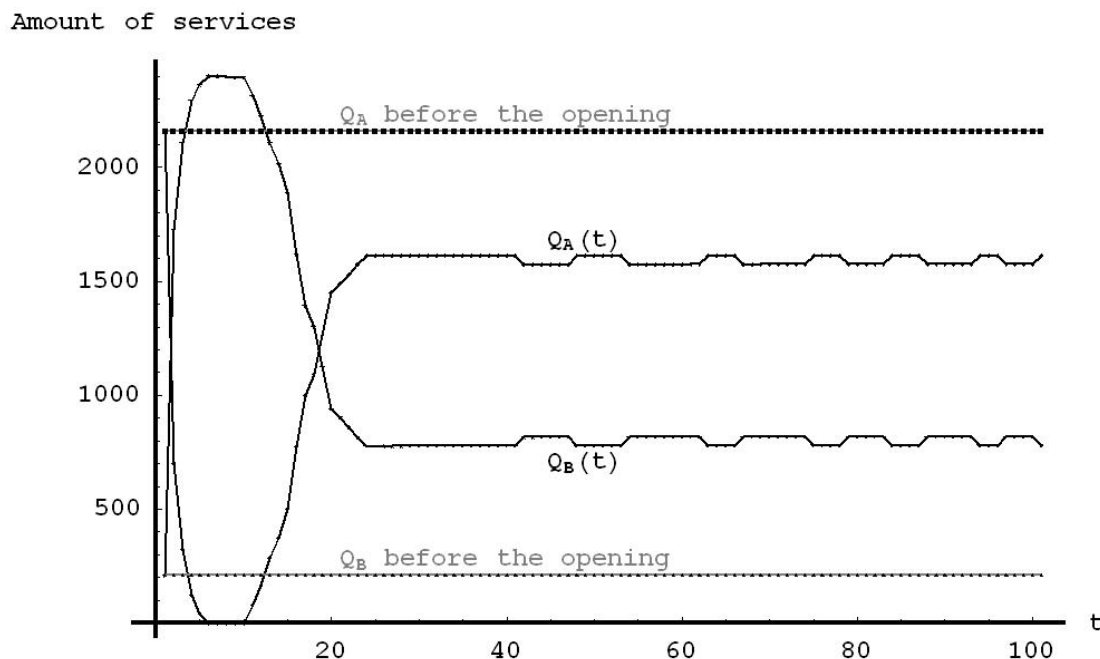


Figure 3.3: The amount of services supplied from Germany (A) and Poland (B) over time in segmented Bertrand markets

have used for calibration are listed in Appendix F³¹. They reflect the two European countries Germany and Poland. In order to keep things simple, we set all tax rates to zero ($\tau = r = 0$) in the beginning. Figure 3.3 shows the change in the amount of services supplied from A and B over time. At first, most firms from A relocate their branch to country B and start supplying country A temporarily. This leads to a sharp drop in the amount of services coming from A (see Figure 3.5), which, in turn, puts pressure on wages in A (see Figure 3.4). They also decrease sharply until it turns profitable for more and more firms to open a branch in A as well in order to supply both countries permanently. Finally, depending on their specific unit costs most firms have branches in both countries whereas some firms only have a branch in B.

The wages in both countries develop according to Figure 3.4, where we have used a larger time horizon in order to show the convergence of actual wages to the wages implied by the labor supply curves. The fluctuations in figures 3.3, 3.4 and 3.5 are due to the fact that there exists one firm which is on its cost side right at the boundary between having a branch in each country ($\{1, \pi, \pi\}$) or just in B ($\{1, 0, \pi\}$). Every little change

³¹They are identical to the ones used in paper 1.

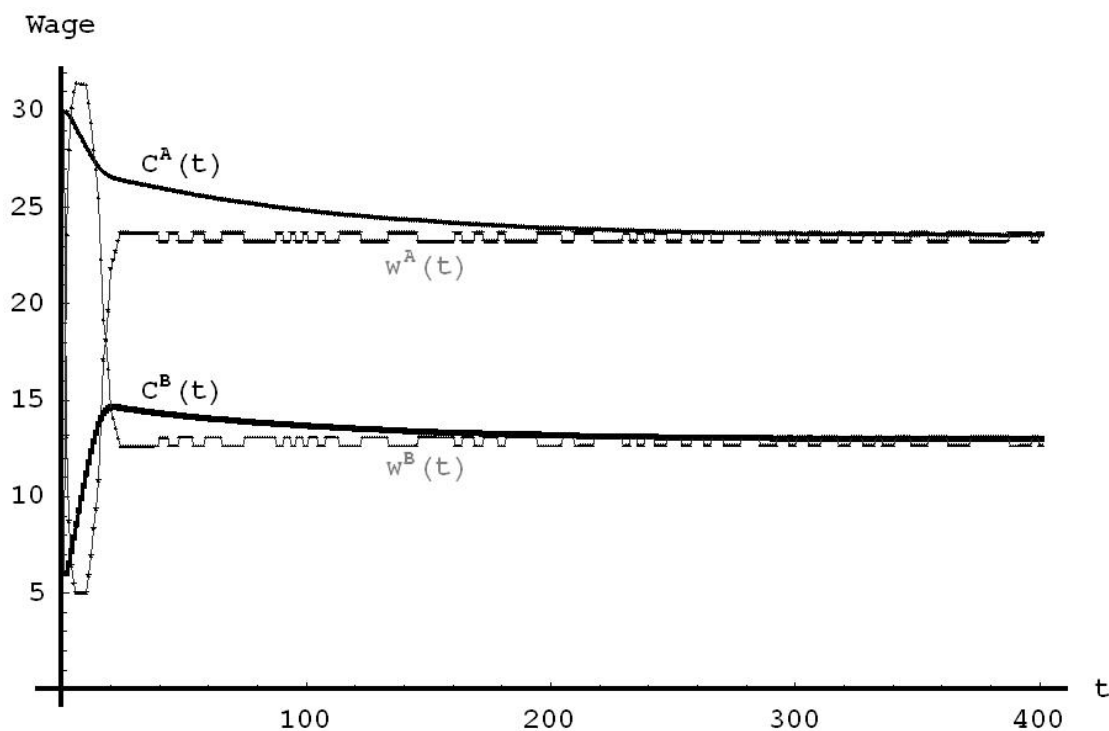


Figure 3.4: The actual wages ($C(t)$) and the wages implied by the labor supply curve ($w(t)$) for Germany (A) and Poland (B) against time

in costs has an impact on its decision and when the firm gets the chance to reallocate its branches it will do so with a high probability.

The implications of these findings are discussed in detail for both countries in Section 3.4. We will now turn to the case of integrated service markets in both countries.

3.3.3.2 Integrated markets

In the case of integrated markets, there are only two types of prices: p^A as the price for A-firm services and p^B as the price for B-firm services. Demand for services is then given by

$$q_{i,t}^{A(B),(A,B)} = \alpha^A - \beta(1 + \tau_{A(B)})\theta^{(A,B)}p_{i,t}^{(A,B)} + \frac{\beta(1 + \tau_{A(B)})}{n_A + n_B} \cdot \left(\sum_{\substack{j=1 \\ j \neq i}}^{n_A} \theta^A p_{j,t}^A + \sum_{\substack{j=n_A+1 \\ j \neq i}}^{n_A+n_B} \theta^B p_{j,t}^B \right)$$

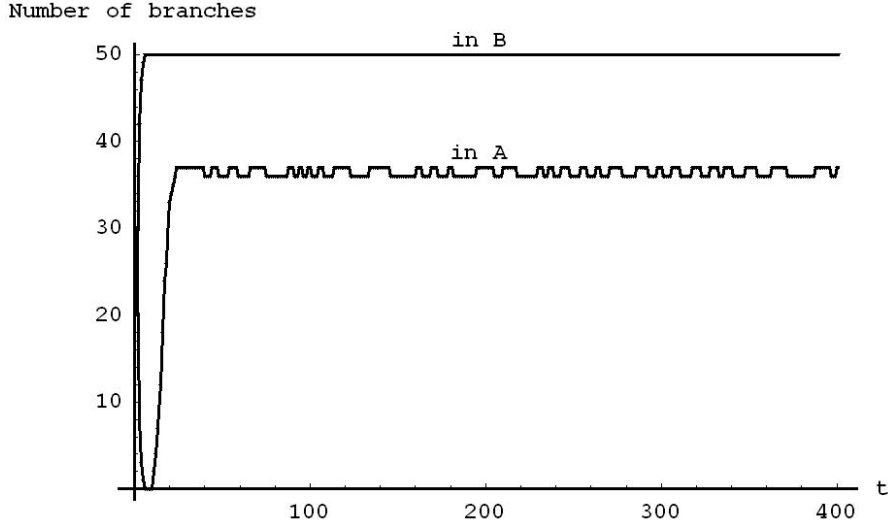


Figure 3.5: The number of branches in Germany (A) and Poland (B) against time in segmented Bertrand markets

The profit functions of firms from A and B are

$$\begin{aligned}\pi_{i,t}^A &= (1 - r_{A,i,t}) (p_{i,t}^A - \kappa_{i,t}^A) q_{i,t}^{A,A} + (1 - r_{B,i,t}) (p_{i,t}^A - \kappa_{i,t}^B) q_{i,t}^{B,A} \\ \pi_{i,t}^B &= (1 - r_{A,i,t}) (p_{i,t}^B - \kappa_{i,t}^A) q_{i,t}^{A,B} + (1 - r_{B,i,t}) (p_{i,t}^B - \kappa_{i,t}^B) q_{i,t}^{B,B}\end{aligned}$$

where $r_{A(B),i,t}$ and $\kappa_{i,t}^{A(B)}$ are defined as in (3.13), (3.14), and (3.15), (3.16). The following profit maximizing quantities and prices result:

$$\begin{aligned}q_{i,t}^{A,A} &= \frac{((n_A + n_B + 1)(1 + \tau_B) + (n_A + n_B)(1 + \tau_A))K_A - (1 + \tau_A)K_B}{(2 + \tau_A + \tau_B)(n_A + n_B + 1)} \\ &+ \frac{\beta\xi}{2 + \tau_A + \tau_B} \sum_{j=1}^{n_A+n_B} \theta_j((1 + \tau_A)\kappa_{j,t}^A + (1 + \tau_B)\kappa_{j,t}^B) \\ &- \frac{\beta\xi(n_B + n_A + 1)^2}{(2 + \tau_A + \tau_B)(n_A + n_B)} \theta_A((1 + \tau_A)\kappa_{i,t}^A + (1 + \tau_B)\kappa_{i,t}^B)\end{aligned}\quad (3.28)$$

$$\begin{aligned}q_{i,t}^{A,B} &= \frac{((n_A + n_B + 1)(1 + \tau_B) + (n_A + n_B)(1 + \tau_A))K_A - (1 + \tau_A)K_B}{(2 + \tau_A + \tau_B)(n_A + n_B + 1)} \\ &+ \frac{\beta\xi}{2 + \tau_A + \tau_B} \sum_{j=1}^{n_A+n_B} \theta_j((1 + \tau_A)\kappa_{j,t}^A + (1 + \tau_B)\kappa_{j,t}^B) \\ &- \frac{\beta\xi(n_B + n_A + 1)^2}{(2 + \tau_A + \tau_B)(n_A + n_B)} \theta_B((1 + \tau_A)\kappa_{i,t}^A + (1 + \tau_B)\kappa_{i,t}^B)\end{aligned}\quad (3.29)$$

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$$\begin{aligned}
q_{i,t}^{B,A} &= \frac{((n_A + n_B + 1)(1 + \tau_A) + (n_A + n_B)(1 + \tau_B))K_B - (1 + \tau_B)K_A}{(2 + \tau_A + \tau_B)(n_A + n_B + 1)} \\
&+ \frac{\beta\xi}{2 + \tau_A + \tau_B} \sum_{j=1}^{n_A+n_B} \theta_j((1 + \tau_A)\kappa_{j,t}^A + (1 + \tau_B)\kappa_{j,t}^B) \\
&- \frac{\beta\xi(n_B + n_A + 1)^2}{(2 + \tau_A + \tau_B)(n_A + n_B)} \theta_A((1 + \tau_A)\kappa_{i,t}^A + (1 + \tau_B)\kappa_{i,t}^B) \quad (3.30)
\end{aligned}$$

$$\begin{aligned}
q_{i,t}^{B,B} &= \frac{((n_A + n_B + 1)(1 + \tau_A) + (n_A + n_B)(1 + \tau_B))K_B - (1 + \tau_B)K_A}{(2 + \tau_A + \tau_B)(n_A + n_B + 1)} \\
&+ \frac{\beta\xi}{2 + \tau_A + \tau_B} \sum_{j=1}^{n_A+n_B} \theta_j((1 + \tau_A)\kappa_{j,t}^A + (1 + \tau_B)\kappa_{j,t}^B) \\
&- \frac{\beta\xi(n_B + n_A + 1)^2}{(2 + \tau_A + \tau_B)(n_A + n_B)} \theta_B((1 + \tau_A)\kappa_{i,t}^A + (1 + \tau_B)\kappa_{i,t}^B) \quad (3.31)
\end{aligned}$$

$$\begin{aligned}
p_{i,t}^A &= \frac{(K_A + K_B)}{(n_A + n_B + 1)\beta(2 + \tau_A + \tau_B)\theta_A} + \frac{\xi(n_A + n_B + 1)}{2 + \tau_A + \tau_B} ((1 + \tau_A)\kappa_{i,t}^A + (1 + \tau_B)\kappa_{i,t}^B) \\
&+ \frac{\xi}{(2 + \tau_A + \tau_B)\theta_A} \sum_{j=1}^{n_A+n_B} \theta_j((1 + \tau_A)\kappa_{j,t}^A + (1 + \tau_B)\kappa_{j,t}^B) \quad (3.32)
\end{aligned}$$

$$\begin{aligned}
p_{i,t}^B &= \frac{(K_A + K_B)}{(n_A + n_B + 1)\beta(2 + \tau_A + \tau_B)\theta_B} + \frac{\xi(n_A + n_B + 1)}{2 + \tau_A + \tau_B} ((1 + \tau_A)\kappa_{i,t}^A + (1 + \tau_B)\kappa_{i,t}^B) \\
&+ \frac{\xi}{(2 + \tau_A + \tau_B)\theta_B} \sum_{j=1}^{n_A+n_B} \theta_j((1 + \tau_A)\kappa_{j,t}^A + (1 + \tau_B)\kappa_{j,t}^B) \quad (3.33)
\end{aligned}$$

The maximized profits are:

$$\begin{aligned}
\pi_{i,t}^A &= \frac{1}{\beta\theta_A} \left(\frac{1 - r_{A,i,t}}{1 + \tau_A} (q_{i,t}^{A,A})^2 + \frac{1 - r_{B,i,t}}{1 + \tau_B} (q_{i,t}^{B,A})^2 \right) \\
\pi_{i,t}^B &= \frac{1}{\beta\theta_B} \left(\frac{1 - r_{A,i,t}}{1 + \tau_A} (q_{i,t}^{A,B})^2 + \frac{1 - r_{B,i,t}}{1 + \tau_B} (q_{i,t}^{B,B})^2 \right)
\end{aligned}$$

Again, if we use the same values as before and neglect taxes we can plot the amount of service from a country, the wages and number of branches. But as they have a similar run as before and because a detailed comparison between the findings of segmented and integrated markets is part of Section 3.4, we will instead look at the validity of conditions 1 and 2 of Section 3.3.2. Figure 3.6 clarifies that in period $t \approx 20$ it has become more

profitable³² for almost all firms to open a branch in A than to supply it temporarily from B. The case where it becomes more profitable to supply country B only temporarily from A is not reached, though.

Next, we will analyze the case of Cournot competition. Again, our investigation will be split into the two cases of segmented and integrated markets.

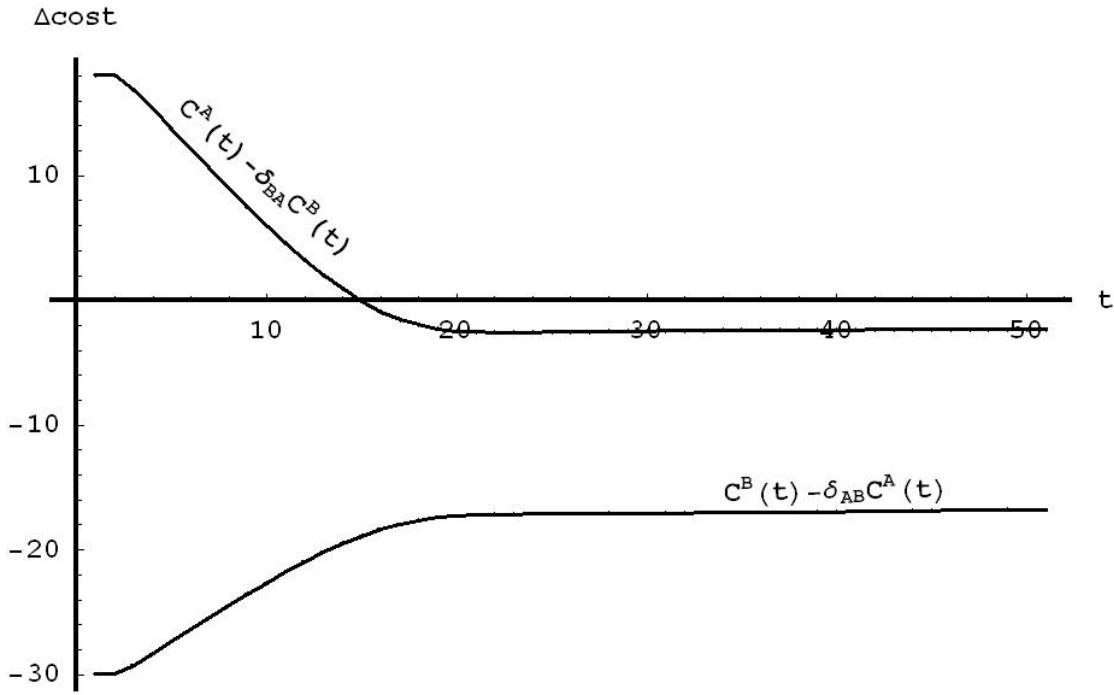


Figure 3.6: Cost differences between permanent and temporary supply of service against time in integrated Bertrand markets

3.3.4 Cournot competition

In $t=0$ the service markets in both countries can be described by the inverse demand

$$p^{A(B)} = \frac{1}{1 + \tau_{A(B)}} \left(\gamma^{A(B)} - \chi \cdot \sum_{j=1}^{n_{A(B)}} \theta^{A(B)} q_j^{A(B)} \right)$$

³²Concerning general wages in both countries.

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and firm profits

$$\pi_i^{A(B)} = (1 - r_{A(B)}) \left(p^{A(B)} - c_i^{A(B)} \right) q_i^{A(B)}$$

where γ^A is the maximum price the consumers in A are willing to pay for product i and χ serves as a scaling variable, which is again set to be equal to one.

By maximizing profit we find the following quantity, price and profit of an A-firm in period t=0:

$$q_{i,t=0}^A = \frac{\gamma_A - (1 + \tau_A)(n_A + 1)c_i^A + (1 + \tau_A) \sum_{j=1}^{n_A} c_j^A}{(n_A + 1)\chi\theta_A} \quad (3.34)$$

$$p_{t=0}^A = \frac{\gamma_A + (1 + \tau_A) \sum_{j=1}^{n_A} c_j^A}{(1 + \tau_A)(n_A + 1)} \quad (3.35)$$

$$\pi_{i,t=0}^A = \chi\theta_A \cdot (q_{i,t=0}^A)^2 / (1 + \tau_A) \quad (3.36)$$

In the following sections we will investigate again segmented and integrated markets. However, in order to avoid redundancies we will just quote the findings for the equilibrium quantities and prices without further explanations.

3.3.4.1 Segmented markets

If markets are segmented, we obtain the profit maximizing quantities (3.37) to (3.40). The following profit maximizing quantities and prices apply:

$$q_{i,t}^{A,A} = \frac{\gamma_A - (1 + \tau_A)(n_A + n_B + 1)\kappa_{i,t}^A + (1 + \tau_A) \sum_{j=1}^{n_A+n_B} \kappa_{j,t}^A}{(n_A + n_B + 1)\chi\theta_A} \quad (3.37)$$

$$q_{i,t}^{A,B} = \frac{\gamma_A - (1 + \tau_A)(n_A + n_B + 1)\kappa_{i,t}^A + (1 + \tau_A) \sum_{j=1}^{n_A+n_B} \kappa_{j,t}^A}{(n_A + n_B + 1)\chi\theta_B} \quad (3.38)$$

$$q_{i,t}^{B,A} = \frac{\gamma_B - (1 + \tau_B)(n_A + n_B + 1)\kappa_{i,t}^B + (1 + \tau_B) \sum_{j=1}^{n_A+n_B} \kappa_{j,t}^B}{(n_A + n_B + 1)\chi\theta_A} \quad (3.39)$$

$$q_{i,t}^{B,B} = \frac{\gamma_B - (1 + \tau_B)(n_A + n_B + 1)\kappa_{i,t}^B + (1 + \tau_B) \sum_{j=1}^{n_A+n_B} \kappa_{j,t}^B}{(n_A + n_B + 1)\chi\theta_B} \quad (3.40)$$

and the profit maximizing prices (3.41) and (3.42)

$$p_t^A = \frac{\gamma_A + (1 + \tau_A) \sum_{j=1}^{n_A+n_B} \kappa_{j,t}^A}{(1 + \tau_A)(n_A + n_B + 1)} \quad (3.41)$$

$$p_t^B = \frac{\gamma_B + (1 + \tau_B) \sum_{j=1}^{n_A+n_B} \kappa_{j,t}^B}{(1 + \tau_B)(n_A + n_B + 1)} \quad (3.42)$$

This yields the following profit for firm i in period t :

$$\pi_{i,t}^A = \chi \theta_A \left(\frac{1 - r_{A,i,t}}{1 + \tau_A} (q_{i,t}^{A,A})^2 + \frac{1 - r_{B,i,t}}{1 + \tau_B} (q_{i,t}^{B,A})^2 \right) \quad (3.43)$$

$$\pi_{i,t}^B = \chi \theta_B \left(\frac{1 - r_{A,i,t}}{1 + \tau_A} (q_{i,t}^{A,B})^2 + \frac{1 - r_{B,i,t}}{1 + \tau_B} (q_{i,t}^{B,B})^2 \right) \quad (3.44)$$

The plots concerning the amount of services, the wages and number of branches in a country as well as the plot of the conditions 1 and 2 are very similar to the ones of Section 3.3.3. Therefore, we will now investigate the effect of different wage coefficients λ (as in (3.8) and (3.9)) on the market structure. Figure 3.7 plots the amount of services

Amount of services

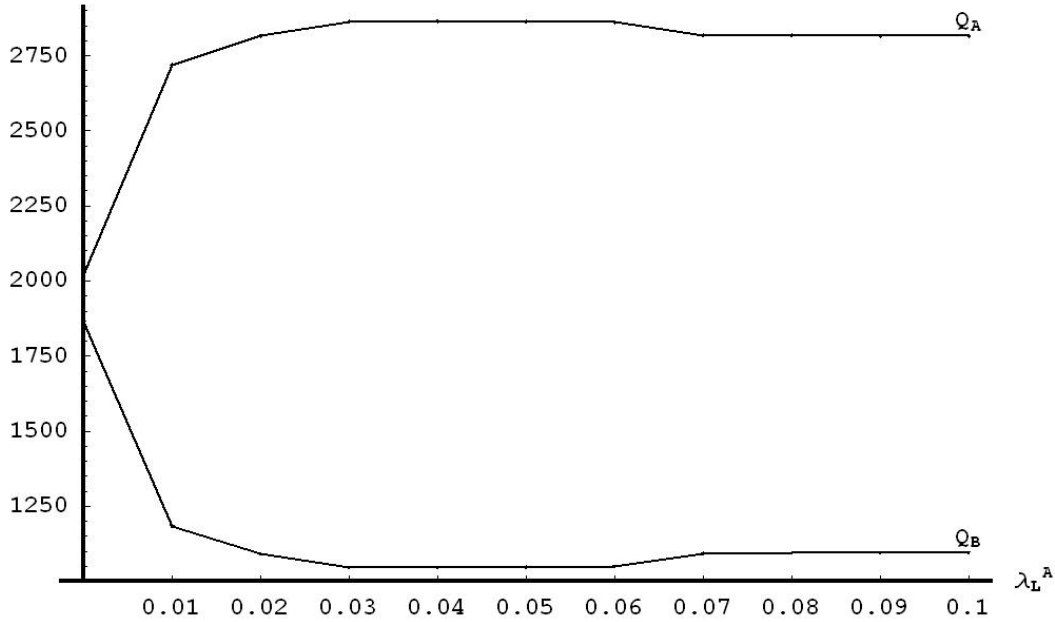


Figure 3.7: The amount of services each country - Germany (A) and Poland (B) - is supplying in segmented Cournot markets in the last period $t_{max} = 80$ against the wage flexibility factor λ_L^A

each country is supplying in the last period t_{max} against λ_L^A ³³. It is obvious that only at the beginning - up to $\lambda_L^A = 0.02$ - a change in the relative step size of the wages has

³³Here, we have used in contrast to the previous sections $\lambda_H^A = \lambda_H^B = 0.09$ and $\lambda_L^B = 0.01$. Still, tax rates were set to zero.

3 The EU directive on services' long term implications

a significant influence on the amount of services coming from the country in the end³⁴. Thus, even if the labor relations are so flexible that wages decrease rather strongly, it does not change the outcome significantly in the long-run. It is only important that they can decrease at all.

In the next section with integrated Cournot markets, we will check if this is also true for λ_H^B - the factor which determines the wage increase in country B.

3.3.4.2 Integrated markets

The profit maximizing quantities and prices are:

$$q_{i,t}^A = \frac{\frac{\gamma_A}{1+\tau_A} + \frac{\gamma_B}{1+\tau_B} - (n_A + n_B + 1)(\kappa_{i,t}^A + \kappa_{i,t}^B) + \sum_{j=1}^{n_A+n_B} (\kappa_{j,t}^A + \kappa_{j,t}^B)}{(n_A + n_B + 1)\chi\theta_A(\frac{1}{1+\tau_A} + \frac{1}{1+\tau_B})} \quad (3.45)$$

$$q_{i,t}^B = \frac{\frac{\gamma_A}{1+\tau_A} + \frac{\gamma_B}{1+\tau_B} - (n_A + n_B + 1)(\kappa_{i,t}^A + \kappa_{i,t}^B) + \sum_{j=1}^{n_A+n_B} (\kappa_{j,t}^A + \kappa_{j,t}^B)}{(n_A + n_B + 1)\chi\theta_B(\frac{1}{1+\tau_A} + \frac{1}{1+\tau_B})} \quad (3.46)$$

$$p_t^A = \frac{(\frac{n_A+n_B+1}{1+\tau_B} + \frac{1}{1+\tau_A})\gamma_A - \frac{(n_A+n_B)\gamma_B}{1+\tau_A} + \frac{1}{1+\tau_A} \sum_{j=1}^{n_A+n_B} (\kappa_{j,t}^A + \kappa_{j,t}^B)}{(n_A + n_B + 1)(\frac{1}{1+\tau_A} + \frac{1}{1+\tau_B})} \quad (3.47)$$

$$p_t^B = \frac{(\frac{n_A+n_B+1}{1+\tau_A} + \frac{1}{1+\tau_B})\gamma_B - \frac{(n_A+n_B)\gamma_A}{1+\tau_B} + \frac{1}{1+\tau_B} \sum_{j=1}^{n_A+n_B} (\kappa_{j,t}^A + \kappa_{j,t}^B)}{(n_A + n_B + 1)(\frac{1}{1+\tau_A} + \frac{1}{1+\tau_B})} \quad (3.48)$$

And the maximized profit of firm i in period t is:

$$\pi_{i,t}^A = \chi\left(\frac{1}{1+\tau_A} + \frac{1}{1+\tau_B}\right)\theta_A (q_{i,t}^A)^2 \quad (3.49)$$

$$\pi_{i,t}^B = \chi\left(\frac{1}{1+\tau_A} + \frac{1}{1+\tau_B}\right)\theta_B (q_{i,t}^B)^2 \quad (3.50)$$

Now, we will investigate the implication of different λ_H^B on the market. If we plot - Figure 3.8 - the amount of services each country is supplying in the last period against λ_H^B , we see two interesting effects³⁵. As in Figure 3.7 we note that it does not make a big difference if λ_H^B is rather high or low - it is just important that it is positive, meaning that it is possible to raise wages. The other interesting effect results from the fact of integrated markets. Here, the amounts of services supplied from both countries reach the

³⁴The fluctuations between similar λ_L^A are due to the randomness of the costs via v_i .

³⁵Now, we have used in contrast to the previous sections $\lambda_L^A = \lambda_L^B = 0.02$ and $\lambda_H^A = 0.05$. Still, taxes rates equal zero.



Figure 3.8: The amount of services each country - Germany (A) and Poland (B) - is supplying in integrated Cournot markets in the last period $t_{max} = 80$ against the wage flexibility factor λ_H^B

same level eventually³⁶. However, this result is sensitive to the chosen parameter values, because as (3.47) and (3.48) imply, for countries with highly different market sizes one of both prices will become negative, which means that this country will not be supplied anymore. Thus, only one country is supplied by both kinds of firms. If market sizes are similar, however, both prices will be positive and this effect vanishes³⁷.

3.4 Comparison and Discussion

3.4.1 Differences between segmented and integrated markets

Under Bertrand competition we can see from Figures 3.9 and I.1 (in Appendix I) that the differences between the outcomes in segmented and integrated markets are barely noticeable³⁸. In the Cournot case, however, the differences between segmented and integrated markets seem to be more pronounced as implied by Figure 3.10. However, here we

³⁶If λ_H^B is bigger than zero.

³⁷An exemplary graph is shown in Appendix H.

³⁸Even after a longer time period than $t_{max} = 100$ the differences are not significant.

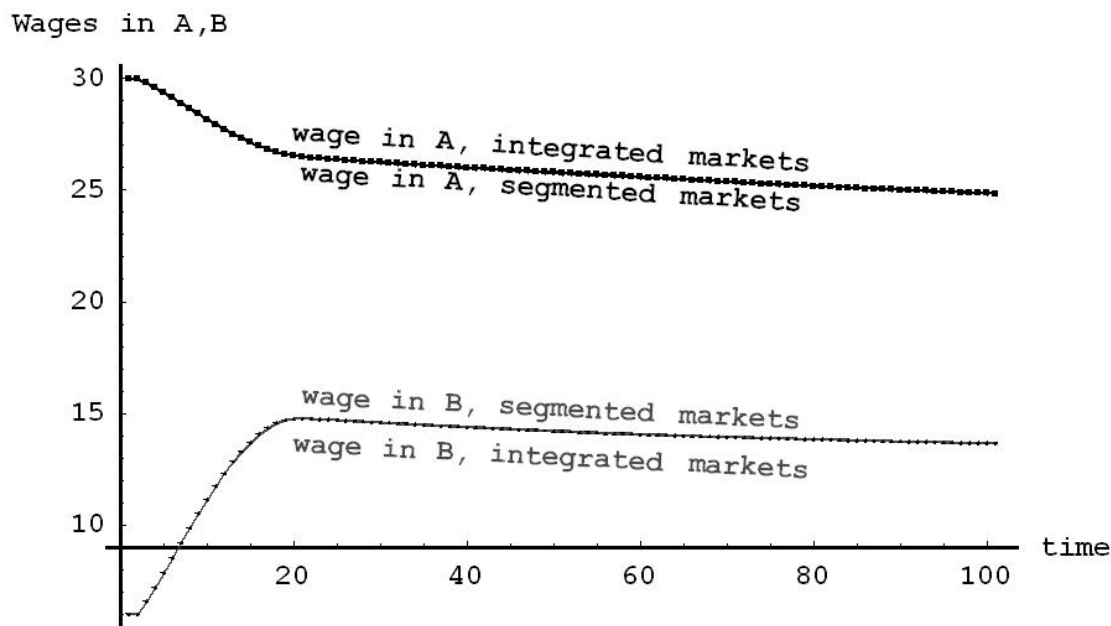


Figure 3.9: Bertrand competition: Wages in countries A (Germany) and B (Poland) over time in segmented and integrated markets

recognize the same effect that emerged in Section 3.3.4: the prices in integrated markets become negative in the smaller country if the maximum prices in both countries are very different. If this is not the case, we do not observe stark differences between segmented and integrated markets³⁹. Thus, we may conclude that it does not matter for country A or B concerning the development of their service markets if they are segmented or not. Hence, in order to simplify our further analysis, we will only investigate segmented markets in the following sections.

3.4.2 Effect of the wage-coefficient

How does wage flexibility influence the market outcome in both countries? We have already noticed in Section 3.3.4 that it does not really matter in the long-run if the wages in one country increase or fall more than in the other country - in the end the amount of services supplied from both countries does not change significantly with different wage flexibilities⁴⁰. The same holds for wages⁴¹. Here, the differences between the final wages in $t = t_{max}$ become smaller with every λ_L^A -step.

³⁹See Figure H.2 and Figure H.3 in Appendix H.

⁴⁰See Figures 3.7 and H.1.

⁴¹See Figure I.2 in Appendix I.

Services from A,B

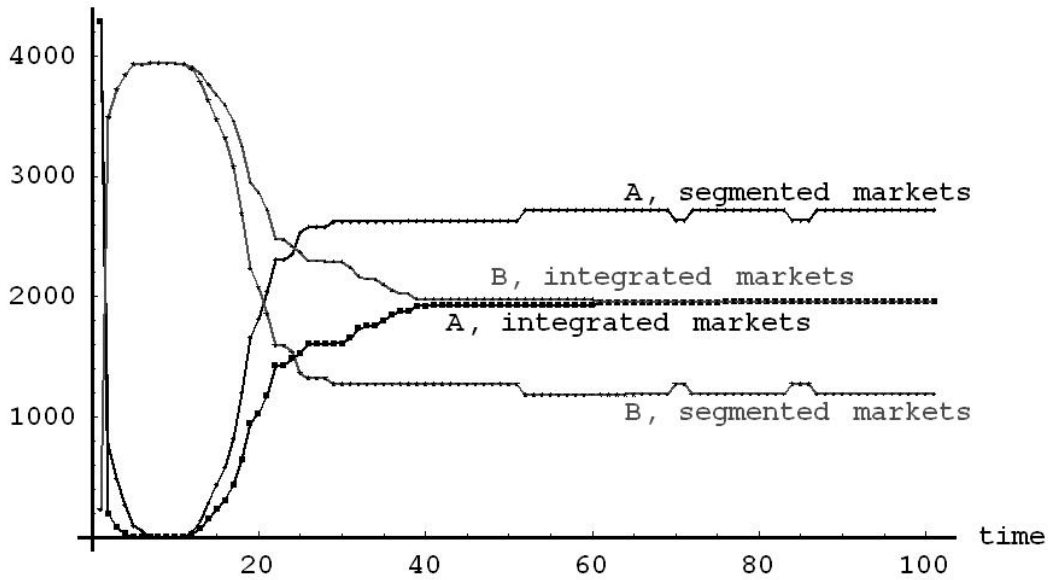


Figure 3.10: Cournot competition: Amount of services supplied from countries A (Germany) and B (Poland) over time in segmented and integrated markets

However, if we look at the timing of the changes there are distinct outcomes with different wage flexibilities λ . The higher λ_L^A the faster is the wage-decrease in A. Figure 3.11, which plots the wage in country A against time for different λ_L^A , makes this point clear. It becomes obvious that the difference between the two wage curves becomes smaller the higher λ_L^A . This is in line with our findings in Section 3.3.4 for the Cournot case, in which beyond a certain threshold a further rise in λ does not lower the wage significantly, anymore. Equivalently, the amount of services supplied from A rises faster the higher λ_L^A . Unsurprisingly, the effect is similar if only λ_H^B (the factor concerning wage increases in country B) changes: The higher λ_H^B the slower is the decrease in the wage of employees from A, but the amount of services supplied from A rises faster the higher λ_H^B ⁴².

Our findings can be further interpreted as follows. Generally, there should be room to lower wages, which is the case in all countries. How much they can be lowered is also important, because the economy will recover faster from the shock of the market opening the more wages can be lowered. However, independent of flexibility the economy will recover eventually, as the wages in the other country will rise as the demand for labor increases

⁴²See Figure I.3 in Appendix I.

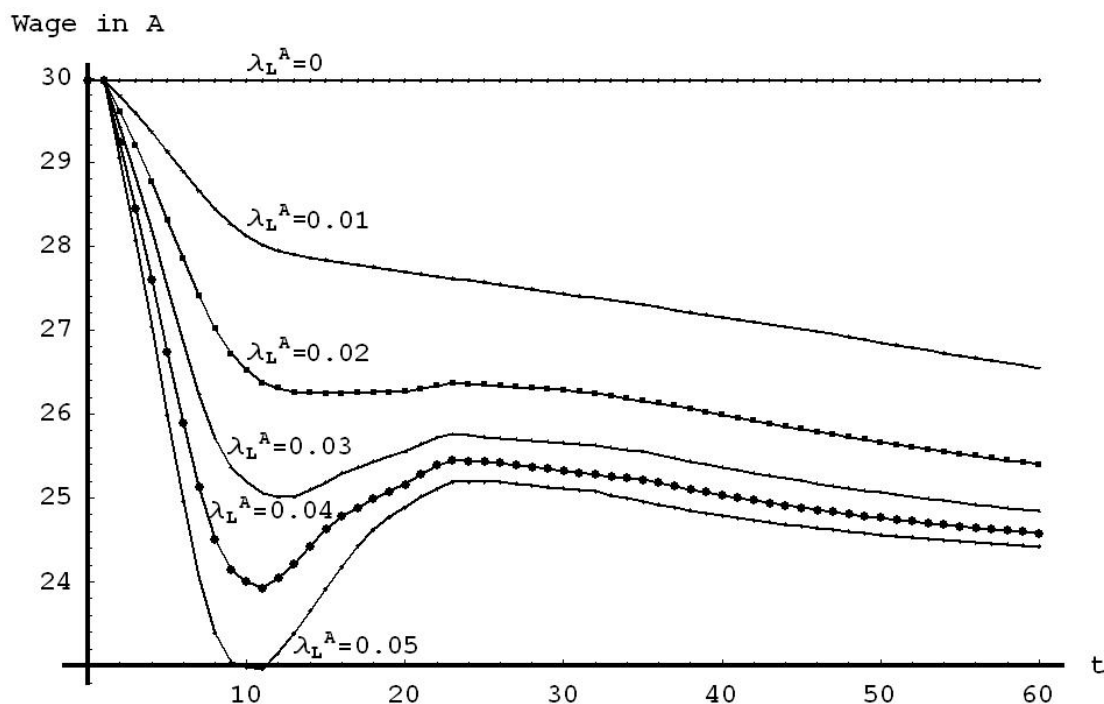


Figure 3.11: Bertrand competition: Wages in country A over time with different wage flexibilities λ_L^A

with the number of branches⁴³.

But if the wages in the foreign country do not increase significantly - possibly due to a huge labor force as, for instance, in China or India - flexibility in wages is extremely important in order to keep the domestic service industry in its home country, because a big cost difference between the two countries will eventually drive them to the lower-cost country⁴⁴. Unless, of course, the transaction factor δ is very high, which is the case for some services. Medical care is e.g. such a service, where the time uncertainty of demand together with the necessary promptness of supply makes the transaction factor very high⁴⁵.

3.4.3 Differences between Bertrand and Cournot

From Figures 3.12 and 3.13 we learn that quantity competition implies higher total output in both countries and lower wages. The run of the graphs is similar, however. This

⁴³We did not consider wage increases with decreasing amount of services, because this is economically not reasonable.

⁴⁴And they will also return faster the faster wages decrease.

⁴⁵Public health care services are explicitly not included in the directive, anyhow.

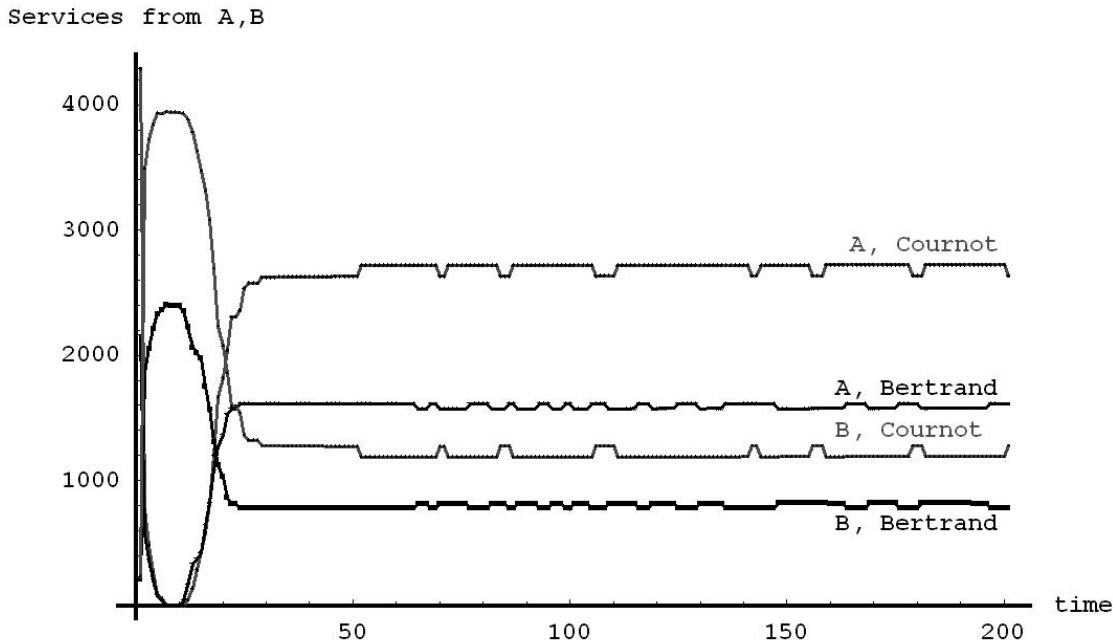


Figure 3.12: Amount of services supplied from Germany (A) and Poland (B) over time under Bertrand and Cournot competition

outcome supports a preference for Cournot competition as lower wages imply lower prices, which together with a higher output yield a higher consumer surplus. In the following sections we will further investigate which kind of competition between the service firms yields a higher surplus for the economy. Then, we will also allow for positive tax-rates in order to calculate the government surplus and its influence on the overall welfare.

3.4.4 Producer and consumer surplus

What happens on a firm and consumer level? How e.g. do firms' profits and sales change over time? We have already described in Section 3.3.2 that the cost differences between the two countries are a major driver for the firms' choice of location. We will now change our perspective and analyze the relevant integration level. Hence, country B is set to be the rest of the European Union without Germany and the tax rates are set as stated in Appendix F. In order to keep things simple, our further analysis is only based on segmented Bertrand markets.

Concerning the producer surplus we need to aggregate the firms' individual profits⁴⁶. They are aggregated independently of the location of their branches as we assumed that

⁴⁶Fixed costs are zero.

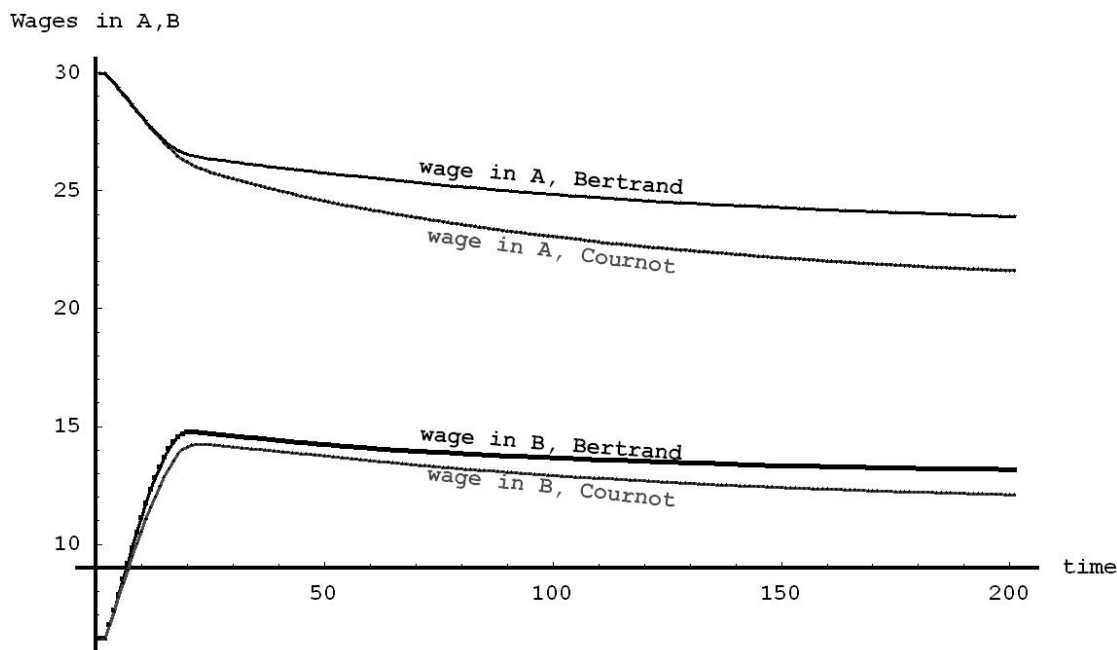


Figure 3.13: Wages in Germany (A) and Poland (B) over time under Bertrand and Cournot competition

the profits flow back to the domestic country of the firm. We know from previous research (paper 1) that firms from A experience a strong fall in profits after the opening of the service markets. But how does it develop in the long-run if country B is the rest of the EU? Figure 3.14 shows that the profits of A-firms are lower than before the opening and that after a few periods the profits of the (exemplary) firms do not change significantly anymore⁴⁷. Three of them have a branch in Germany and one in the rest of the European Union. Only one of them has just one branch in the rest of the European Union. The original level of profits, however, is not reached anymore.

Concerning the total quantity which is sold in both countries we know from previous research (paper 1) that in the first time step after the opening the consumer surplus in A increases whereas it decreases in B. But how does it evolve in the long-run? Figures 3.15 and 3.16 show the evolution of the total quantity and the average price⁴⁸ in both countries. Consumers in A and B are better off after the opening on account of the fact that the amount of services offered in both countries rises and prices fall. Although the quantity and prices adjust after a little while (up to $t \approx 20$), their level is still higher (or

⁴⁷As stated in Section 3.3.2 π or 0 in $\{1, \pi, 0\}$ refers to the existence of a branch in A and none in B, respectively. The first number can be either 1 or 0 and refers to the origin of the specific firm.

⁴⁸The mean value of all prices by A- and B-firms in country B.

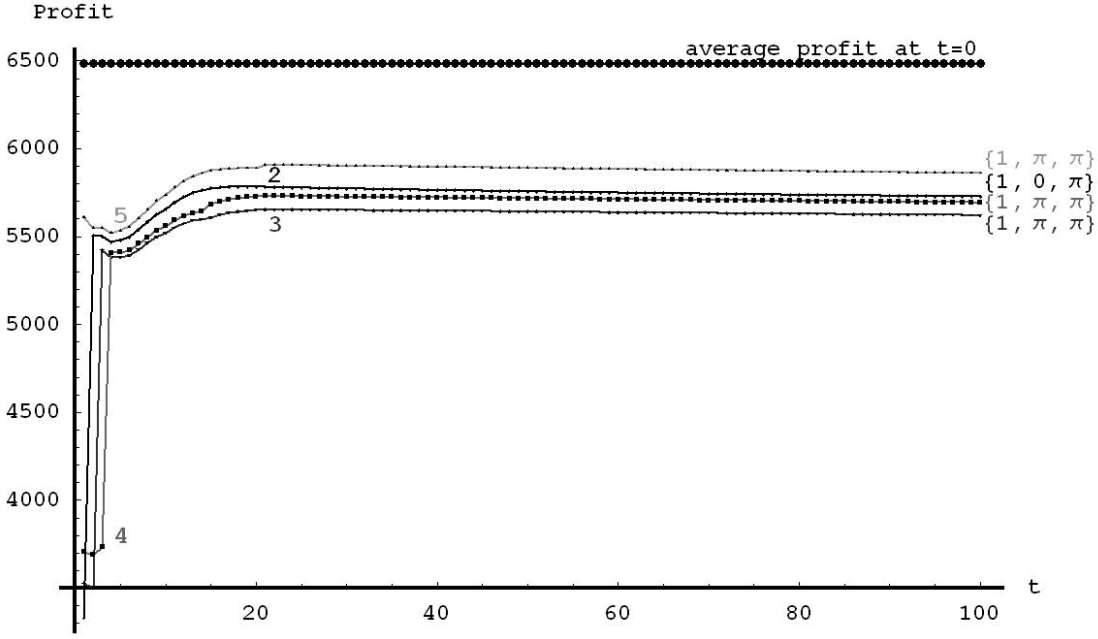


Figure 3.14: Bertrand competition: Profits of firms 2-5 from A (Germany) against time and their status in the last period after the opening of the European service market

in case of the prices lower) than before the opening.

In order to calculate the consumer surplus in A we need to look at the total amount of services supplied in A at a specific price P^{49} :

$$Q_{A,t} = \sum_{i=1}^{n_A+n_B} q_{i,t}^A = K_A - \sum_{i=1}^{n_A+n_B} \beta(1+\tau_A)\theta_i \cdot P_t + \frac{\beta(1+\tau_A)}{n_A+n_B} \sum_{i=1}^{n_A+n_B} \sum_{j \neq i}^{n_A+n_B} \theta_j \cdot P_t \quad (3.51)$$

Equation (3.51) simplifies to

$$Q_{A,t} = K_A - \frac{\beta(1+\tau_A)}{n_A+n_B} \sum_{i=1}^{n_A+n_B} \theta_i \cdot P_t = K_A - \beta(1+\tau_A) \cdot \bar{p}_t \quad (3.52)$$

where \bar{p}_t represents the perceived value of the service by the consumers in t . This value is calculated by weighting each firm's price with the quality of its service. Thus, we can

⁴⁹For the case of Cournot competition we need to look at a specific total amount.

3 The EU directive on services' long term implications

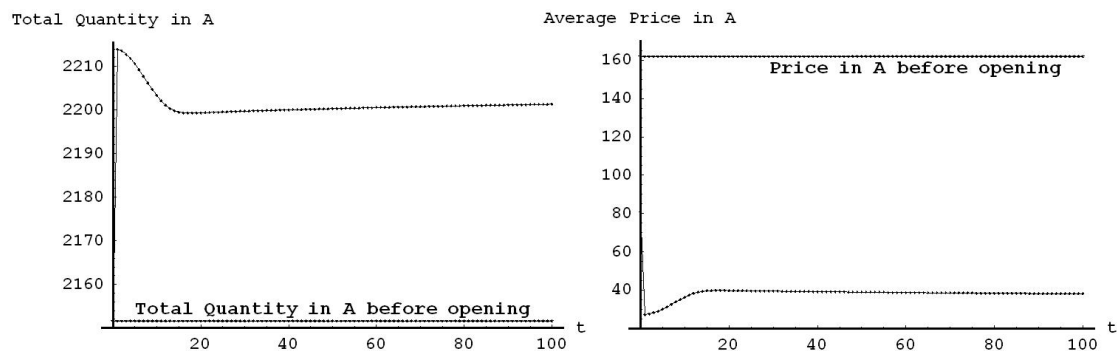


Figure 3.15: Bertrand competition: Total Quantity and average price in country A (Germany) against time

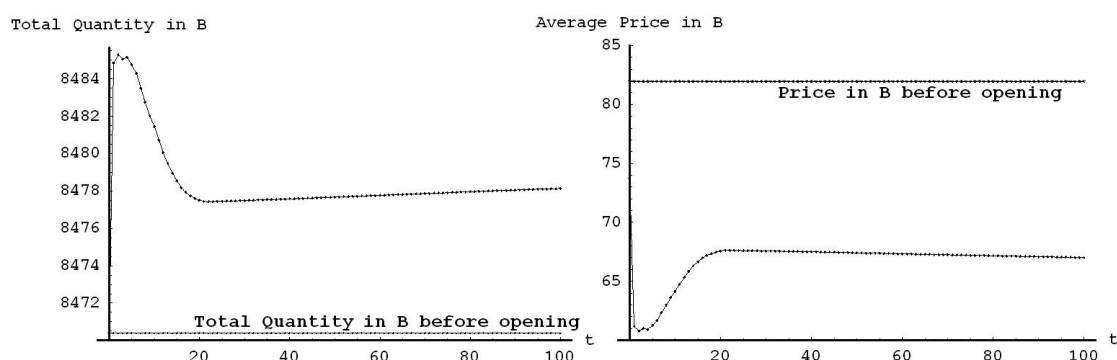


Figure 3.16: Bertrand competition: Total Quantity and average price in country B (rest of the EU) against time

derive the consumer surplus by using the value of the service \bar{p}_t and solving⁵⁰:

$$CS_t^A = \int_0^{Q_{A,t}^*} \bar{p}_t dQ_{A,t} - Q_{A,t}^* \cdot \bar{p}_t = \frac{(Q_{A,t}^*)^2}{2\beta(1 + \tau_A)} \quad (3.53)$$

Concerning the producer surplus we have to look at the aggregated economic profits of the firms. Making use of the assumption stated in Section 3.3.1 that all owners of the A-firms are situated in country A, we can write:

$$PS_t^A = \sum_{i=1}^{n_A} \pi_{i,t}^A \quad (3.54)$$

⁵⁰For Cournot competition, instead of $(Q_{A,t}^*)^2$ we have $(\sum_{i=1}^{n_A+n_B} \theta_i \cdot q_{i,t}^A)^2$.

3.4.5 Government surplus

Finally, we consider the surplus of the government, which is nothing else but the tax revenue generated by the general sales tax on all sales of services in A and the tax on the (domestic) profits of domestic and foreign firms which have a branch in A. The latter is rather complicated to calculate. The government in A is only allowed to tax the profits which are generated via the branch of the firm in A. Here, we assumed of course that this distinction can be made in reality.

$$GS_t^A = \tau_A \left(\sum_{i=1}^{n_A} p_{i,t}^{AA} \cdot q_{i,t}^{AA} + \sum_{i=n_A+1}^{n_A+n_B} p_{i,t}^{AB} \cdot q_{i,t}^{AB} \right) + r_A \cdot \sum_{i=1}^{n_A+n_B} \bar{\pi}_{i,t}^A \quad (3.55)$$

with⁵¹

$$\bar{\pi}_{i,t}^A = \begin{cases} \pi_{i,t} & \text{if firm } i\text{'s only branch is in A or } g_{i,t} = \{(1, 0), \pi, 0\} \\ \frac{(q_{i,t}^{A,(A,B)})^2}{\beta\theta_{(A,B)}(1+\tau_A)} & \text{if firm } i \text{ has a branch in A and B or } g_{i,t} = \{(1, 0), \pi, \pi\} \\ 0 & \text{otherwise} \end{cases}$$

We do also assume that the government's tax income is used in a way that it fully contributes to total surplus⁵².

3.4.6 Total surplus

Let us assume no taxes first. In the case of Bertrand competition with country A as Germany ($n_A = 30$) and B as the rest of the European Union ($n_B = 110$) total surplus is just the sum of producer and consumer surplus. Figures 3.17 and 3.18 display the total surplus in A and B against the time after the opening. The x-axis represents the level of welfare the country enjoyed before the opening. After the opening the welfare in country A (Germany) increases whereas the welfare in the rest of the European Union slightly decreases. This finding corresponds to our previous research.

In the case of Cournot competition Figures 3.19 and 3.20 show that the total surplus is higher in Germany and lower in the rest of the EU than before the opening. The welfare level after stabilization is also quite similar. Thus, the welfare differences between Cournot and Bertrand competition are not very pronounced. Accordingly, our analysis of Cournot competition does also not contradict the findings from previous research on short-run effects, where only the time before and immediately after the opening of the

⁵¹For Cournot competition, $\bar{\pi}_{i,t}^A$ changes according to the equations (3.43) and (3.44).

⁵²Although there are of course other opinions.

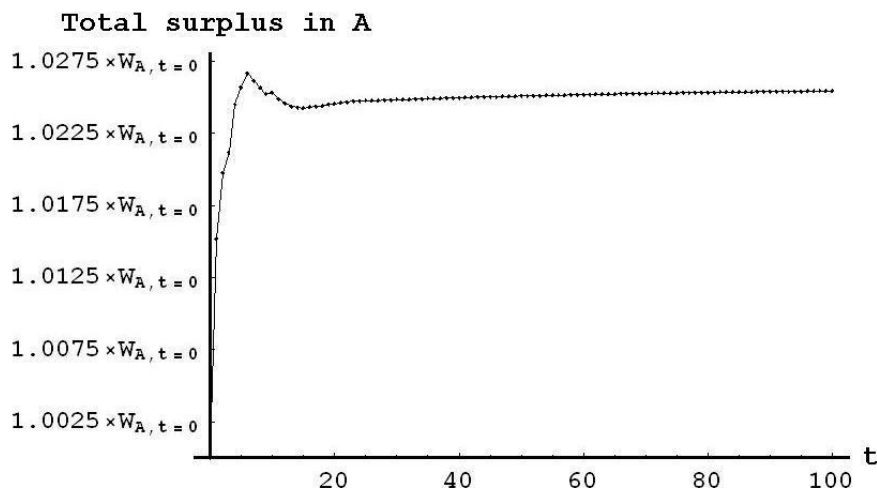


Figure 3.17: Bertrand competition: Total surplus in country A (Germany) without taxation against time

service market were investigated.

Let us turn to positive tax rates and inclusion of the government⁵³. This changes the results remarkably, as Figures 3.21 and 3.22 for the case of Bertrand competition indicate. With taxation the total surplus of the economy does not reach its pre-opening level anymore (for $n_B = 110$). It only overcomes the old level at $t = 0$, if there exist just 100 firms in B. However, as the market size of the rest of the EU is almost 4 times higher than the market size of Germany a firm number from B, which is much lower than $4 \cdot n_A$ can hardly be justified. Especially because an opening of such a big European market as Germany might even trigger the formation of service firms in specific service sectors of the other countries, which would drive up the number of foreign firms even further.

The reason why the overall welfare decreases in A lies in the slump of the government revenue⁵⁴, which suffers due to the loss of many domestic branches. This is a new feature of our model as compared to previous research, where taxation has not been investigated. We can now also see some interesting dynamics right after the opening. At first total surplus seems to rise considerably due to the higher profits of the firms which moved to the other country and higher consumer surplus. Then, however, as more and more firms relocate their branches (see Figure 3.5) the government experiences a sharp fall in tax revenues, which would in reality be even sharper as the newly unemployed would receive unemployment support. Therefore, and because of a fall in consumer surplus

⁵³ $\tau_A = 0.19$ and $\tau_B = 0.197$ and $r_A = r_B = 0.25$.

⁵⁴See Figure I.4 in Appendix I.

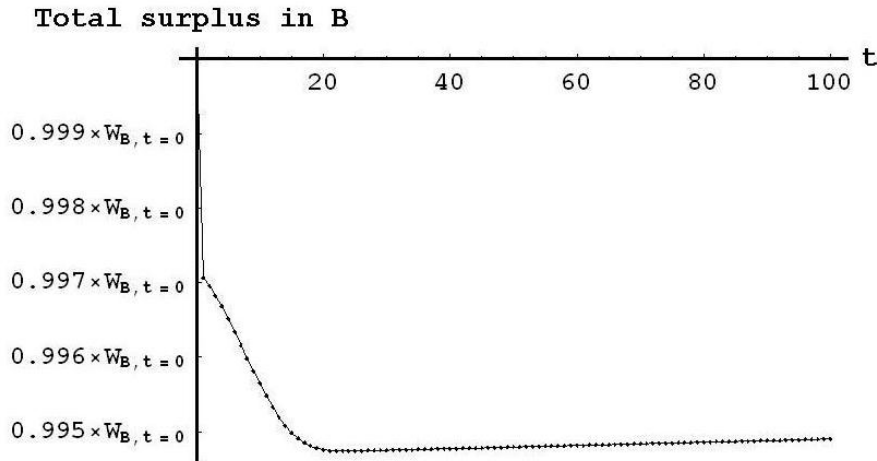


Figure 3.18: Bertrand competition: Total surplus in country B (rest of the EU) without taxation against time

due to a lower quantity from B-firms⁵⁵, total surplus also decreases. But after a while - with lower wages due to a lower demand for labor - firms return to the home country because a branch in A now yields higher profits, which implies a higher government tax revenue and also increasing producer surplus due to higher profits. Whether the overall welfare finally exceeds the pre-opening level depends on the number of firms from the foreign country. However, as it was not set too high, it seems reasonable to assume that altogether the EU directive on services has a negative effect on Germany's total surplus.

What can a country (in our case Germany) do in order to avoid these negative effects? We have already seen that it is very important to allow wages to decrease fast enough. This basis can only be of regulatory nature by e.g. allowing deviations from the collective wage agreements. The other possibilities lie e.g. in the variance of y^A and δ_{BA} . As Figure 3.23 indicates, if the "minimum wage" in Germany was halved⁵⁶, it would yield a much higher total surplus⁵⁷ on account of the fact that both the producer and government surplus increase which outweighs the small decrease of consumer surplus⁵⁸. Concerning the transaction factor we see in Figure 3.24 that a cutback of regulatory barriers also leads to a higher total welfare in Germany⁵⁹, which is based on the fact that the

⁵⁵On account of the fact that now more A-firms enjoy the lower costs after their relocation.

⁵⁶The change in total surplus for the rest of the EU is displayed in Figure I.5 in Appendix I.

⁵⁷As usual, we neglected the government assignments to the unemployed which would make the effect in this case even stronger.

⁵⁸See Figures I.7, I.8 and I.9 in Appendix I.

⁵⁹The change in total surplus for the rest of the EU is displayed in Figure I.6 in Appendix I.

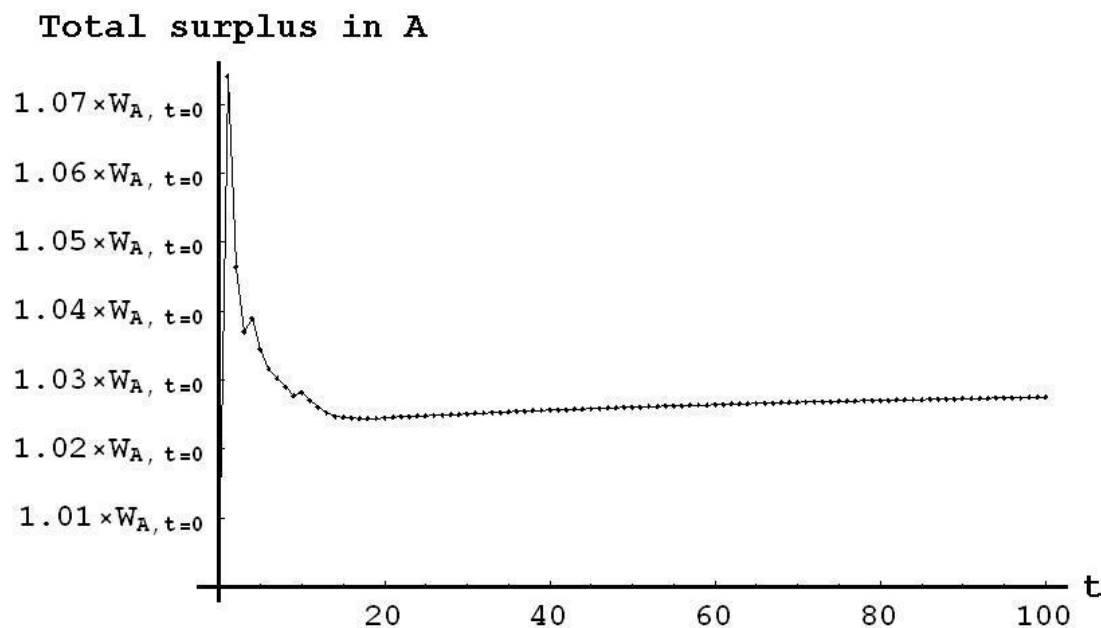


Figure 3.19: Cournot competition: Total surplus in country A (Germany) without taxation against time

consumer surplus increases whereas producer surplus and government surplus stay about the same⁶⁰. This might be counterintuitive at first, because half the transaction factor more than halves the number of branches in Germany. This naturally has a negative effect on the tax on profits. However, this negative impact is balanced by the increase in the sales tax revenue. Thus, neglecting the expenditures for the newly unemployed the change in total surplus is positive.

Altogether, the German government has three major options to moderate the effects of the service market opening: wage flexibility, unemployment aid and the level of regulatory difficulties service firms are facing compared to foreign markets. In the next section we will discuss the feasibility of each option.

3.5 Conclusion and policy recommendations

Using a simulation model we analyzed the long-term implications of the directive on services of the European Commission. For that purpose, we modeled the trade of labor-intensive services between two countries A and B which had effectively self-sufficient

⁶⁰See Figures I.10, I.11 and I.12 in Appendix I.

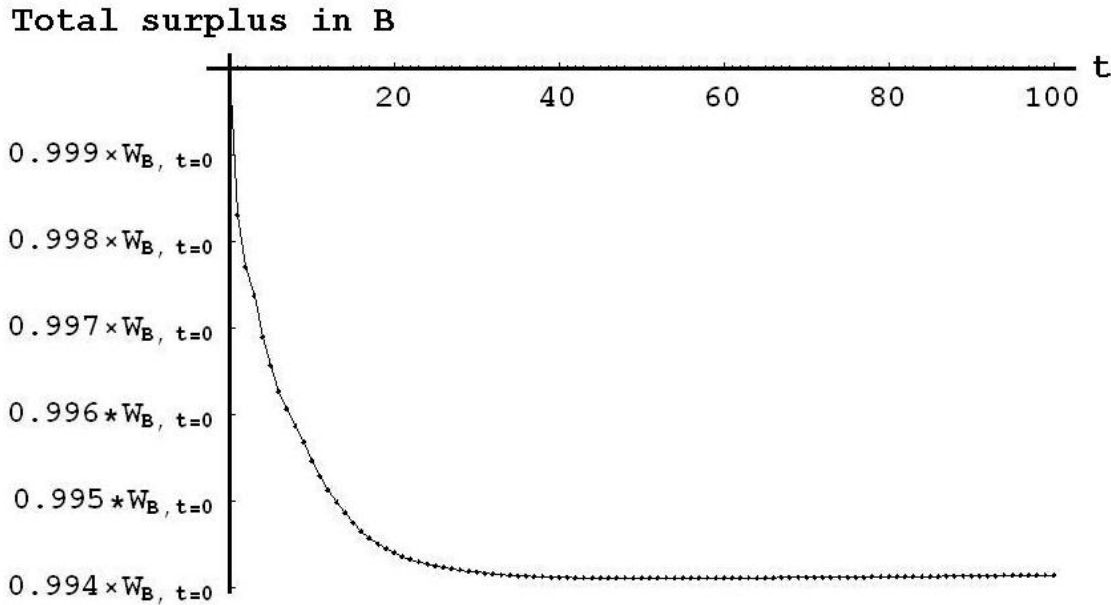


Figure 3.20: Cournot competition: Total surplus in country B (rest of the EU) without taxation against time

service markets before the opening. The costs - proportional to the wage level in each country - and service quality - exogenously set in our model - were assumed to be higher in A than in B. After the opening firms chose the location of their branches on the basis of their unit costs, whereas the wage level in each country changed depending on the amount of services offered or supplied from one country. We looked at the development of the amount of services offered in both countries, the price of the service and the change in total surplus consisting of consumer, producer and government surplus. Our analysis focused on two cases: country A was set to be a country like Germany and country B was set to be either Poland - in order to investigate the basic characteristics of our model - or the rest of the European Union, which is more important in order to analyze the long-term implications of the EU directive.

Concerning the development of the wages and, relatedly, the amount of services coming from one country we found that there is no difference between segmented or integrated service markets. Hence, this result seems to hold for any tradable service. We also found that the more flexible the wages are the higher is a country's ability to recover from the shock of the opening of its service market in terms of branches and amount of services supplied from that country. It is especially important for the government that there is

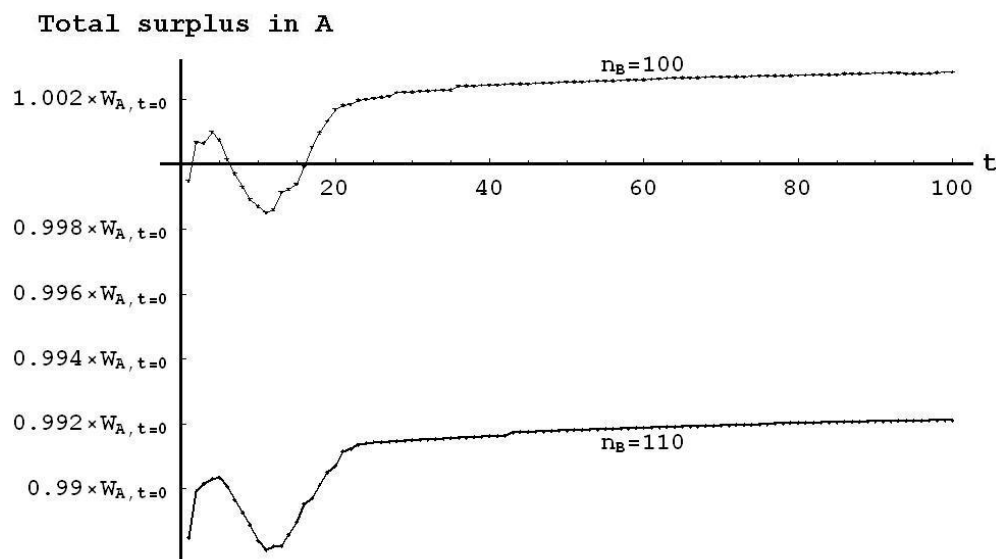


Figure 3.21: Bertrand competition: Total surplus in country A (Germany) with taxation against time ($n_A = 30$)

a possibility to lower wages in order to increase its tax revenue⁶¹, which depends on the number of branches in that country⁶².

The profits of the A-firms experience a sharp fall right after the European service market is open, because foreign firms enter their home market and the erosion of their domestic sales is not compensated by the sales in the foreign country. But after they open a branch in the foreign country, their profits recover, although they do not reach the respective pre-opening level anymore.

Concerning the change in welfare we found that the consumer surplus in both countries increases after the opening. However, as the producer surplus and the tax revenue of the governments decrease the total surplus reaches almost the pre-opening level. In country A, depending on the number of firms coming from B, it can be higher or lower than before (although the changes are only in the per mil regime), whereas the total surplus in B is always lower than before⁶³. Without taxation the total surplus would be higher than before the opening. Thus, the slump in government surplus is an important issue in an analysis about the implications of the directive on services.

⁶¹And to keep the number of unemployed down, which we did not incorporate in our model, but which is politically a very important measure.

⁶²The minimum in government tax revenue right after the opening, which Figure I.4 in Appendix I illustrates, is due to the loss of branches in A at the beginning.

⁶³The few firms from A are not enough in order to increase the consumer surplus difference in B so much that it exceeds the loss in producer surplus in B.

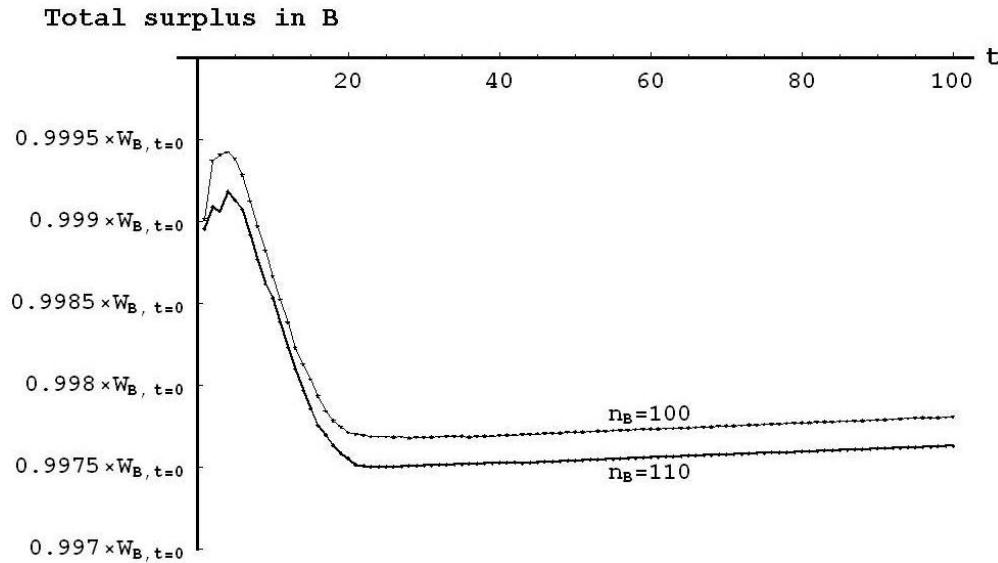


Figure 3.22: Bertrand competition: Total surplus in country B (rest of the EU) with taxation against time ($n_A = 30$)

The type of competition - Cournot or Bertrand - is rather unimportant as the total surplus reaches about the same level in the long-run. However, as the consumer surplus is higher in Cournot competition than in Bertrand competition it can be considered socially more desirable⁶⁴.

For policy recommendations we first need to look at the options the government has. As we do not consider changes in taxation⁶⁵, only the level of unemployment aid (y^A), the level of bureaucracy (δ) and the principles concerning labor agreements (λ) are within the government's reach. Starting with the government's assignments to the unemployed we saw in Figure 3.23 that a cut of these assignments would de facto lower the minimum wage and increase the total welfare of the country⁶⁶. In reality, it would also unburden the budget of the government by reducing the expenditures for the unemployed. However, the social desirability and political practicability of reducing the aid to the poor and the consumer surplus in general in order to increase the surplus for the producers

⁶⁴This is an important result, because Kreps and Scheinkman (1983) [46] showed that the Cournot model describes long-run relations better than the Bertrand model. The Bertrand model "merges in" the Cournot model in the long run

⁶⁵They are anyhow rather unlikely on the one hand due to political reasons (tax cuts for firms are perceived as socially unfair.), and on the other hand due to budget deficits

⁶⁶The producer and government surplus increase, whereas the consumer surplus is reduced. See Figures I.7, I.8 and I.9 in Appendix I.

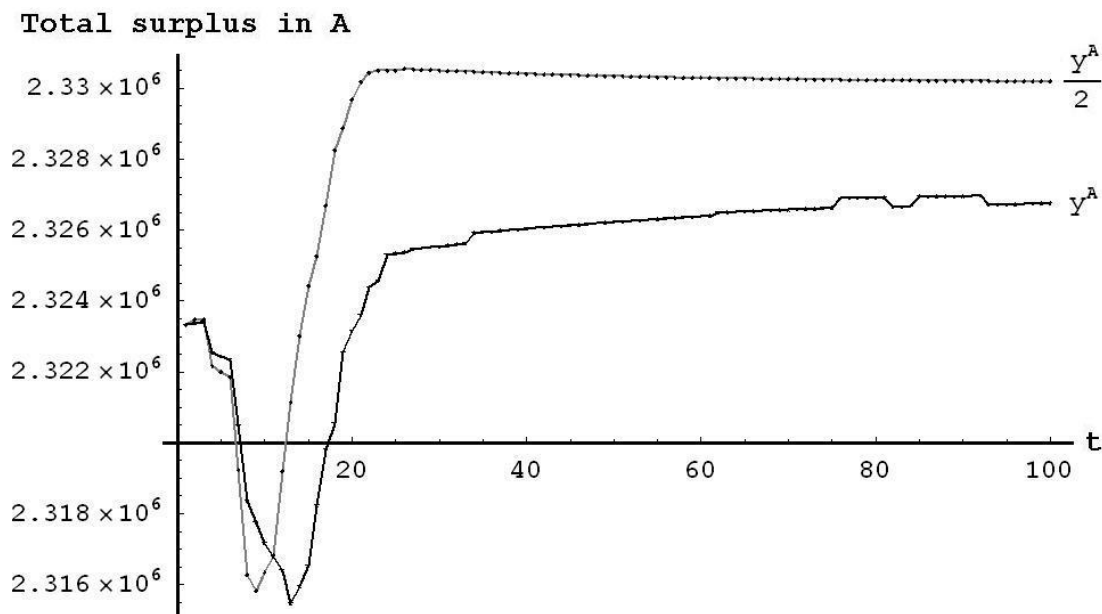


Figure 3.23: Bertrand competition: Total surplus in country A (Germany) with different "minimum wages" (y^A) against time

and the government is more than doubtful and definitely not recommendable.

If the government reduced bureaucracy by lowering e.g. labor standards it would de facto lower transaction costs for foreign firms. The effect on total welfare can be seen in Figures 3.24 and I.10 to I.12 in Appendix I: Both the consumer surplus and producer surplus rise whereas the government surplus stays about the same. Hence, at first glance this measure has a positive effect. However, as the number of branches in A is reduced significantly with lower transaction costs, the demand for labor in A is also much lower. Hence, the government will face higher unemployment the lower the transaction factor. This is politically and financially (through the unemployment compensation) not desirable. This finding contradicts the views of great parts of the business literature and press where a relaxation of labor standards is an often repeated remedy for the problems on the German labor market.

The only measure left is adjusting the labor law, e.g. by weakening the general collective labor agreements on wages, as it is present in Germany, and allowing firms to find their own specific labor agreement with the unions. This would increase the wage flexibility and would thereby enhance the country's pace of adjustment. Although this does not increase the level of total surplus in the long-run as the other measures, it at least gets country A faster through the slump in total welfare and implies no socially undesirable

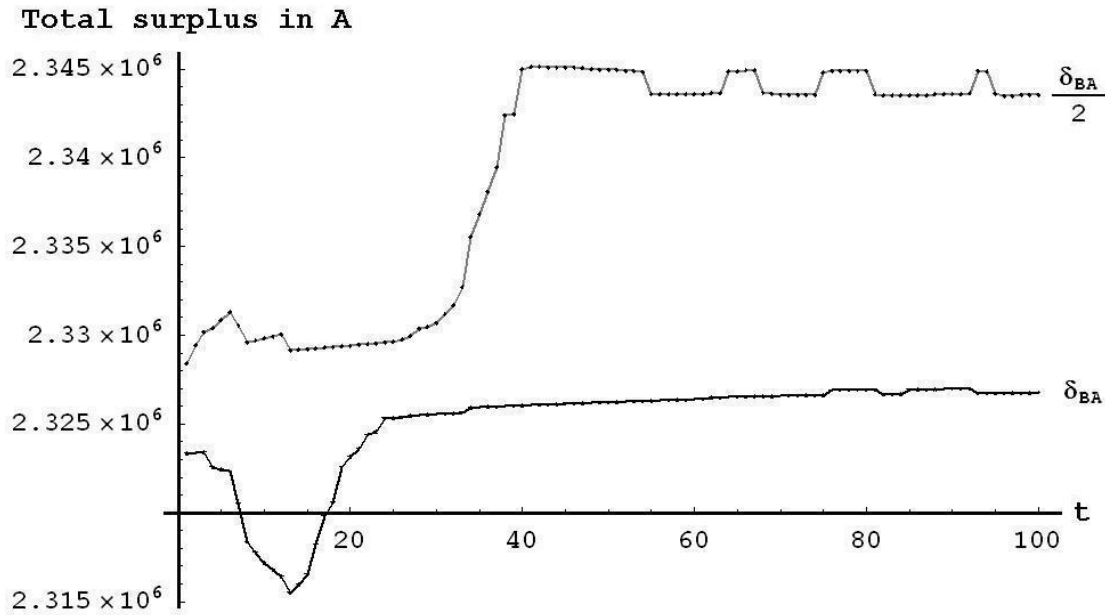


Figure 3.24: Bertrand competition: Total surplus in country A (Germany) with different transaction factors (δ_{BA}) against time

effects.

In order to keep things simple, our analysis did not consider a few points, which would mostly just enhance the effects found. As already mentioned above, we did not consider the expenditures of the government for unemployment compensation as both the tax revenue and the unemployment aid are proportional to the amount of branches in A. Thus, government surplus would depend even stronger on the number of branches.

Another interesting but neglected point is the possibility of entry and exit. This should be investigated further, although it would probably also just strengthen our model's outcome. In this context, it would also be interesting to investigate excess-entry prior to the opening of the service market on account of the fact that European service firms might just enter the market anticipating the opening of the service market in Germany. This will probably also amplify the outcome we have found in our model.

Another interesting issue, which might change our outcome, lies in the connection of the tradable and non-tradable service sector through the Balassa-Samuelson effect⁶⁷, which we could not implement in our analysis.

⁶⁷First in Balassa (1964) [4] and Samuelson (1964) [52].

3 The EU directive on services' long term implications

Our findings are based upon the characteristics of a representative service. Therefore, they will not hold for services with e.g. different transaction costs, but they can be used as a good average over all kinds of services. Other simplifications in our model are e.g. that wages change every period, and the assumption of complete information. Relaxing these assumptions, however, may probably not lead to significantly different results. Further research should rather focus on taxation⁶⁸ and the effects of entry and exit on total surplus. In this context, a location decision of the firms which is based on their profits after taxation and by that introducing tax competition would also be a worthwhile topic for future research.

⁶⁸E.g. what kind of taxation could prevent - if possible - a negative outcome for country A in terms of total surplus.

4 Shakeouts in Early Bertrand Markets

In this paper we investigate different investment strategies a firm in a new Bertrand market may pursue in order to survive a shakeout. By comparing our results under different definitions of the total market size and the agents' behavior, we conclude that only if the firms anticipate a coming shakeout and invest strategically to hurt their rivals, investments in process innovation are generally the main reason of the shakeout as it has been found in the existing literature for Cournot competition. We make use of a numerical model with underlying industry life cycle. There every firm is able to invest every period in the measures which either increases its profit the most or which increases its profits and simultaneously decreases its rivals' profits the most. This model exhibits for every period of the industry life cycle the best investment strategies a firm can undertake in order to survive.

4.1 The relation between the directive on services and shakeout theory

In the last chapters we have analyzed the economic implications of the EU directive on services for Germany and the European service market. We were also able to recommend political measures which might help to reduce the negative effects of the opening. Additionally, we could show that there are specific thresholds for the cost and quality of German service firms after which the opening would be profitable for them. Concerning their costs they also had the possibility to move to the other country in order to have lower costs. But what happens if the firm does not want to leave the high-cost country¹? Or how can a firm prepare for the opening of its service market in the near future? How should it position itself?

A firm has basically three options. It can try to decrease its costs through investments in process innovation, increase its customer base through investments in marketing or distribution, or it might invest in its quality in order to differentiate itself from other service firms. Which of these possible strategies really help in the end will be the topic of the next chapter.

If we break the effects of the directive down to just some key facts, we can state that competition will increase because there will be much more firms in the market. Consequently, the price will become lower and the total amount of services will rise. Eventually, not all service firms will survive this increasing competition. These facts are analogous to the stylized facts of the shakeout theory. There, after the entry of many firms into a new market, a shakeout of producers happens despite a robust growth in output. Thus, the best investments during a shakeout are simultaneously the best investments to increase the competitiveness of a service firm after the directive came into force. However, most of the research on shakeouts has focused on the goods industry. The theoretically (under Cournot competition) derived proposition that R&D in process innovation is the main driver of the shakeout has been empirically proven for four products - ranging from television to penicillin². The literature has only investigated Cournot competition, because in most goods industries this is the type of competition the market faces at the beginning due to a lack of production facilities. In many labor-intensive service markets, in which the employees do not need higher education in order to provide the service, this will not

¹There are various reasons why this could be the case, ranging from purely financial reasons to emotional ones.

²For details, see next chapter.

4.1 *The relation between the directive on services and shakeout theory*

be the case. There are also goods industries, in which production capacities can be rather easily adjusted. These markets also face price competition right away.

However, an analysis of the reasons for the shakeout under Bertrand competition has not been carried out so far. By doing this we will be able to fill two research gaps. On the one hand, the general picture of the reasons for a shakeout can be completed. This will be the topic of the next chapter 4. On the other hand, we can finally conclude how Germany and its service firms should prepare for the coming directive on services, which we will outline in the main conclusion (chapter 5).

Because of the generality of the model in the following chapter, our analysis concerns both goods and services. The difference between these two economic sectors lies in the different impact of the possible investments. I.e., investments in e.g. process innovation have a different impact depending on the sector in which the respective firm is in. Firms in goods markets are much more able to improve their processes (and consequently lower their costs) than labor-intensive service firms, in which the service is in most cases directly tied to the employee providing it³. Therefore, our following investigation will always look at both goods and service firms. Consequently, we will use the word quantity for both the quantity of products *and* the amount of services. Additionally, on account of better readability, we will sometimes use the word "product" for both physical products and services, e.g. related to product differentiation⁴.

We will concentrate on finding the best investments a firm can undertake depending on the number of firms in the market. This leads to the question which investment strategy a firm should pursue in order to survive a shakeout. Our findings will of course always differ between goods and service firms.

³Wage cuts are of course an alternative possibility to lower costs, but they are more difficult to achieve due to labor-unions and existing tariff agreements.

⁴Besides, German service firms often use the word "product" instead of "service".

4.2 Introduction

4.2.1 General aspects

The life cycles⁵ of many industries share an interesting characteristic. The number of producers in the new industry increases within a few years to a peak after which it falls rapidly during a rather short time period. The latter effect is called the shakeout of firms.

It finally stabilizes after some time with only a few producers left, which is called the maturity phase. These stylized facts of industry evolution have been supported by Gort and Klepper [31] and Klepper and Graddy [39] for most products out of a sample of 46 products. The shakeout of firms⁶ after the number of producers peaks happens despite a robust growth in total output and is due to the exit of many firms with a - at the same time - negligible entry rate. Simons [55] has listed seven hypotheses about the shakeout with most of them being supported empirically⁷.

The fact of continued growth in output is in stark contrast to the general product life cycle theory of marketing research. There, a shakeout is happening due to a decline in output during the maturity phase of the product.

The question for a firm in a new (Bertrand) market is now how to react to the upcoming threat of exit during the shakeout. Its possible strategies involve e.g. to become a cost leader or a leader in differentiation⁸. But are these strategies static in the sense of being dominant for any number of firms and any level of investment during the evolution of the industry?

The main purpose of this paper is to discriminate among the possible strategies of the firm for different states of the evolving industry. Especially the link between Bertrand or price competition and the cause of the shakeout has not been examined thoroughly in the literature yet. A critical assumption about the anticipation of the players in the industry will be made in this study. It is needed in the case of an endogenous definition of the total market size in order to link our basic economic modeling to the findings of the existing literature about the shakeout.

⁵The industry life cycle shows the number of firms in an industry over time. A stylized graph is shown in appendix L.

⁶In some cases as many as 90% of producers left the industry over a period of 15 to 20 years.

⁷See Section 4.2.2.

⁸See Porter [51].

4.2.2 Existing theories about the shakeout

The explanations in the literature for the shakeout of producers range from innovation-based over technological-change to nontechnological reasons⁹. We will concentrate on the innovation-based approaches and leave the other approaches aside because they either do not put firms in a strategic position to act or are not supported by the evidence¹⁰. Among them, three main theories for the cause of the shakeout are prevalent in the literature.

The "exogenous technological shock" hypothesis by Jovanovic and MacDonald [37] assumes that a technological innovation which is costly and difficult to adopt leads to the exit of many firms in the shakeout phase which were not able to adopt the innovation. At first, a new industry is created and firms begin to enter. Then, the technological innovation occurs which rises the efficient scale of output substantially. Entry after the innovation is only profitable if it occurs immediately. It ceases after that. Firms which were successful to innovate expand to their new efficient production scale which, consequently, puts pressure on price. The industry experiences a shakeout due to the exit of all firms unable to innovate.

Utterback and Suarez [59] assume the emergence of a dominant product design which leads to the exit of all those firms with different designs.

After the new industry is created firms enter with different product designs. After a while a product design becomes a de facto product standard, e.g. by meeting the taste of the consumers or through legislation. As the possibility of entry with a new product design ceases the entry rate slows down. The remaining firms in the industry concentrate on the reduction of unit costs and the less successful fall out of the market.

While these theories concentrate on the appearance of a new process technology or product design, Klepper [40] and [41] looks at the cost of production right away. He assumes economies of scale in R&D where firms invest in R&D to lower their unit cost. Because firms with a high output save more money through R&D they are more inclined to invest in research. This spiral finally leads to a few firms with high output and low costs and others which have to exit the market because they cannot compete anymore.

Aside from these theories, other theoretical models tried to explain the trends of the industry life cycle. Carree and Thurik [11] model the shakeout in the U.S. tire industry, contradicting the views of Jovanovic and MacDonald. They attribute the shakeout of firms to the price decline of tires due to the decrease in per unit costs which is in line

⁹Nontechnological reasons are for example overconfidence (Camerer and Lovo [10]) or herd behavior (Bikhchandani et al. [7]; Geroski and Mazzucato [30]), etc.

¹⁰See Simons (2003) [55] for details.

4 *Shakeouts in Early Bertrand Markets*

with the findings of Klepper [40].

Allanson and Montagna [2] show theoretically that not only economies of scale are important. Economies of scope are also a reason for the decline in the number of producers.

Klepper and Simons [42] have tested the theories of Jovanovic and MacDonald, Utterback and Suarez and Klepper empirically. They studied the industry life cycles of four industries, namely Automobiles, Tires, Television and Penicillin. Using "hazard rates" of exit they concluded that the hypothesis of Klepper suits to the industries examined best.

Simons [55] tested in his empirical study seven hypotheses. The first two refer to the internationally same shakeout patterns of similar products. The third hypothesis states that only the entry rate declines during the shakeout and that the exit rate stays almost constant. The fourth relates the timing of entry to survival. The earlier a firm enters the lower the exit rate during the shakeout. In an industry without a shakeout this effect is insignificant or nonexistent. Hypothesis five, which is the only one with an insignificant empirical result, states that in an industry with a shakeout during its life cycle the improvements in product and manufacturing methods are larger than in an industry without a shakeout. The sixth hypothesis states that in industries with strong shakeouts early entrants have the greatest R&D output, whereas the last hypothesis claims that the higher the R&D output of a firm the lower its probability of exit.

4.2.3 **Main focus of the analysis**

If we put ourselves in the shoes of a firm which has just got started in a new and developing industry and knows that the shakeout will eventually come? What strategy should we pursue in order to survive the increasing competition? Should it raise the customers' awareness of the product via e.g. marketing or better distribution? Or should we concentrate on cost reduction in order to become a cost and price leader? Or would it finally be better to invest in product differentiation¹¹ to stand out of the crowd of products and make ourselves more independent of price? And it also remains questionable if the best strategy is static in the sense that it is the best strategy for all numbers of firms in the market, different definitions of the total market size (see below) and all levels of investment.

In this paper we will investigate these different strategies subject to the number of firms

¹¹In the sense of quality improvements.

and the investments already made. As they, of course, also depend on the kind of competition the firm is facing, namely if firms compete over quantities or prices, we will split the investigation into two parts: The main part will examine strategies during a shakeout in a Bertrand market over time - this has not been done in the literature before - after which we will have a short look at the best strategies over time in a Cournot market. We will then compare our results with the findings of the existing literature.

The two different types of competition - Bertrand and Cournot - are assumed to remain unchanged in the course of industry evolution. This is, however, not always the case, as there are many (goods) industries which start off as quantity competing industries and eventually turn into industries where firms compete over price. Cournot competition is widely the basis for emerging industries as constraints on production capabilities are a fundamental problem of new firms which usually do not have huge financial possibilities. On the contrary, many industries can be found which do not suffer from capacity constraints at their beginning and are competing over price right from the start. Prominent examples are many labor-intensive service industries or e-commerce which start off in Bertrand competition right away. Theoretical analysis of the life cycles of these industries has been missing so far. We will therefore particularly consider service industries in our analysis, although our investigation fits to goods, which start off in Bertrand competition right away, as well.

Our analysis of the Bertrand case will be divided into two parts. We will examine two extreme scenarios, in which entering firms either bring in their own small market demand or in which they steal a slice of the existing market size from the incumbents. Although the former case is in our understanding more realistic in new industries, we analyze both cases and their implications for the firms' strategies.

Besides our concentration to close the gap of theoretical understanding of the shakeout in Bertrand competition, we will also investigate the best investment strategies of the firms over time using numerical methods. Therefore, we will assume a typical industry life cycle, which will be the basis for the decisions of the firms. In every period of this life cycle we will give all existing firms the opportunity to pursue one of the three possible investments: they can decrease cost, raise awareness of the customer via marketing/distribution or differentiate their product. Thereby, we will be able to see which investment strategy is the best for the firms depending on the number of firms in the market, the investments already made and their time of entry.

In the course of our investigation we will introduce an important assumption. We will

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allow firms to look ahead and anticipate the coming shakeout. This is not an unrealistic assumption as firms in our setting are able to observe the entry of other firms in their market and it is only a matter of right prediction that the market will eventually consolidate. But if a firm foresees a shakeout it will be eager to be one of the survivors¹². So what can it do in order to become one of them?

Firms exit, when their profit becomes negative. Therefore, a firm which anticipates a coming shakeout and wants to belong to the survivors will try to decrease its rivals' profits without getting hurt itself. Or in other words: in order to survive it will not be sufficient anymore to only increase the firm's own profit but also to invest in measures which will at the same time decrease its rivals' profits.

Thus, the logical consequence of introducing foresight is the goal of the firms to decrease their rivals' profits, because they know that the weakest among all firms will exit during the shakeout. Hence, the chosen investment will raise the own profit and simultaneously decrease the profit of the rivals the most among the three alternatives. This investment will not be the same as if the firm only maximized its profit. Therefore, in order to discriminate between non-strategic investments¹³ and the strategic investments¹⁴ as outlined before, our investigation will always consider both. We will conclude that only the assumption of anticipation bears a result, which is in line with the existing literature for both possibilities of allocating total market size.

4.2.4 **Outline**

The remainder of the paper is organized as follows: In Section 4.3.2 we will examine Bertrand competition and Cournot competition. In Section 4.4 we will compare our results with the findings of the theoretical and empirical literature on the shakeout phenomenon. Section 4.5 discusses the assumptions of our approach and concludes with some thoughts for future research.

¹²In our model we do not consider that firms might not have the goal to survive but to be sold to a rival, for instance. Although this is also a realistic option of exit, we think that, at least at first, all firms have the goal to survive

¹³I.e., firms do not invest strategically and simply maximize their profits

¹⁴I.e., anticipating firms invest strategically

4.3 Theory

4.3.1 General assumptions

We consider an industry with $i=1, \dots, n$ firms and assume that each firm i only supplies one kind of service or produces one kind of product, respectively. Thus, the index i can be used interchangeably to identify firms or products/services. We also assume that each player has perfect information about prices, quantities¹⁵ and profits of the other players and that all players are rational. Each firm faces a cost function

$$C_i(q_i) = c_i q_i \quad (4.1)$$

so that c_i are the marginal and unit costs of firm i and q_i is its output.

4.3.2 Bertrand competition

In Bertrand competition product/service production is flexible. Firms decide which price to set rather than how many units of products/service they will offer. The demand for service i , q_i , is given by (4.2), and depends on the price p_i of product/service i and the prices of other products/services, $p_j \forall j \neq i$ in a way that q_i decreases if there is an increase in p_i and q_i increases if there is a rise in the mean price of the other firms. Thus, we have

$$q_i(n) = \alpha_i - \beta \theta_i p_i + \beta/n \cdot \sum_{j \neq i}^n \theta_j p_j \quad (4.2)$$

α_i is the maximum quantity firm i can sell in the market or in other words the market size for firm i , $0 < \theta_i \leq 1$ is the product/service quality (and/or design)¹⁶. The upper bound of the sum, n , labels the number of firms present in the industry. β is associated with the own-price effect¹⁷.

The form of the equation becomes clearer if we look at $n = 1$ or the total output. Equation (4.2) simplifies for $n = 1$ ¹⁸ to

$$q_1(1) = \alpha_1 - \beta \theta_1 p_1$$

¹⁵We will use the term quantity also for the amount of services.

¹⁶It is an absolute measure, meaning that it is associated with one product/service and is not set relatively to other products/services.

¹⁷ β/n is the cross-price effect.

¹⁸Then the sum is zero due to $j \neq i$

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which is the linear demand of a monopolist.

With more than one firm, the total output of all firms Q depends on the mean price of the industry:

$$Q = \sum_{i=1}^n q_i(n) = \sum_{i=1}^n \alpha_i - \beta/n \cdot \sum_{i=1}^n \theta_i p_i \quad (4.3)$$

Here, we have to split our investigation concerning the values of α . On the one hand, the total size of the market can be assumed to be endogenously given by aggregated firm market sizes $\sum_{i=1}^n \alpha_i$ as in (4.3). On the other hand we can assign an exogenous total market demand and accommodate the individual market sizes α_i accordingly. These contrary possibilities both have to be investigated. Therefore, we will first look at one edge of the possibilities by assuming that each firm i brings in its own market size α_i and leaves the other α_j for $j \neq i$ unchanged, which leads to an endogenous total market size. Then, we will examine the case where an entering firm automatically steals its share from the others.

In the now following subsection we will investigate the first option, where each firm brings in its own market demand α_i .

4.3.2.1 Independent maximal market demand

By letting the firms invest directly in α , they are able to increase the maximum amount of products/services they want to sell. But they may also invest in cost cutting measures which will lower the unit costs, or they may undertake investments which will increase the quality of their product/service (or the design of the product) in order to differentiate it. However, the latter will be a quite uncertain measure as consumers might not appreciate the changes. Investments in marketing/distribution correspond to investments in α_i , whereas investments in product/service differentiation correspond to investments in θ_i . Thus, we can rewrite equation (4.2):

$$q_i(n) = \tilde{\alpha}_i - \beta \tilde{\theta}_i p_i + \beta/n \cdot \sum_{j \neq i}^n \tilde{\theta}_j p_j \quad (4.4)$$

where

$$\begin{aligned} \tilde{\alpha}_i &= \alpha_i + g_{\alpha,i} f_{\alpha}(I_{\alpha,i}) - \epsilon_i^{\alpha} \\ \tilde{\theta}_i &= \theta_i - g_{\theta,i} f_{\theta}(I_{\theta,i}) + \epsilon_i^{\theta} \end{aligned}$$

The investments $I_{\alpha,i}$ and $I_{\theta,i}$ only affect α_i and θ_i via the functions f_A and f_θ which have the property of $f(0) = 0$ and $f'(I) > 0 \wedge f''(I) < 0$ to reflect diminishing returns on investments. $g_{\alpha,i}$ and $g_{\theta,i}$ are used to scale the change of the maximum price and product differentiation, respectively. We also introduced uncertainty in our equations through the random effects ϵ^α and ϵ^θ .

For investments in cost, which we will introduce subsequently, we will use $g_{c,i}$. $g_{\theta,i}$ and $g_{c,i}$ have the order of magnitude of their counterparts θ_i and c_i , whereas g_α can be much higher than α itself depending on the market size firms are able to win. Concerning the investment functions, we assume that $f_\theta = f_\alpha < f_c$ because the firm will only experience the same effect $f_\theta(I_1) = f_\alpha(I_2) = f_c(I_3)$ of its investments if it invests more in the first two kinds, meaning $I_1 = I_2 > I_3$. This is due to the fact that a small investment in cost reduction is more effective than in product differentiation or marketing/distribution where the outcome depends on the perception of the customers, so that a much higher investment is needed in order to have a visible effect.

Investments in cost reduction are reflected in the profit function of firm i:

$$\pi_i = (p_i - \tilde{c}_i)q_i - I_{c,i} - I_{\alpha,i} - I_{\theta,i} - F_i \quad (4.5)$$

where again:

$$\tilde{c}_i = c_i - g_{c,i} f_c(I_{c,i}) + \epsilon_i^c$$

Using (4.5) we can easily obtain the following profit maximizing prices and quantities subject to the number of firms n:

$$p_i^*(n) = \frac{n(n+1) \left[\tilde{\alpha}_i + \beta \tilde{\theta}_i \tilde{c}_i \right] + n \sum_{j=1}^n (\tilde{\alpha}_j + \beta \tilde{\theta}_j \tilde{c}_j)}{\beta(2n+1)(n+1)\tilde{\theta}_i} \quad (4.6)$$

$$q_i^*(n) = \frac{n(n+1) \left[\tilde{\alpha}_i - \frac{n+1}{n} \beta \tilde{\theta}_i \tilde{c}_i \right] + n \sum_{j=1}^n (\tilde{\alpha}_j + \beta \tilde{\theta}_j \tilde{c}_j)}{(2n+1)(n+1)} \quad (4.7)$$

The maximum profit for firm i simplifies to:

$$\pi_i^*(n) = \frac{(q_i^*)^2}{\beta \tilde{\theta}_i} - I_{\alpha,i} - I_{\theta,i} - I_{c,i} - F_i \quad (4.8)$$

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This is the maximum profit of firm i subject to the number of firms in the market. We are now interested in the effect an investment I has on the profit of firm i and the other firms j . As outlined before, there are three possible investments I : either in process innovation, marketing/distribution or product differentiation. To distinguish between these alternatives, we use the derivative of the equilibrium profit to $I_{c,i}$, $I_{\alpha,i}$ and $I_{\theta,i}$, *ceteris paribus*.

$$\frac{\partial \pi_i^*(n)}{\partial I_{c,j}} = \begin{cases} \frac{-2n\theta_j g_{c,j} f'_c(I_{c,j})}{\theta_i(2n+1)(n+1)} \cdot q_i^*(n) & \text{for } j \neq i \\ \frac{2(n^2+n+1)g_{c,i} f'_c(I_{c,i})}{(2n+1)(n+1)} \cdot q_i^*(n) - 1 & \text{for } j = i \end{cases} \quad (4.9)$$

$$\frac{\partial \pi_i^*(n)}{\partial I_{\alpha,j}} = \begin{cases} \frac{2ng_{\alpha,j} f'_\alpha(I_{\alpha,j})}{\beta\theta_i(2n+1)(n+1)} \cdot q_i^*(n) & \text{for } j \neq i \\ \frac{2n(n+2)g_{\alpha,i} f'_\alpha(I_{\alpha,i})}{\beta\theta_i(2n+1)(n+1)} \cdot q_i^*(n) - 1 & \text{for } j = i \end{cases} \quad (4.10)$$

$$\frac{\partial \pi_i^*(n)}{\partial I_{\theta,j}} = \begin{cases} \frac{-2nc_j g_{\theta,j} f'_\theta(I_{\theta,j})}{\theta_i(2n+1)(n+1)} \cdot q_i^*(n) & \text{for } j \neq i \\ \frac{g_{\theta,i} f'_\theta(I_{\theta,i})}{\beta\theta_i^2} \cdot q_i^*(n)^2 + \frac{2(n^2+n+1)c_i g_{\theta,i} f'_\theta(I_{\theta,i})}{\theta_i(2n+1)(n+1)} \cdot q_i^*(n) - 1 & \text{for } j = i \end{cases} \quad (4.11)$$

Several characteristics of these equations are interesting. First of all, we see that a cost reduction or product differentiation of rival firm j negatively affects the profit of firm i . In contrast to these investments, our Bertrand model exhibits a spill-over effect for investments in marketing/distribution. This can be interpreted that by increasing its marketing/distribution expenditures, firm j is "setting the path" for other companies. Besides, all of the investments exhibit economies of scale because their effect depends on the quantity produced/supplied. We can also see that investments in product differentiation will become more important with rising quantities than the other forms of investment. However, in order to distinguish between the different investments we have to ask which of them yields the highest return on profit.

If we assume identical firms we are able to derive the following Corollaries¹⁹:

Corollary 1 If firms are identical, investments in marketing/distribution are more profitable than investments in cost reduction if and only if

$$\frac{g_\alpha f'_\alpha(I_\alpha)}{g_c f'_c(I_c)} > \frac{n^2 + n + 1}{n^2 + 2n} \beta\theta. \quad (4.12)$$

¹⁹See Appendix J.1.

The right hand side of the inequality is smaller than 1 ($\beta\theta < 1$) and g_α is at least in the order of magnitude of α . Hence, if the left hand side should be smaller than 1, we would have to assume an extremely low marginal return on investment f'_α as compared to f'_c . Thus, as a general rule, we can state that investments in marketing/distribution increase the own profit more than investments in cost reduction.

Corollary 2 If firms are identical, investments in marketing/distribution are more profitable than investments in product/service differentiation if and only if

$$\frac{g_\alpha f'_\alpha(I_\alpha)}{\alpha} > \left(\frac{2n+1}{2n+4} + \frac{2n^2+1}{2n^2+4n} \cdot \frac{\beta\theta c}{\alpha} \right) \frac{g_\theta f'_\theta(I_\theta)}{\theta}. \quad (4.13)$$

Again, the right hand side of the inequality is definitely smaller than 2 and generally smaller than or about 1, as all terms in the bracket are smaller than 1 and $g_\theta/\tilde{\theta} < 1$ as well. The left hand side is in our case always greater than 2 and is in general always about 1. Thus, as a general rule investments in marketing/distribution increase the own profit more than investments in product differentiation. Finally, we have to compare investments in product differentiation to investments in cost reduction.

Corollary 3 If firms are identical, investments in cost reduction are more profitable than investments in product/service differentiation if and only if

$$\frac{g_c f'_c(I_c)}{g_\theta f'_\theta(I_\theta)} > \frac{2n^2+n}{2n^2+2n+2} \cdot \frac{\alpha}{\beta\theta^2} + \frac{2n^2+1}{2n^2+2n+2} \cdot \frac{c}{\theta}. \quad (4.14)$$

Here, it is not clear which investment yields a higher return because it strongly depends on the chosen parameter values. In Figure 4.1 we used common-sense values²⁰ in order to visualize the discussed effects. As already mentioned above, we see that an investment in marketing/distribution bears the highest profitability for firm i . Cost reduction and investment in product/service quality have a much lower impact on profit. Does that mean that a firm in a Bertrand market should always invest in marketing/distribution rather than in cost reduction or quality/design enhancement in order to survive the shakeout?

In order to answer this question, we have to take the information of the firms into account. If the firm anticipates the shakeout by observing that many new players enter the industry and that not all of these firms will be able to survive in the long run, it might think ahead and involve the other firms' profits in its decision, because firms with negative profits will eventually exit the market. The best strategic effect of an investment would then be if it, on the one hand, raises the profit of the firm and, on the other hand,

²⁰See appendix K.1.

4 Shakeouts in Early Bertrand Markets

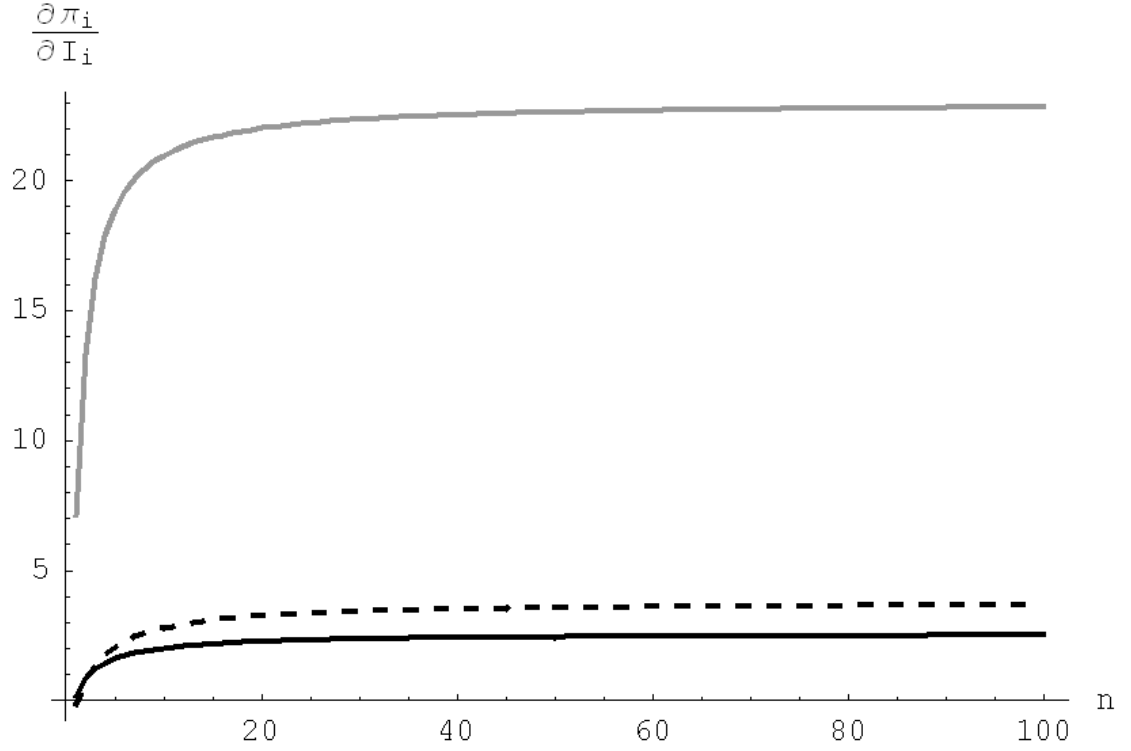


Figure 4.1: The marginal change in profit by investing I in either process innovation (*black line*), marketing/distribution (*gray line*) or product/service differentiation (*dashed line*) in a Bertrand market with independent market sizes against the number of firms in the market

lowers the profits of all other players in the industry. This is the same as asking which of the following derivatives for $m = c, \alpha, \theta$ is the highest:

$$\frac{\partial \pi_i^*(n)}{\partial I_{m,i}} - \sum_{j \neq i}^n \frac{\partial \pi_j^*(n)}{\partial I_{m,i}} \quad m \in \{c, \alpha, \theta\} \quad (4.15)$$

This leads us to the following Corollaries²¹:

Corollary 4 If firms are identical, *strategic* investments in cost reduction are more profitable than investments in marketing/distribution if and only if

$$\frac{g_c f'_c(I_c)}{g_\alpha f'_\alpha(I_\alpha)} \beta \theta > \frac{3n}{2n^2 + 1}. \quad (4.16)$$

²¹See Appendix J.2.

As the right hand side of the inequality is decreasing with increasing number of firms in the market, the strategic effect of investing in cost reduction will eventually become higher than the strategic effect of investing in marketing/distribution. Put differently, there exists a particular number of firms in the market for which investments in cost reduction are strategically more favorable than investments in marketing/distribution. Corollary 5 states a similar fact for the case of product differentiation.

Corollary 5 If firms are identical, *strategic* investments in product/service differentiation are more profitable than investments in marketing/distribution if and only if

$$\frac{g_\alpha}{g_\theta} > \frac{2n^2 + 2n + 1}{6n} \beta c + \frac{2n + 1}{6} \cdot \frac{\alpha}{\theta}. \quad (4.17)$$

Again, with a rising number of firms investments in product differentiation eventually become strategically better than investments in marketing/distribution. Thus, there also exists a particular number of firms for which it is better to invest in the former than in the latter. This number depends on the chosen parameter values.

Corollary 6 If firms are identical, *strategic* investments in cost reduction are more profitable than investments in product/service differentiation if and only if

$$\frac{g_c f'_c(I_c)}{g_\theta f'_\theta(I_\theta)} > \frac{2n^2 + n}{4n^2 + 2} \cdot \frac{\alpha}{\beta\theta^2} + \frac{4n^2 - 2n + 1}{4n^2 + 2} \cdot \frac{c}{\theta}. \quad (4.18)$$

As we do not have a significant difference in the number of firms in the numerator and denominator, it depends on the chosen parameter values, which investment is strategically better. For many reasonable values for firms in a goods market we experienced that the strategic effect of investments in cost reduction exceeds the strategic effect of investments in product differentiation. Labor-intensive service firms, however, have other underlying values, because they cannot reduce their costs as much as firms from a goods industry, as their costs mainly consist of wages which cannot be lowered easily. Thus, for many service firms, investments in cost reduction are not as strategically good as investments in service quality. However, in order to keep things simple, we will stick with values which imply the possibility of higher cost reduction.

If we plot the strategic change in profits using the same values as in Figure 4.1 we see in Figure 4.2 that the picture has changed completely as we already anticipated with Corollaries 4 to 6. If the firm is in a market with only a few firms it should invest in marketing/distribution. However, if the number of firms increases as it does before the shakeout, the best choice for firm i is to invest in cost reduction, followed by investments in product differentiation. This is in a sense obvious, because an investment in cost re-

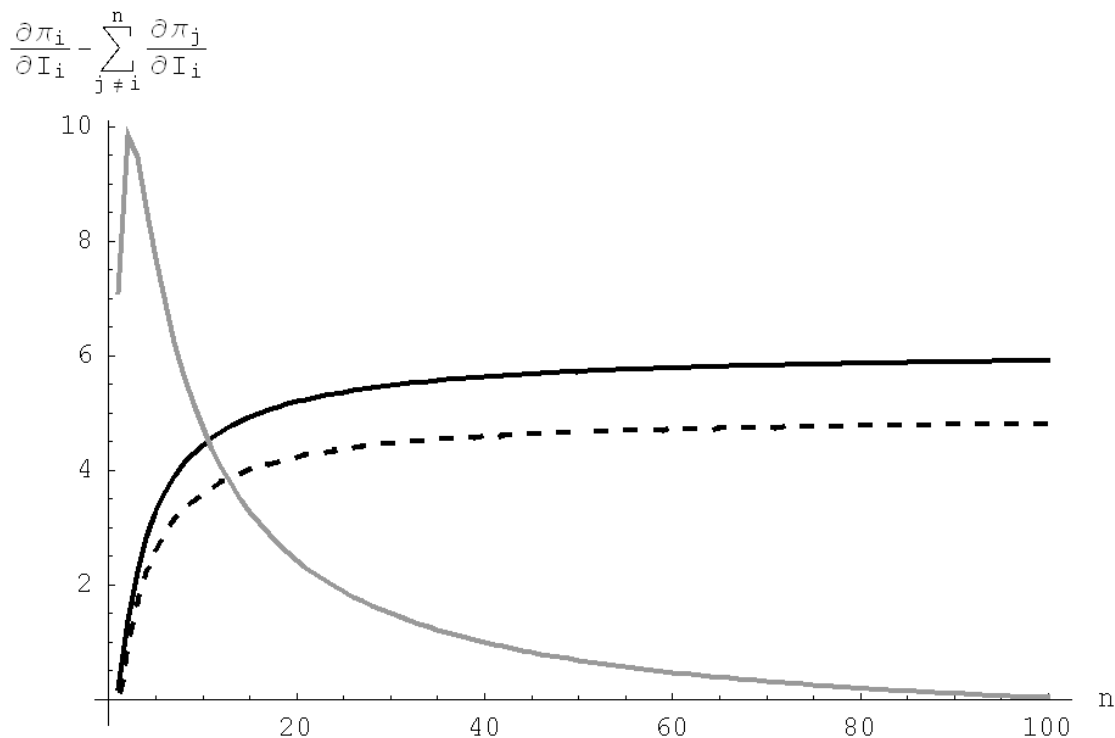


Figure 4.2: The *strategic* effect of investing I in either process innovation (*black line*), marketing/distribution (*gray line*) or product/service differentiation (*dashed line*) in a Bertrand market with independent market sizes against the number of firms in the market

duction or product differentiation hurts your rivals the most. With cost reduction, you are able to charge lower prices or, with a better product/service, you are more independent of your rivals' prices because your product is considered more valuable than the others. This is in line with the theory of Porter [51] where successful firms are either cost leaders or they successfully differentiated their product. However, these findings depend crucially on the amount of I which has been invested. By definition of f_c , f_α and f_θ , the level at which, e.g., the unit costs are very low is reached faster with an investment I than the corresponding level of product/service differentiation. To cover this fact and introduce dynamics into our model, we created an underlying industry life cycle (see appendix K.3). In each period the firms know the stage of the life cycle²² and have the opportunity to invest in their preferred measure. Firms only invest if the investments have a positive effect. They choose the investment which yields either highest growth in profit (see Figure 4.3) or the highest strategic effect on profit (see Figure 4.4). In

²²I.e. the number of firms in the market at that time.

other words, in Figure 4.3 firms were only able to invest in non-strategic investments whereas in Figure 4.4 firms invested strategically in line with 4.15. The differences are

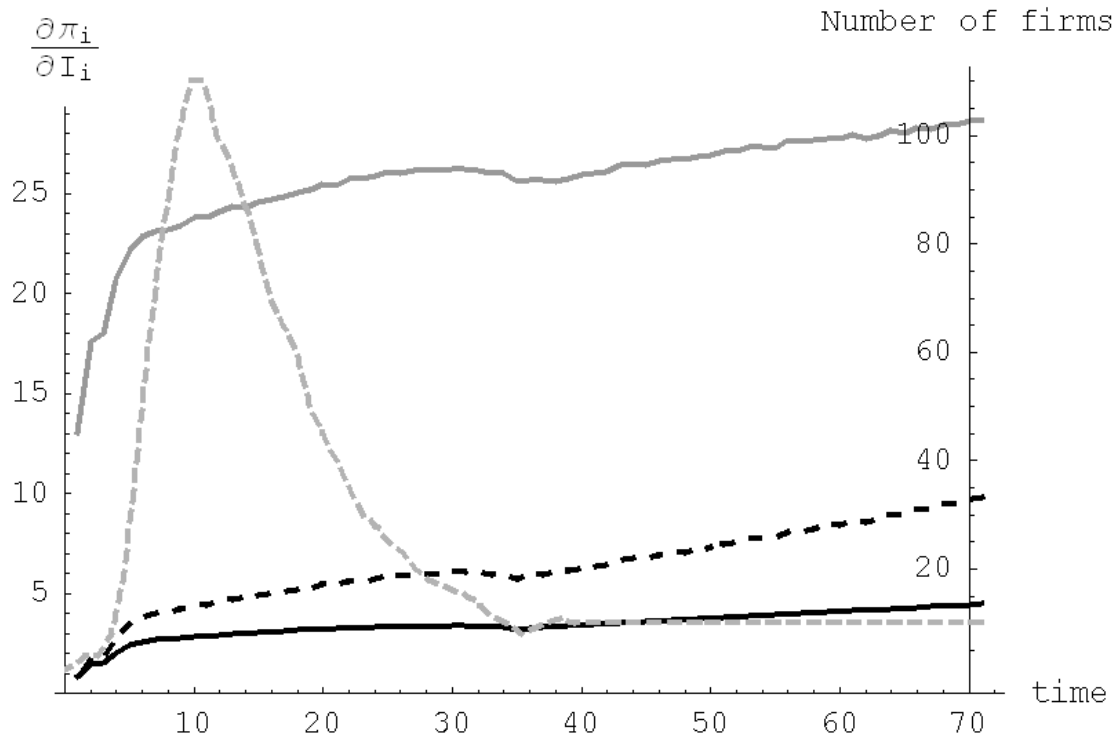


Figure 4.3: The marginal change in profit by investments in either process innovation (*black line*), marketing/distribution (*gray line*) or product differentiation (*dashed line*) over an industry life cycle (*gray, dashed line*) in a Bertrand market with independent market sizes

obvious. If firms only pursue profit maximization as in Figure 4.3 they invest heavily in marketing/distribution over the whole life cycle. Thus, with non-strategic firms investments in marketing/distribution would be the key factor of success for all firms in a Bertrand market in order to survive the shakeout. This, however, contradicts the views of the empirical literature as cited in Section 4.2.2. If firms invest strategically the picture changes. In Figure 4.4 we see that after the number of firms reaches a certain level the firms change their strategy from investments in marketing/distribution to investments in cost reduction. This strategy is carried out throughout most of the shakeout until the returns of further investments in cost reduction are diminished. These findings are in line with the existing literature. Therefore, our assumption of anticipating and strategic investment is crucial.

So what is the best strategy for a firm in a Bertrand market? The answer to this ques-

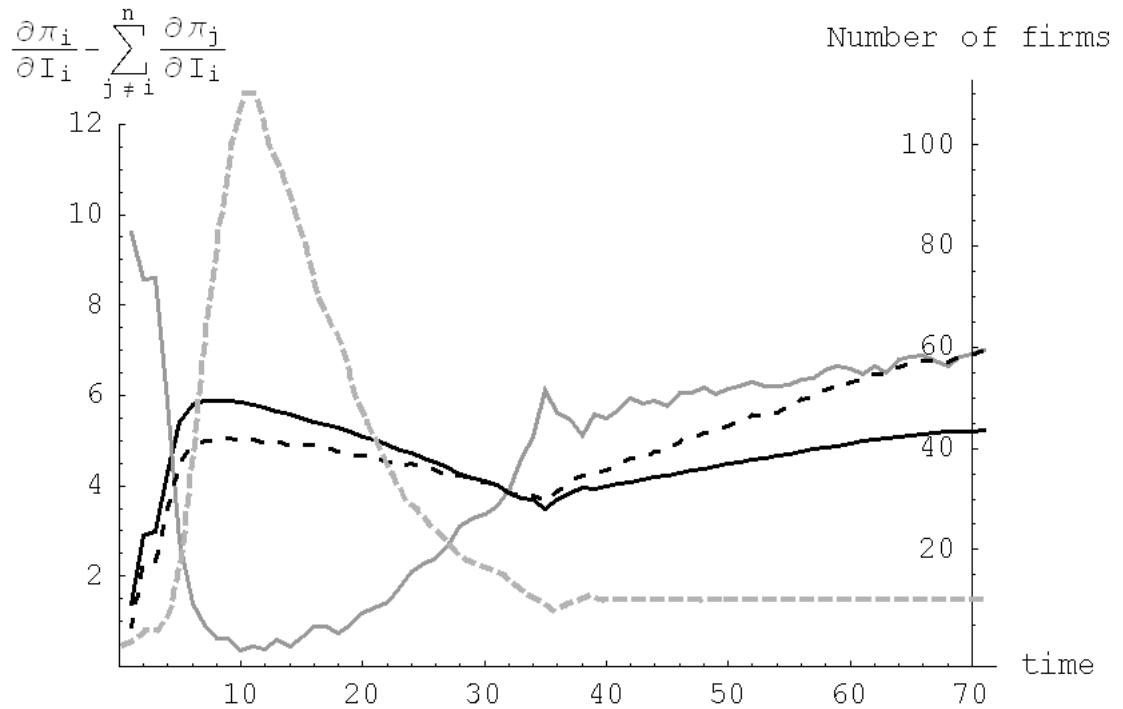


Figure 4.4: The *strategic* effect of investments in either process innovation (*black line*), marketing/distribution (*gray line*) or product differentiation (*dashed line*) over an industry life cycle (*gray, dashed line*) in a Bertrand market with independent market sizes

tion clearly depends on the timing of its entry and the nature of its business. If it is an early entrant it should at first try to expand its reach through investments in marketing/distribution (see Figures 4.2 and 4.4). If the number of producers continues to rise it should then change its strategy to investments in cost reduction. When process innovation consumes more and more money in order to further lower unit costs, the firm should change to investments in product differentiation. However, if it is a service firm having less potential of decreasing costs, the firm would start off with investments in marketing/distribution, would then continue by investing in service differentiation and would finally move to process innovation.

4.3.2.2 Interdependent maximal market demand

We now assume that each entrant takes a share of the exogenously given total market size, i.e., the entrant steals business from the incumbents. This is compared to the case just examined, where every entering firm brought in its own market size, the contrary

assumption. In general, the reality will lie somewhere between those two extremes. On the one hand, it will be hard to find an industry, where each firm brings in its own market size like in Section 4.3.2.1 without directly affecting its rivals. On the other hand, entrants - especially in new industries - will not only steal its maximum demand from an existing pie, as we assume in this section, but will also increase the general pie. However, we have to investigate both extremes in order to cover the whole range of possible forms of α and be able to investigate which strategy - subject to the number of firms in the market - is the best to survive the shakeout in a Bertrand market.

Therefore, we rewrite α_i as

$$\alpha_i = K \frac{\xi_i}{\sum_{j=1}^n \xi_j} \quad (4.19)$$

where K is the total market size and $\frac{\xi_i}{\sum_{j=1}^n \xi_j}$ the fraction which firm i serves. Investments shift the demand from one firm to another. This is implemented in the model by letting the firms invest in ξ :

$$\tilde{\xi}_i = \xi_i + g_{\xi,i} f_{\xi}(I_{\xi,i}) - \epsilon_i^{\xi}$$

The other forms of investment in θ or c remain the same as before. We can now use the equations (4.6) through (4.8) listed above by setting $\tilde{\alpha}_i = K \frac{\tilde{\xi}_i}{\sum_{j=1}^n \tilde{\xi}_j}$. Consequently, we only observe changes in equation (4.10) which becomes:

$$\frac{\partial \pi_i^*(n)}{\partial I_{\xi,j}} = \begin{cases} \frac{2ng_{\xi,j} f'_{\xi}(I_{\xi,j}) \sum_{k \neq j}^n \xi_k}{\beta \theta_i (2n+1)(n+1) (\sum_{k=1}^n \xi_k)^2} \cdot K \cdot q_i^*(n) & \text{for } j \neq i \\ \frac{2n(n+2)g_{\xi,i} f'_{\xi}(I_{\xi,i}) \sum_{k \neq i}^n \xi_k}{\beta \theta_i (2n+1)(n+1) (\sum_{k=1}^n \xi_k)^2} \cdot K \cdot q_i^*(n) - 1 & \text{for } j = i \end{cases} \quad (4.20)$$

As the derivative $\frac{\partial \pi_i^*(n)}{\partial I_{\xi,j}}$ has changed, Corollaries 1, 2, 4 and 5 also have to be changed. The following Corollaries 7 to 10 reflect these changes²³. Corollary 7 is the equivalent to Corollary 1 and investigates the difference between the non-strategic investments in marketing/distribution and cost reduction.

Corollary 7 If firms are identical, investments in marketing/distribution are more profitable than investments in cost reduction if and only if

$$\frac{g_{\xi} f'_{\xi}(I_{\xi})}{g_c f'_c(I_c)} > \frac{n^3 + n^2 + n}{(n+2)(n-1)} \cdot \frac{\beta \theta \xi}{K}. \quad (4.21)$$

²³See Appendix J.3.

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Here, we see that with exogenous market demand investments in cost reduction will eventually be more profitable than investments in marketing/distribution if the number of firms in the market increases. Accordingly, this holds also true for investments in product/service differentiation.

Corollary 8 If firms are identical, investments in marketing/distribution are more profitable than investments in product/service differentiation if and only if

$$\frac{g_{\xi} f'_{\xi}(I_{\xi})}{g_{\theta} f'_{\theta}(I_{\theta})} > \frac{2n^3 + n^2}{(2n + 4)(n - 1)} \cdot \frac{\alpha\xi}{\theta K} + \frac{2n^3 + n}{(2n + 4)(n - 1)} \cdot \frac{\beta c\xi}{K}. \quad (4.22)$$

As Corollary 3 remains almost²⁴ unchanged, we can conclude that if we assign an exogenous absolute demand to the model the assumption of strategically investing firms is not needed anymore in order to show that investments in cost reduction or product/service differentiation outweigh investments in marketing/distribution.

However, as the following two corollaries will show, by assuming strategically investing firms as in Section 4.3.2.1 the particular number of firms, for which the strategic effect of investments in cost reduction or product differentiation exceeds the effect of investments in marketing/distribution, is much lower than if non-strategic behavior is assumed. Or in other words: the point where these two kinds of investments take over is reached much faster.

Corollary 9 If firms are identical, *strategic* investments in cost reduction are more profitable than investments in marketing/distribution if and only if

$$\frac{g_c f'_c(I_c)}{g_{\xi} f'_{\xi}(I_{\xi})} \beta \theta > \frac{3(n - 1)}{2n^3 + n} \cdot \frac{K}{\xi}. \quad (4.23)$$

Corollary 10 If firms are identical, *strategic* investments in product/service differentiation are more profitable than investments in marketing/distribution if and only if

$$\frac{g_{\xi} f'_{\xi}(I_{\xi})}{g_{\theta} f'_{\theta}(I_{\theta})} > \frac{2n^3 + 2n^2 + n}{6(n - 1)} \cdot \frac{\beta c\xi}{K} + \frac{2n^3 + n^2}{6(n - 1)} \cdot \frac{\alpha\xi}{\theta K}. \quad (4.24)$$

Thus, the effect of foresight increases the advantage of the investments in process and product/service innovation. For high total market demand K this might be a crucial assumption in order to confirm that process and product innovation are more important than marketing/distribution before and during the shakeout.

This fact is illustrated in Figure 4.5, where only non-strategic investments were consid-

²⁴Just α changes compared to Corollary 3.

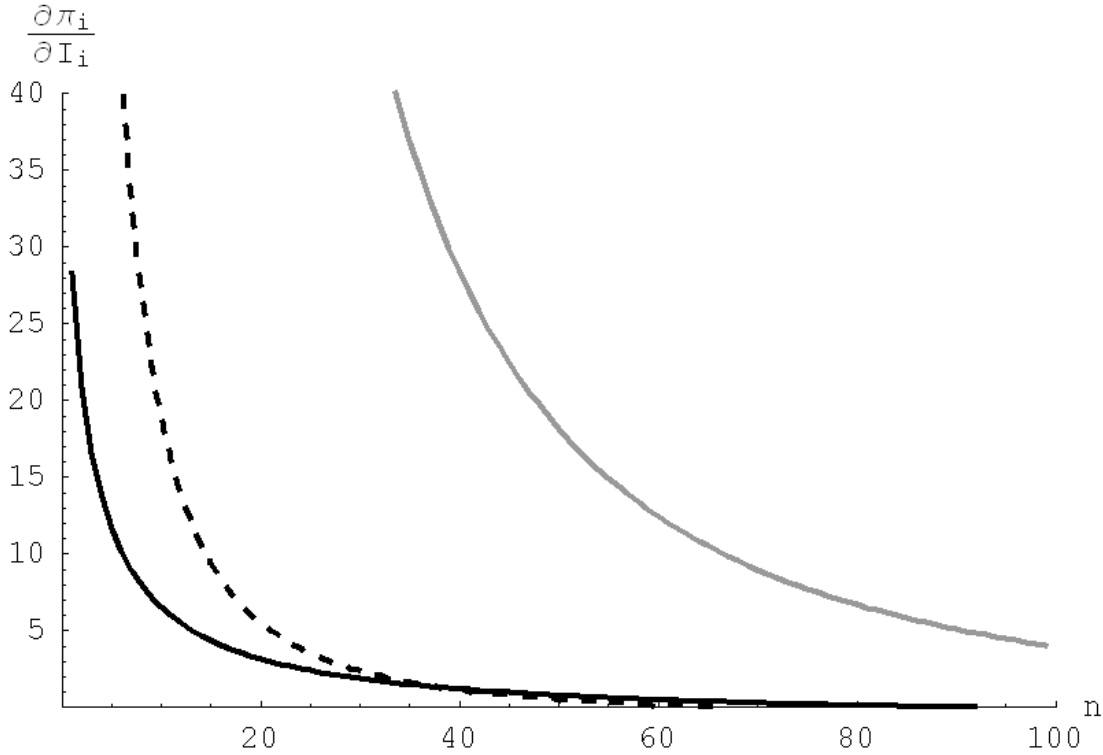


Figure 4.5: The marginal change in profit by investing I in either process innovation (*black line*), marketing/distribution (*gray line*) or product differentiation (*dashed line*) in a Bertrand market with interdependent market sizes against the number of firms in the market

ered, and Figure 4.6²⁵, where *strategic* investments were considered. In Figure 4.6 the number of firms, where investments in cost reduction outperform the other forms of investment is much lower than in Figure 4.5, where this point would be reached well above the number of 100 firms.

Summing up, we have provided an answer to the question of optimal investments in a young market competing over prices for both extreme forms of total market size. We introduced the crucial assumption of strategic investments which - with an endogenous definition of total market size - was the only way to align theory with the empirical findings in the literature. For exogenous total market size it tightened the conditions of the desired outcome. Now, we still have to analyze if the assumption of strategic investments has an effect on the firms' decisions in an environment, where a largely homogeneous product/service is produced/supplied, the production/service capacity is

²⁵The values used in the calculations can be found in Appendix K.2.

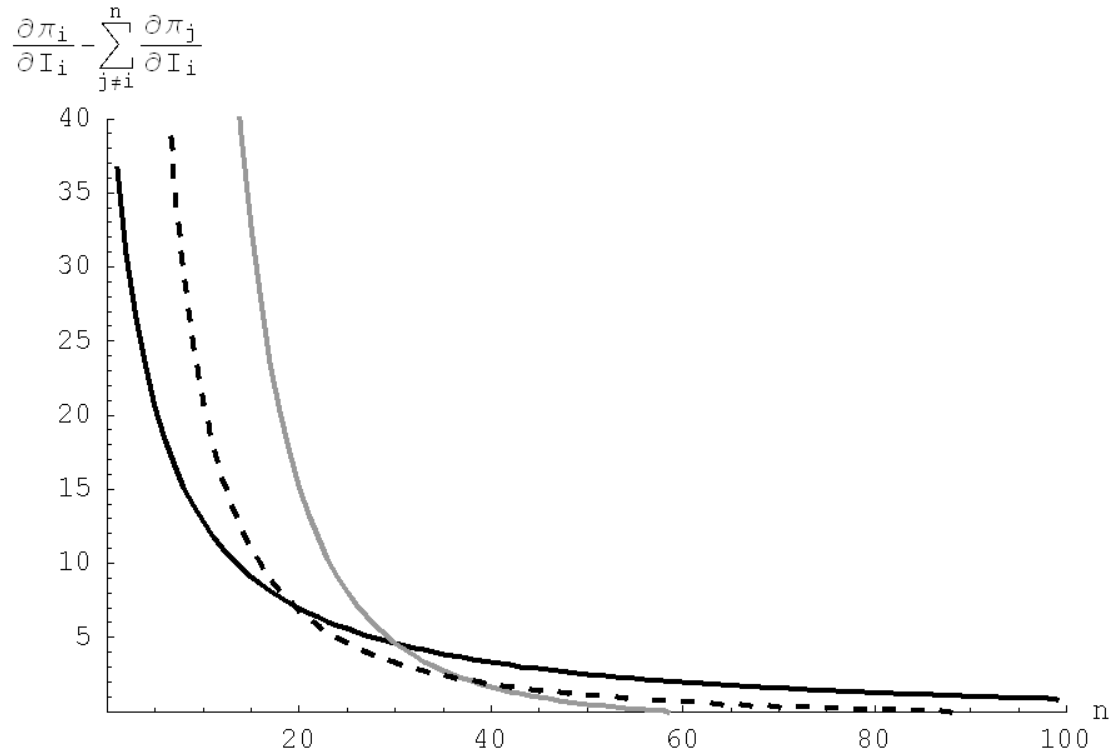


Figure 4.6: The *strategic* effect of investing I in either process innovation (*black line*), marketing/distribution (*gray line*) or product differentiation (*dashed line*) in a Bertrand market with interdependent market sizes against the number of firms in the market

relatively fixed and the firms compete over quantities - a Cournot market.

4.3.3 Cournot competition

In this environment a firm i faces a price

$$p_i = A_i - B \sum_{j=1}^n \theta_j q_j \quad (4.25)$$

where A_i is the maximum price a consumer is willing to pay for the product/service of firm i , $0 < \theta_i \leq 1$ is the product/service quality (and/or design) and q_i is the total quantity of product or service i . B serves as a scaling variable.

Again firms can invest in different measures. It may e.g. change the maximum price consumers are willing to pay for its product by investing in e.g. marketing which pushes the demand curve for its product higher - this corresponds to investments in A_i . But it

may also invest in process innovation which will lower the unit costs, or it may invest in measures to increase the quality of its product/service and differentiate it - corresponding to investments in θ_i .

Thus, we can rewrite the inverse demand function:

$$p_i = \tilde{A}_i - B \sum_{j=1}^n \tilde{\theta}_j q_j \quad (4.26)$$

using the following abbreviations

$$\begin{aligned} \tilde{A}_i &= A_i + g_{A,i} f_A(I_{A,i}) - \epsilon_i^A \\ \tilde{\theta}_i &= \theta_i - g_{\theta,i} f_\theta(I_{\theta,i}) + \epsilon_i^\theta \end{aligned}$$

The different investments $I_{A,i}$ and $I_{\theta,i}$ only affect A_i and θ_i via the functions f_A and f_θ which also have the property of $f(0) = 0$ and $f'(I) > 0 \wedge f''(I) < 0$ as in the Bertrand case. Uncertainty is introduced via the functions ϵ .

Investments in cost reduction are reflected in the profit function of firm i:

$$\pi_i = (p_i - \tilde{c}_i)q_i - I_{c,i} - I_{A,i} - I_{\theta,i} - F_i \quad (4.27)$$

with $\tilde{c}_i = c_i - g_{c,i} f_c(I_{c,i}) + \epsilon_i^c$. This leads us to the following profit maximizing quantities and prices:

$$q_i^*(n) = \frac{(n+1)(\tilde{A}_i - \tilde{c}_i) + \sum_{j=1}^n (\tilde{c}_j - \tilde{A}_j)}{B\tilde{\theta}_i(n+1)} \quad (4.28)$$

$$p_i^*(n) = \frac{(n+1)\tilde{A}_i + \sum_{j=1}^n (\tilde{c}_j - \tilde{A}_j)}{(n+1)} \quad (4.29)$$

Using (4.28), the maximum profit results to

$$\begin{aligned} \pi_i^*(n) &= B\tilde{\theta}_i(q_i^*(n))^2 - I_{c,i} - I_{A,i} - I_{\theta,i} - F_i \\ &= \frac{((n+1)(\tilde{A}_i - \tilde{c}_i) + \sum_{j=1}^n (\tilde{c}_j - \tilde{A}_j))^2}{B\tilde{\theta}_i(n+1)^2} - I_{c,i} - I_{A,i} - I_{\theta,i} - F_i \end{aligned} \quad (4.30)$$

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As we are interested in the effect of investment I on the firms' profits, we take the derivative of the profit to $I_{c,i}$, $I_{A,i}$ and $I_{\theta,i}$, *ceteris paribus*.

$$\frac{\partial \pi_i^*(n)}{\partial I_{c,j}} = \begin{cases} \frac{-2g_{c,j} f'_c(I_{c,j})}{n+1} \cdot q_i^*(n) & \text{for } j \neq i \\ \frac{2ng_{c,i} f'_c(I_{c,i})}{n+1} \cdot q_i^*(n) - 1 & \text{for } j = i \end{cases} \quad (4.31)$$

$$\frac{\partial \pi_i^*(n)}{\partial I_{A,j}} = \begin{cases} \frac{-2g_{A,j} f'_A(I_{A,j})}{n+1} \cdot q_i^*(n) & \text{for } j \neq i \\ \frac{2ng_{A,i} f'_A(I_{A,i})}{n+1} \cdot q_i^*(n) - 1 & \text{for } j = i \end{cases} \quad (4.32)$$

$$\frac{\partial \pi_i^*(n)}{\partial I_{\theta,j}} = \begin{cases} 0 & \text{for } j \neq i \\ Bg_{\theta,i} f'_\theta(I_{\theta,i}) \cdot q_i^*(n)^2 - 1 & \text{for } j = i \end{cases} \quad (4.33)$$

From (4.31) to (4.33) we learn that the effect of investing in cost cutting or investing in marketing/distribution depends equally on n. Thus, the marginal impact of investment $g f'(I)$ determines which investment prevails for all n. Besides, both are also increasingly effective with rising quantities and investing in one of them will have a negative effect on the rival firms. This is different if we invest in product differentiation via θ_i . Here we do not observe any effect on rival firms. However, its positive effect on profit depends stronger on the quantity than for the two other kinds of investment.

Assuming that the firms are not investing strategically, we already established that investments in marketing/distribution and investments in cost reduction are changing parallel in the sense that their ratio does not change with the number of firms in the market. But in the case of product differentiation we can make the following Corollary²⁶:

Corollary 11 If firms are identical, investments in cost reduction or marketing/distribution are more profitable than investments in product/service differentiation if and only if

$$\frac{g_m f'_m(I_m)}{g_\theta f'_\theta(I_\theta)} > \frac{1}{2n} \frac{\tilde{A} - \tilde{c}}{\tilde{\theta}} \quad \text{for } m \in \{A, c\}. \quad (4.34)$$

Thus, with an increasing number of firms in the market investments in cost reduction or marketing/distribution raise profits more than investments in product differentiation.

Now, we have to check whether our assumption of strategic investments (4.15), which we

²⁶See Appendix J.4.

needed in the Bertrand case in order to be in line with the empirical findings, changes the results in the Cournot case significantly.

As the effects of investments in cost (4.31) or marketing (4.32) on profit are equal except for the marginal impact of investment $g f'(I)$, our assumption does not change the outcome. It does change the outcome for product differentiation compared to both other types, though.

Corollary 12 If firms are identical, *strategic* investments in cost reduction or marketing/distribution are more profitable than investments in product differentiation if and only if

$$\frac{g_m f'_m(I_m)}{g_\theta f'_\theta(I_\theta)} > \frac{1}{4n-2} \cdot \frac{\tilde{A} - \tilde{c}}{\tilde{\theta}} \text{ for } m \in \{A, c\}. \quad (4.35)$$

However, the change does not affect the basic direction, it only tightens the effect of Corollary 11. Still, investments in product differentiation become less important as compared to the two other types with an increasing number of firms in the market. Thus, in Cournot competition the outcome with strategic investments is very similar to the case of non-strategic behavior.

4.4 Discussion

If we compare our results with the received theory we see that in the Cournot case by setting $g_c f_c(I) > g_A f_A(I)$ our model corroborates existing theories, such as Klepper [40], Carree and Thurik [11] (which were also based on Cournot models), and empirical evidence provided by Klepper and Simons [42] for the markets of automobiles, televisions, tires and penicillin (which were at least in their beginning Cournot markets). In these cases R&D in process innovation was the driving force which led to the shakeout of the least successful firms due to the fact that it is the dominant strategy for firms in a Cournot market in order to survive the shakeout. However, by introducing the possibility of investing in marketing/distribution we could show that, depending on its efficiency, it can also be a good measure to survive the shakeout by increasing the individual maximum price of the firm. However, the impact of investments in marketing/distribution ($g_A f_A(I)$) will probably not be as high as the impact of investments in cost reduction ($g_c f_c(I)$). Thus, for the Cournot case we support the views of Klepper [40], Carree and Thurik [11] and Klepper and Simons [42].

With Bertrand competition, however, it becomes more complicated. If we do not specify a particular exogenous total market size and only assume non-strategic behavior, we are

not able to confirm R&D in process innovation as a dominant strategy of a firm during the shakeout. On the contrary, investments in marketing or distribution dominate over the other forms of investments. Only if we introduce the assumption of strategic foresight, we are led to a result where process innovation plays the major role.

However, by introducing an exogenous total market size to the model, non-strategic-behavior leads to the fact that investments in process or product innovation overcome investments in marketing/distribution eventually. Yet, if we again introduce strategic foresight by the firms here, this happens much faster - implying a lower number of firms in the market. Therefore, this assumption remains reasonable. However, the question, if economies of scale in R&D in unit cost reduction are really the only driver of the shakeout in a Bertrand market, could not be fully solved, as our own analysis suggests that in price competition a strategy of differentiating its own product/service might just work out as well²⁷ which is in line with the theory of Porter [51] for the long-run.

Concerning the findings of Simons [55] our model confirms his hypotheses four to six²⁸. Number four is verified by our model because it predicts that an early entrant can choose its optimal investment strategy right away and therefore has a head start with higher output. And as the effect on profit of all investment choices increases with output an early entrant's profit is much higher as a later entrant's profit which is confirmed by our model. Thus, early entrants will not exit as frequently as later entrants. The second part of hypothesis four can also be explained with our model. As the firms in our model anticipate the shakeout they tend to invest their money in a way that it increases profit and hurts the rival. If there was no shakeout, the firms would only try to maximize their own profit, which would in return leave the later entrants more unaffected. This finding holds especially true in Bertrand markets, where the strategies differ with the anticipation of a shakeout. The solution of our model with price competition also confirms hypothesis five, as both R&D in unit cost reduction and investment in product differentiation are the best strategies to pursue in the wake of a shakeout. And through these investments, improvements in the product and manufacturing methods are achieved. Hypothesis six is already implemented in our model. As early entrants have already increased their profit by investing right from the start, they are able to invest more money and as $f'(I) > 0$ they will have a higher return.

But what about "economies of scope" as a reason for shakeout as Allanson and Montagna [2] propose? Our model cannot test this hypothesis as it does not incorporate different

²⁷Especially in (labor-intensive) service industries.

²⁸The other hypotheses cannot be tested with this model as they refer to either entry and exit rates or internationally similar patterns of shakeouts.

varieties of products in one firm. However, generally speaking, economies of scope are perhaps not a cause of a shakeout, but rather a consequence of it, because it is more a characteristic of mature industries that firms increase their product portfolio.

The question remains whether our analysis offers new insights into the shakeout phenomenon. Looking at a general²⁹ Bertrand market we saw that the simple assumption of profit maximizing agents disagrees with the empirical facts. Only the assumption that (some of) the existing and entering firms anticipate the shakeout and prepare for it by investing strategically produces the empirically backed results. This assumption does not affect the results for the Cournot case, though. If the market competes on quantities both models of non-strategic investments and strategic investments back the existing theory. Therefore, the assumption of anticipation is crucial in the sense that a shakeout in an early market - either Bertrand or Cournot - will not be as severe (or even might not happen in the case of Bertrand competition) if firms do not look ahead and invest strategically. Additionally, the firms who did not anticipate a shakeout will have to leave the industry eventually as they have not prepared for the falling prices. Thus, the most successful in process innovation among the firms survive the shakeout, whereas the least successful and/or the ones who did not foresee the shakeout will leave the market. We can conclude that foresight of a coming shakeout is important to survive it and additionally, that foresight will lead the firms' investments into cost reduction.

²⁹I.e. that the market size parameter lies somewhere in-between the two extremes outlined in Section 4.3.2.1.

4.5 Conclusion

In this paper we examined how firms who anticipated an industry shakeout can invest strategically in process innovation, product or service differentiation or marketing/distribution to increase their profits and survive. Two standard models of Industrial Organization - the differentiated Bertrand and differentiated Cournot model - were used to describe industry competition.

In the case of Bertrand competition the optimal strategy of a firm depends crucially on the number of firms in the market and strategic foresight. If the firm enters the market early, it is best to quickly invest in marketing/distribution in order to raise output and profit. Then, with a rising number of firms it will eventually be better to invest in process innovation or product/service differentiation, depending on the investments' respective marginal profitability. In our case with reasonable parameter values for firms in a goods market, investments in cost reduction outweighed investments in product differentiation, whereas firms in a service market would rather invest in service differentiation than in process innovation. That investments in marketing/distribution fall short of the other types of investment in terms of marginal profitability is mainly due to the fact that investments in marketing may spill over to the rival firms (customers growing awareness of the product/service also increases their curiosity for the rivals' products, for instance). But the lead of investments in process innovation or service differentiation does not hold forever. Depending on how much ground the firm may win through the other kinds of investment the strategic effect on profit will deteriorate with rising investments in c or θ . Yet, success in process innovation (service differentiation) is essential for surviving the shakeout in a goods (service) market.

This holds true for both endogenously and exogenously determined total market size. However, with endogenously determined size of the total market, the non-strategic firms will only invest in marketing/distribution, which not only leaves their rivals unaffected but, even worse, raises their profits as well. Here, the assumption of strategic foresight is essential for the upper result. With exogenously determined total market size this assumption is not necessary to hold. Yet, in this case invoking the assumption tightened the condition that investments in process innovation (service differentiation) will be the best choice with a rising number of firms in a goods (service) market. Thus, we can conclude that, in general, anticipation of a shakeout and strategic preparation for it will be beneficial for survival.

Rational players with strategic foresight are more likely to survive, because they understand to make strategic investments that create competitive advantage for themselves but hurt their rivals. Firms that do not anticipate the shakeout are very likely to exit the market in its course. A very interesting effect emerges: the more players in the industry develop strategic foresight and expect a shakeout, the more they will invest strategically and hurt each other. Thus, the firms' strategic behavior will trigger and aggregate the shakeout. In other words, the shakeout turns into a "self fulfilling prophecy".

Under Cournot competition the best strategy for a firm in a new goods or service market is to be a cost leader, irrespective of a shakeout. We find that the marginal profitability of investment in process innovation - assuming reasonable values for the variables - exceeds the other marginal profitabilities of possible investments. Only if returns diminish after high investments in cost reduction - meaning that unit costs cannot be lowered a lot anymore - investments in marketing/distribution become more profitable. This strategy is dominant, independent of firms' ability to strategically anticipate a shakeout.

The model can be modified along several dimensions. The assumption of constant unit costs can be easily relaxed. Explicitly introducing the time in our calculations and letting the firms evaluate their future profits and the investments they want to make without an underlying industry life cycle would lay the ground for an analysis of the evolution of the number of firms over time³⁰. In this context, it would also be interesting to examine strategic investments with regard to soft and tough commitments of the firms and their effect on the industry life cycle. Another improvement of the model would definitely be the introduction of incomplete information.

However, although the model is quite simple, it is still able to generally prove an important aspect of industry evolution: by introducing anticipation of the shakeout we could show that, independent of the kind of competition in the market, process innovation is a key reason for the shakeout in goods and service markets.

³⁰The crucial aspect would hereby be the entry and exit specifications.

5 Conclusion

The main theme of the thesis is the evolution of the service industry structure over time. We first investigated how a change in the institutional or legal setting may disrupt the industry life cycle, in particular its maturity phase. The recent EU directive on services, which will come into force in the different member states soon, served as an example for an exogenous shock that may severely change many service industries. We also analyzed the shakeout phase of an industry life cycle under Bertrand competition in order to find adequate strategies for service firms, after the directive has come into force, and to fill gaps in the general understanding of the basic mechanisms ruling the firm shakeout. Our investigation tools in both topics were the differentiated Bertrand and Cournot model with n firms, which suit very well to service industries in general.

In a first step we investigated which immediate effects the EU directive on services has on the service market right after it comes into force. Our model featured two country markets - a home or domestic market and a foreign market - which, prior to the directive, are de facto closed service markets. The firms in the domestic country have higher quality and costs than the firms from the foreign country. When the markets opened the firms from both countries had the possibility to either enter the other market temporarily, which would increase their costs per service by a country-specific transaction cost factor, or permanently by opening a branch, which implies the costs per service of the other firms in that country¹. The quality, however, remained unaffected by these changes as it was set to be country-specific. We then analyzed the changes in firm performance and which measures a domestic firm can take in order to experience a higher profit after the opening. We also investigated the changes in general welfare right after the directive has come into force. In order to have the full spectrum of possible services we investigated both Bertrand and Cournot competition as well as segmented versus integrated markets in both countries.

¹This distinction illustrated the different ruling of the directive concerning temporary and permanent supply of services.

5 Conclusion

Domestic firms will experience higher profits under Bertrand competition

- if the ratio of costs between the foreign firms and them exceeds a certain threshold or, equivalently,
- if the ratio of qualities exceeds a certain threshold², or
- if the total market size of the foreign country exceeds a certain threshold.

However, as the ratio of costs (or quality) would have to be very high³, the sheer market size of the European Union is the key factor which might yield a positive profit effect for domestic firms after the opening. Although, as the market size threshold depends highly on the number of foreign firms, this statement can be at least doubted.

If firms compete under Cournot domestic firms experience higher profits after the opening

- if all firms supply the other market only temporarily and the ratio of costs between the foreign firms and them exceeds a certain threshold or, equivalently,
- if the total market size of the foreign country exceeds a certain threshold.

The first condition is very strict, and if the ratio of costs is also very high, domestic firms will only benefit from the opening if the new market is big enough.

However, all firms from both countries will prepare themselves for the opening. Domestic firms will mainly try to improve their quality as they are not able to lower costs enough, because wages are the biggest piece in the costs of most service firms and cannot be easily adjusted due to collective wage agreements. Contrarily, foreign firms are not able to improve their quality that fast so they will try to lower their costs even further. As a first effect, we expect the EU directive on services to split Europe further into a high- and low-quality service market⁴.

Next we asked, how will firms offer their services? Here we found that it will be profit maximizing for domestic firms to open a branch in the new country, whereas foreign firms will only supply their new market temporarily. This holds for both kinds of competition, if unit costs satisfy certain inequality relations (See Section 2.3.1).

Concerning total welfare the domestic country will most likely⁵ be better off after the

²If it is not exogenously set.

³Much higher than the actual ratio of costs of about 0.2.

⁴This is in line with the rather intuitive findings of the German Research Institute for Public Administration in Speyer [8].

⁵If the number of incoming foreign firms is not extremely high, which is unlikely as a foreign firm will not enter the domestic market when it faces negative profits there.

opening if the foreign country is set to be the European Union, irrespective of the underlying competition or the kind of supply by the firms. This is due to an increase in consumer surplus on account of lower prices and higher amounts of services. Hence, setting the domestic country to be Germany we concluded that the EU directive on services will benefit Germany at least in the short-run (and if governmental tax income is not included).

What, however, is the long-run impact of the directive? As we did not include the possibility that domestic firms will shut down their branch in the domestic country in order to further increase profits we made an assumption which is reasonable in the short-run, but which definitely has to be dropped in the long-run. Additionally, wages are not fixed in the long-run. They are not independent of the demand for labor, which in turn depends on the amount of services coming from a country. Thus, the once favorable situation for the domestic country after the opening of its market might change quickly - especially after allowing for taxation.

We used an iteration model to predict where firms would locate and how the wages developed, which were assumed to be the only cost factor. In order to introduce some friction we assumed that, (a), firms were not able to choose every time step where or if they opened a branch and (b), that their decision was based solely on unit costs in both countries. After the firms had decided where they opened a branch, the program calculated the amount of services coming from each of the countries. These amounts, in turn, determined the wage via a linear demand curve⁶ which we derived from basic variables. Additionally, the prices and amounts of the services and the profits of the firms were calculated, from which the total surplus - consisting of the producer, consumer and government surplus - was derived. Again, we analyzed both price and quantity competition in segmented and integrated markets⁷. The characteristics of our model were analyzed for Germany as the domestic country and Poland as the foreign country. The welfare analysis, however, based on the more important case that Germany is the domestic country and the rest of the European Union the foreign country.

Concerning the development of wages we found that a country's ability to recover after the market opening highly depends on wage flexibility. The more flexible wages are

⁶We again included some friction coming e.g. from labor unions.

⁷However, as before the differences between segmented and integrated markets were from a country-wide view not significant. The results are therefore robust for many internationally tradable services.

5 Conclusion

the faster the firms (re)open branches in that country, which is important for the tax revenue of the government⁸.

At the firm level, the domestic firms experience a sharp fall in profits right after the opening. However, after a while they regain a large share due to the relocation and the change in wages for all firms. However, their profits do not reach initial levels again.

The introduction of taxation changes the outcome concerning total surplus compared to our previous research. Due to the reduced government surplus after the opening the increase in consumer surplus is outweighed by the decrease of producer and government surplus. Thus, with taxation, the welfare in Germany decreases right after the opening of the service market. However, with changing wages in both regions the total surplus recovers again and reaches the pre-opening level. Whether it may even exceed this level depends on the number of firms entering Germany. In any case, the German welfare in the long run has about the level as before the markets were open (relative changes range only in the per mil regime⁹), whereas the rest of the European Union¹⁰ suffers from a small welfare decrease. These findings also hold under both kinds of competition, although Cournot competition is socially more desirable as the consumer surplus is higher than under price competition.

We could also derive the policy recommendation that a weakening of the general collective labor agreements would not only make wages more flexible, but as a consequence increase the speed of adjustment after the opening, i.e. Germany would get faster through the initial reduction of total surplus. Other possible measures - like e.g. cutting unemployment aid - were found to be socially not desirable as surplus would be shifted from consumers to producers and the government. We also found that lowering German labor standards - an often heard recommendation in the media - is not recommendable for Germany, because it will raise the unemployment rate after the directive comes into force.

With these findings we can now generally conclude that the EU directive on services definitely deserves full attention. Its economic implications depend on a number of factors and are therefore hard to grasp. However, we could show that its politically carried reputation, that it will be of great benefit to all countries, does not hold. Countries like

⁸Besides, of course, other "secondary" effects, like e.g. a decrease of the unemployment rate, which is socially even more important.

⁹1/1000.

¹⁰If taken only as one nation, which is of course a very rude approximation.

Germany might be better off in the end - if they are at all - but it is a long and hard walk with socially very undesirable side effects. A few measures like an increase in wage flexibility might ease the first shock, but it is mostly on the domestic firms to improve their competitiveness. Which steps they should take in order to be more competitive was analyzed in the third part of this thesis, on which we will come back below.

Other possible regulatory steps in order to reduce the negative effects of the directive are rare. On the one hand, they have to be in line with the directive, which might be quite difficult, because one of the directive's major goals is to reduce national rulings to a minimum. On the other hand, the effects of government measures might be socially undesirable, although the total surplus is raised.

However, as our model could not incorporate all possibilities¹¹, we cannot finally judge about the benefits of the directive. History (and innovation research) has shown that increasing competition will often lead to eventually stronger firms and greater benefits for all¹².

There are of course many possibilities to further improve our models like e.g. quantity dependent unit costs or incomplete information, which will probably not lead to significantly different results. Yet, our findings are based upon the characteristics of a specific service and other variables like the transaction factor which we could only estimate. Other values for the variables will change the outcome but not the general development.

There are also other effects, which we did not consider, because they would have only enhanced our findings but complicated the model, like the inclusion of government expenditures for the unemployed or the possibility of entry and exit of firms.

Further research should mostly focus on taxation and the possibilities of governments to strategically use it in order to reduce the negative effects of the directive. In this context, letting the firms decide on the basis of their profits after taxation would introduce tax competition. It could also be interesting to examine the effects of excess entry prior to the opening and the effects of entry and exit on the total surplus of both countries.

We have investigated the implications of the EU directive on services for Germany and its service firms. However, we always implicitly assumed that German service firms are somewhat surprised about the entry of many foreign firms and that they will not change

¹¹We focused, for instance, particularly on labor-intensive services.

¹²Typical examples are the automotive industry or the printing machine industry in Germany.

5 Conclusion

their business strategy on account of the directive. We also assumed that they did not prepare themselves. This led to the question of how to cope with increasing competition. A familiar research focus can be found in the literature on firm shakeout in an industry life cycle. A lot of research in this field tries to identify the reasons for the shakeout, which also implies the best business strategies in order to survive tough competition (as it will be the case after the EU directive comes into force). However, as they mainly investigated goods industries and always assumed Cournot competition, we could not use their findings for the service industry, which in great parts competes on prices right away.

Therefore, we investigated the shakeout phase under Bertrand competition. In particular, we wanted to check whether the well-known empirical regularities for goods industries carry over to service industries. Our oligopoly model featured n firms¹³, that could invest in cost reduction, service (product) differentiation or marketing/distribution in order to increase their profits. We could show that service differentiation (*process innovation*) is the main driver of the shakeout and the key factor to survive it in service (*goods*) markets. This first conclusion is one of our main contributions to the general shakeout theory and already implies the best strategy German service firms should pursue in the wake of the EU directive.

In the Bertrand model we distinguished the two extreme cases of independent and interdependent total market sizes. In the first case the firms bring their own market size into the market and thus make the market pie bigger. In the second case, the market pie is given and remains unchanged by the increasing number of firms, which leads to business stealing. In our opinion the independent total market size is more important in new industries. We nevertheless investigated both forms in order to be clear about which investment is the most important to survive a shakeout. In the case of independent market sizes we needed a crucial assumption in order to confirm the empirical results. We had to assume that firms anticipate the coming shakeout. Only then, they invested in cost reduction or service improvements, which are the key factors found empirically. This assumption was implemented in our model by maximizing the strategic profit of each firm, meaning the difference between the profit of the firm and the aggregated profits of all other firms. A rational firm would do so if it knew that a shakeout is about to come and that only the firms with the highest profits (or positive profits) will survive.

Concerning the interdependent market sizes we did not necessarily need this assumption, but it essentially strengthened the outcome that service differentiation (*process innova-*

¹³As our model did not include service-specific assumptions or parameters, it also fit to goods markets which start off in Bertrand competition.

tion) is the most important measure in service (*goods*) markets in order to survive the shakeout.

We also analyzed strategic foresight in the context of Cournot competition, which typically has been assumed in the existing theoretical shakeout literature. Our findings also hold for Cournot competition and are thus robust as to the type of competition.

These findings lead to our second conclusion. Firms which anticipate the shakeout are more likely to stay in the market than those who don't. The latter ones are highly likely to exit in the course of the shakeout. We can even conclude that the anticipating firms trigger the shakeout because their investments indirectly hurt their rivals. Hence, if most of the firms in the industry develop strategic foresight, the shakeout will be more severe¹⁴. In other words, if firms had no strategic foresight, a shakeout might even not happen, because their investments would not hurt the rivals. Thus, anticipating a shakeout leads to kind of a "self fulfilling prophecy".

At a more general level we may conclude that the best strategy for surviving a shakeout in labor-intensive service markets under price competition¹⁵ is quality differentiation. If firms are not able to change the amount of services they offer very easily, they face quantity competition. Then, cutting costs through e.g. better processes is very important. Alternatively, reducing costs through wage cuts is fairly risky, though, as the employees might leave the firm. Lower wages together with a participation in profit might be a solution here. This could be the subject of further research.

Other topics of subsequent research should focus on the assumption of foresight. By letting the firms maximize their future profits under the anticipation of a shakeout and by including *basic* entry and exit specifications, an industry life cycle might be generated based only on standard model parameters, which has not been done before.

Concerning the EU directive on services, we can now conclude that, besides the regulatory possibilities of the German government, the domestic firms have to think ahead and improve their competitiveness through investments in the quality of their services. This is a lesson we learned from our investigation of the shakeout. When the number of firms increases under price competition the firms are best off if they invest in cost reduction or service quality¹⁶. As the foreign firms already have very low costs and the

¹⁴Which means that more firms will have to exit the market.

¹⁵Which is the case for most services where employees are not rare and the amount of services can be changed rather easily.

¹⁶See 4.4 and 4.5.

5 Conclusion

effects of investments in cost reduction in Germany are very low¹⁷ due to strong labor unions, the firms will have to invest in differentiation in order to soften the negative effects of the opening and survive in the long-run.

In summary, we described the basic mechanisms in the evolution of a service industry ranging from the shakeout to a coming disruption of its mature state. We were able to fill previous gaps in the shakeout literature and contribute to the up-to-date discussion about the EU directive on services, whose implications were found to be not as good as usually assumed. Although the research was purely on a theoretical level, the application of simple and well proven models allowed a sound judgment on the economic effects of the directive.

¹⁷I.e. f_c from chapter 4 is very low.

A Proof of Corollary 1

The basic idea underlying Corollary 1 is that if $x_1 = \frac{c_B}{c_A}$ from $\Delta\pi_A(x_1) = 0$ is negative ($x_1 < 0$) then $c_B < 0$, because c_A is positive per definition. But as the costs of firms in country B cannot be lower than 0 the profit difference for A-firms ($\Delta\pi_A$) must be bigger than zero for all *positive* ratios of the costs. We will now use this argument for the exemplary proof of Corollary 1a¹.

$$\begin{aligned}
& \Delta\pi_A > 0 \quad \forall x_1^t = \frac{c_B}{c_A} < 0 \\
& \Downarrow \\
& \frac{K_B + \delta_{BA}K_A - \beta(1+\xi)(\delta_{AB} + \delta_{BA})\theta_{ACA}}{\beta\xi(1+\delta_{BA}^2)\theta_{BCA}} = \\
& + \left[\left(\frac{K_B + \delta_{BA}K_A - \beta(1+\xi)(\delta_{AB} + \delta_{BA})\theta_{ACA}}{\beta\xi(1+\delta_{BA}^2)\theta_{BCA}} \right)^2 - \frac{(K_A - \beta(1+\xi)\theta_{ACA})^2 + (K_B - \beta(1+\xi)\delta_{AB}\theta_{ACA})^2}{\beta^2\xi^2(1+\delta_{BA}^2)\theta_B^2c_A^2} \right. \\
& \quad \left. + \frac{2n_A + 2n_B + 1 + (n_A + n_B)^2}{\xi^2(1+n_A)^2} \cdot \frac{(K_A - \beta\theta_{ACA})^2}{\beta^2\theta_B^2c_A^2(1+\delta_{AB}^2)} + \frac{(n_A + n_B + 1)^2}{\beta\xi^2(1+\delta_{BA}^2)} \cdot \frac{F_A}{\theta_{BCA}^2} \right]^{1/2} \\
& \quad \Updownarrow \\
& 0 < - \frac{(K_A - \beta(1+\xi)\theta_{ACA})^2 + (K_B - \beta(1+\xi)\delta_{AB}\theta_{ACA})^2}{\beta^2\xi^2(1+\delta_{BA}^2)\theta_B^2c_A^2} + \frac{(n_A + n_B + 1)^2}{\beta\xi^2(1+\delta_{BA}^2)} \cdot \frac{F_A}{\theta_{BCA}^2} \\
& \quad + \frac{2n_A + 2n_B + 1 + (n_A + n_B)^2}{\xi^2(1+n_A)^2} \cdot \frac{(K_A - \beta\theta_{ACA})^2}{\beta^2\theta_B^2c_A^2(1+\delta_{AB}^2)} \\
& \quad \Updownarrow \\
& \exists \hat{K}_B^t : \frac{(K_A - \beta(1+\xi)\theta_{ACA})^2 + (\hat{K}_B^t - \beta(1+\xi)\delta_{AB}\theta_{ACA})^2}{\beta^2\xi^2(1+\delta_{BA}^2)\theta_B^2c_A^2} = \frac{(n_A + n_B + 1)^2}{\beta\xi^2(1+\delta_{BA}^2)} \cdot \frac{F_A}{\theta_{BCA}^2} \\
& \quad + \frac{2n_A + 2n_B + 1 + (n_A + n_B)^2}{\xi^2(1+n_A)^2} \cdot \frac{(K_A - \beta\theta_{ACA})^2}{\beta^2\theta_B^2c_A^2(1+\delta_{AB}^2)} \\
& \quad \Updownarrow \\
& \hat{K}_B^t = \beta(1+\xi)\delta_{AB}\theta_{ACA} + \left[\frac{n_B(2+2n_A+n_B)}{(n_A+1)^2} (K_A - \beta\theta_{ACA})^2 + \right. \\
& \quad \left. \beta\theta_A(n_A + n_B + 1)^2F_A + 2\beta\xi\theta_{ACA}(K_A - \beta(1+\xi/2)\theta_{ACA}) \right]^{1/2}
\end{aligned}$$

¹The proofs of Corollaries 1b and following are carried out accordingly

B Values used in the calculations of chapter 2

By assuming that the demand and inverse demand functions have the form of (2.5), (2.39) or (2.66), (2.86), respectively, we took the following values¹:

$K_A = 2245.5$ [based upon GDP (in Euro) Germany 2005²]

$c_A = 29.97$ [based upon gross monthly earnings (in Euro) Germany 2005³]

$t_A = 0.5$

$F_A = 1000$

$R_A = 300$

$\delta_{AB} = 1.2$

$K_B = \frac{K_A}{10} = 224.5$ [based upon GDP (in Euro) Poland 2005⁴]

$c_B = \frac{c_A}{5} = 5.994$ [based upon gross monthly earnings (in Euro) Poland 2005⁵]

$t_B = 0.9$

$F_B = 500$ [General living expenses in Poland are 50% of those in Germany⁶]

$R_B = 181.269$ [Based upon the value R_A of Germany and the ratio of courts of justice (693/1147) between Poland and Germany⁷]

$\delta_{BA} = 1.986$ [Based upon the value δ_{AB} of Germany and the ratio of courts of justice (693/1147) between Poland and Germany⁸]

$\gamma = \frac{K}{\beta}$

$\beta = 1$

$\chi = 1$

¹Each is based on the statistical value in brackets if applicable

²Source: Statistisches Bundesamt Website, 2006

³Source: Statistisches Bundesamt Website, 2006

⁴Source: Statistisches Bundesamt Website, 2006

⁵Source: Statistisches Bundesamt Website, 2006

⁶Source: Bundesagentur für Arbeit Website, 2006

⁷Source: Statistisches Bundesamt Website, 2006 and de Vries [61]

⁸Source: Statistisches Bundesamt Website, 2006 and de Vries [61]

B Values used in the calculations of chapter 2

$K_{Europe} = 8555.2$ [based upon GDP (in Euro) of EU-25 without Germany 2005⁹]

⁹Source: Statistisches Bundesamt Website, 2006

C Figures - Theory

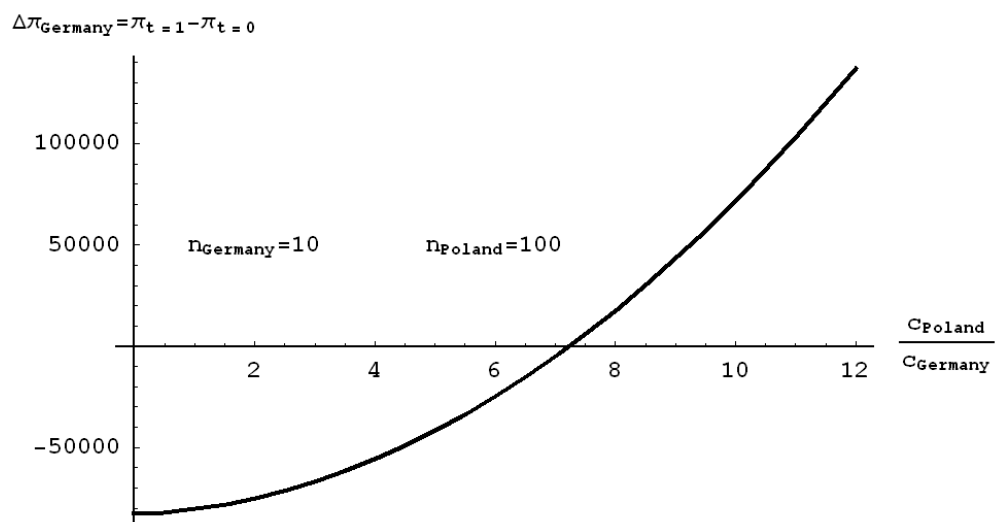


Figure C.1: Temporary supply of services in segmented Bertrand markets: difference in firms' profits in Germany before and after the opening against the ratio of costs in Poland and Germany

C Figures - Theory

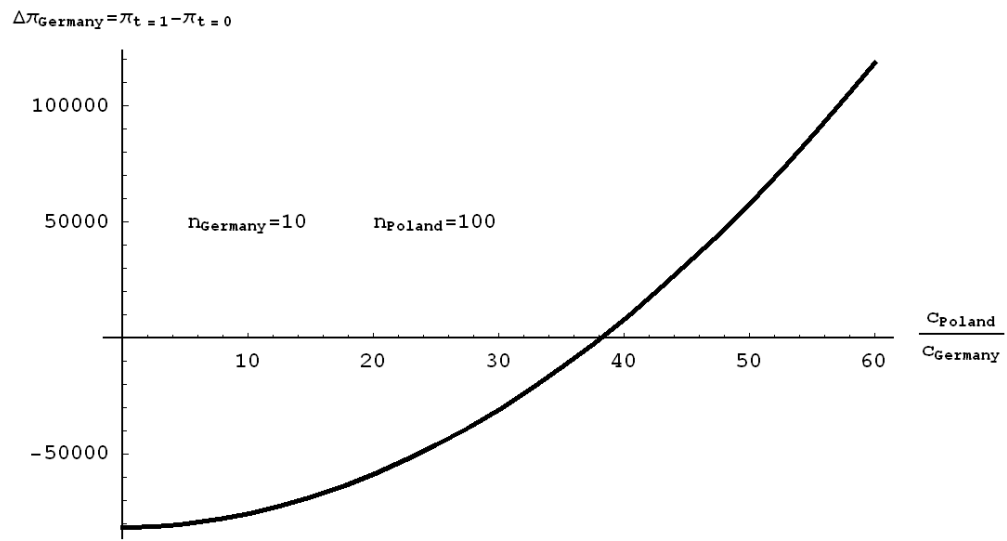


Figure C.2: Permanent supply of services in segmented Bertrand markets: difference in firms' profits in Germany before and after the opening against the ratio of costs in Poland and Germany

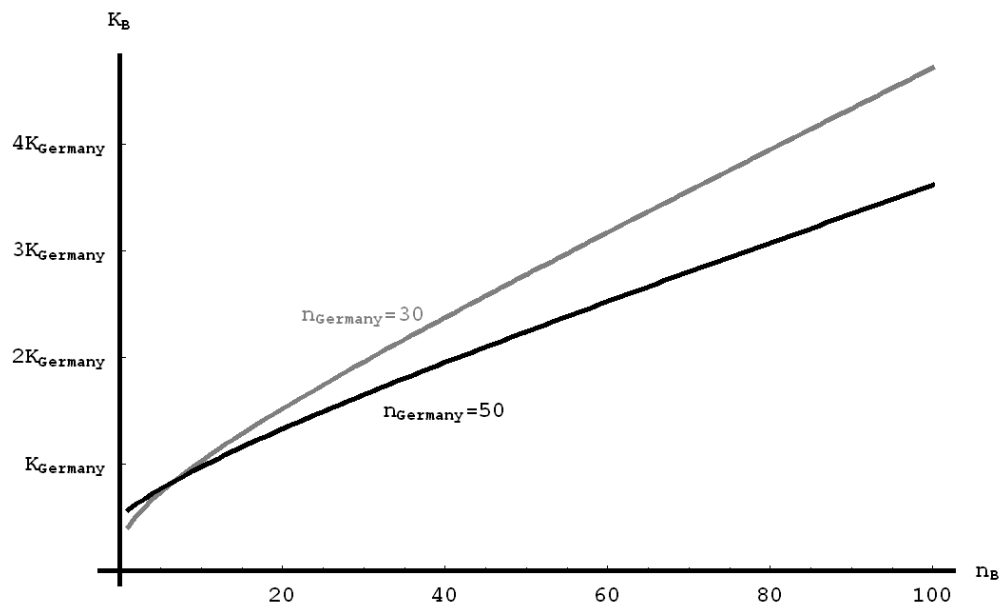


Figure C.3: Temporary supply of services in integrated Bertrand markets: The market size for which an opening of the service market would always be profitable for German firms against the number of firms from country B

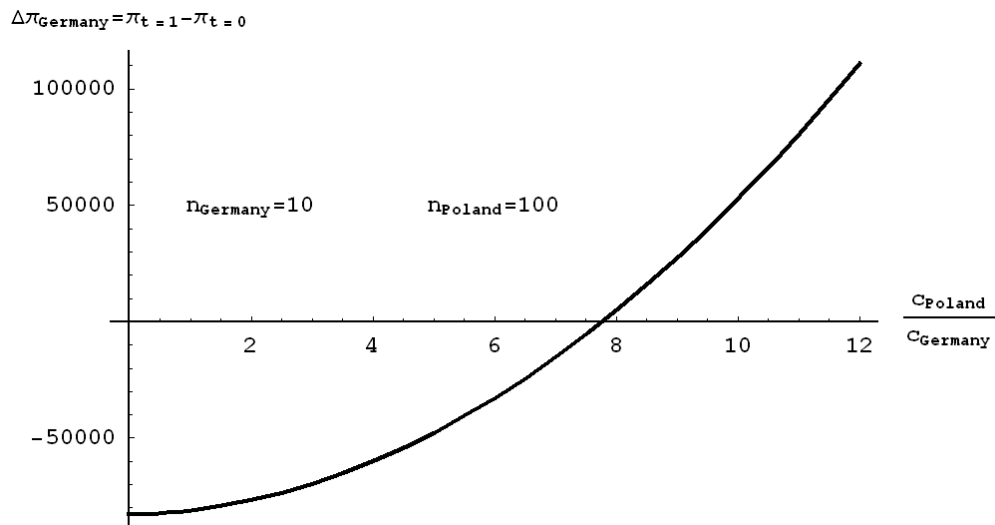


Figure C.4: Temporary supply of services in integrated Bertrand markets: difference in firms' profits in Germany before and after the opening against the ratio of costs in Poland and Germany

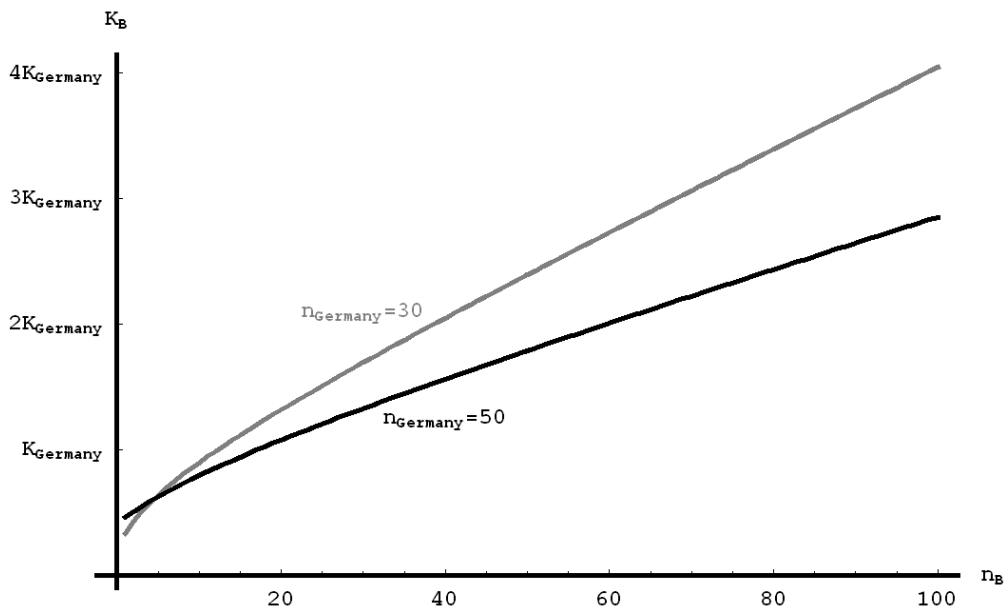


Figure C.5: Permanent supply of services in integrated Bertrand markets: The market size for which an opening of the service market would always be profitable for German firms against the number of firms from country B

C Figures - Theory

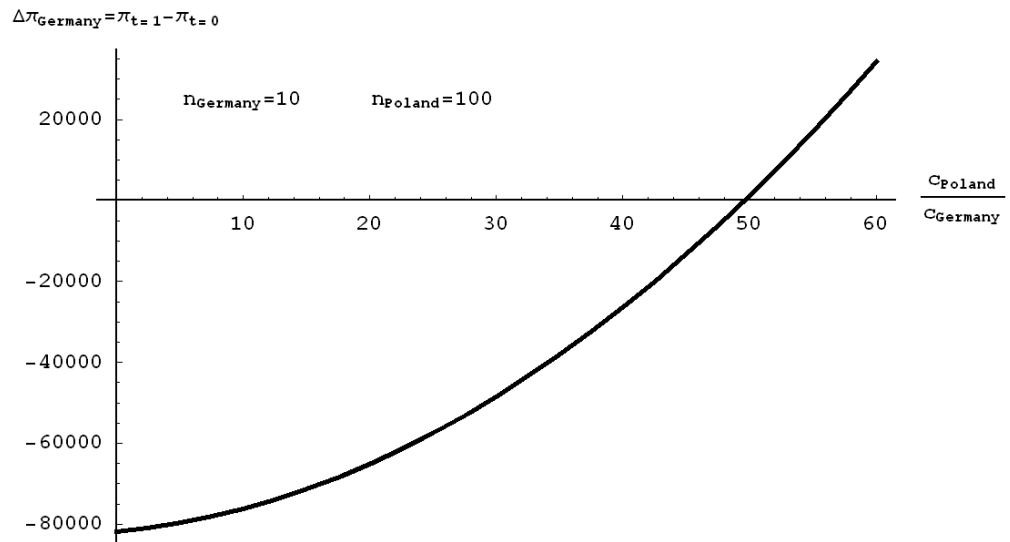


Figure C.6: Permanent supply of services in integrated Bertrand markets: difference in firms' profits in Germany before and after the opening against the ratio of costs in Poland and Germany

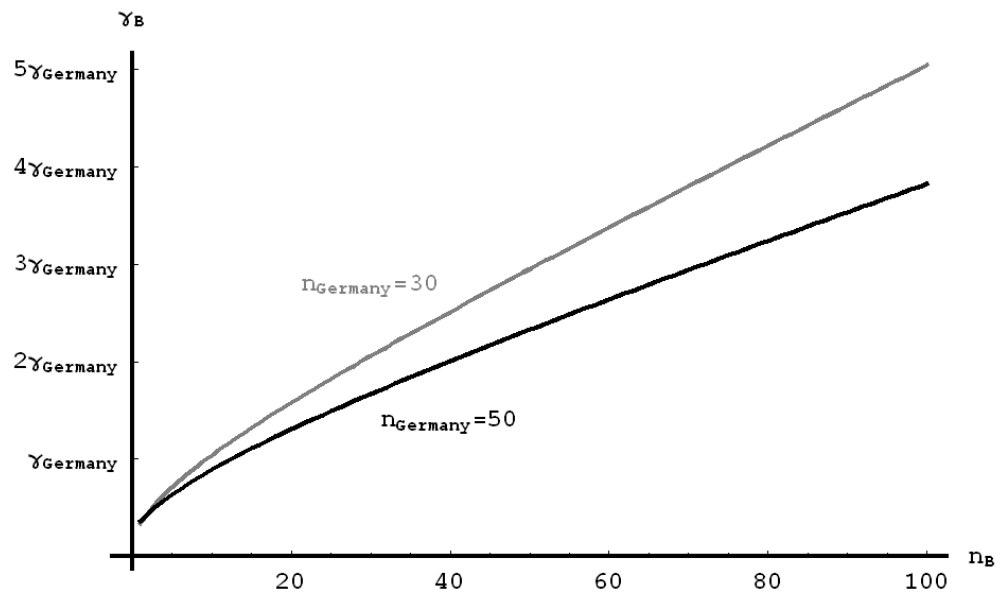


Figure C.7: Temporary supply of services in segmented Cournot markets: The maximum price for which an opening of the service market would always be profitable for German firms against the number of firms from country B

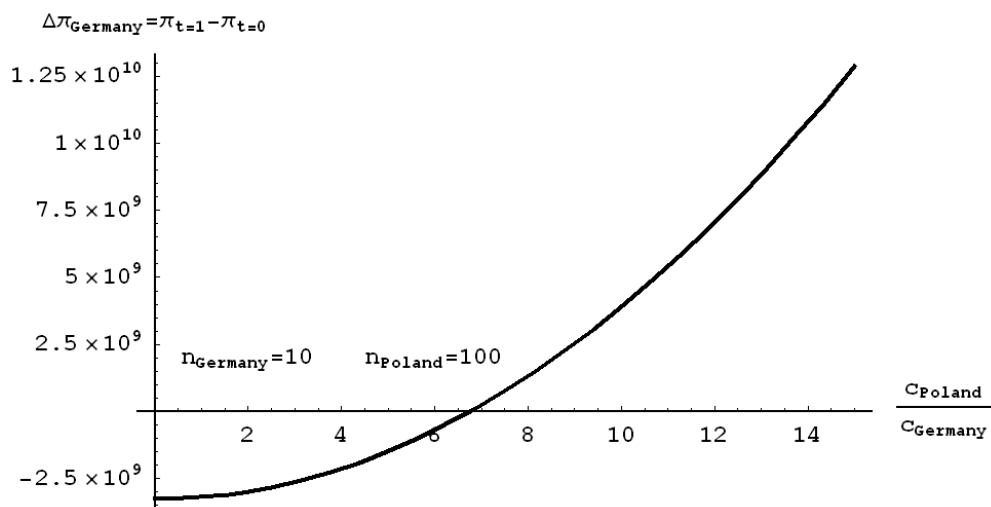


Figure C.8: Temporary supply of services in segmented Cournot markets: difference in firms' profits in Germany before and after the opening against the ratio of costs in Poland and Germany

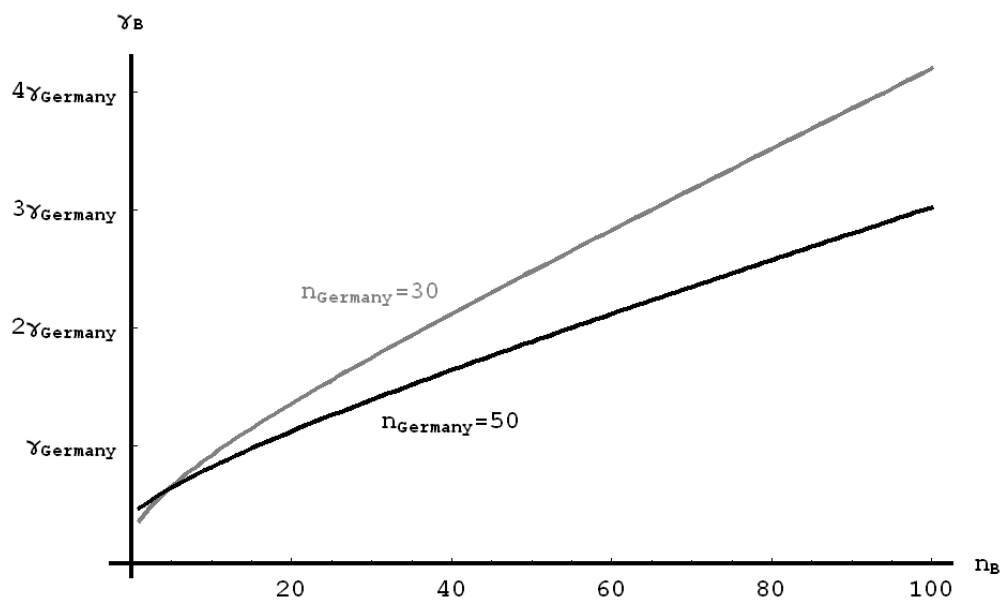


Figure C.9: Permanent supply of services in segmented Cournot markets: The maximum price for which an opening of the service market would always be profitable for German firms against the number of firms from country B

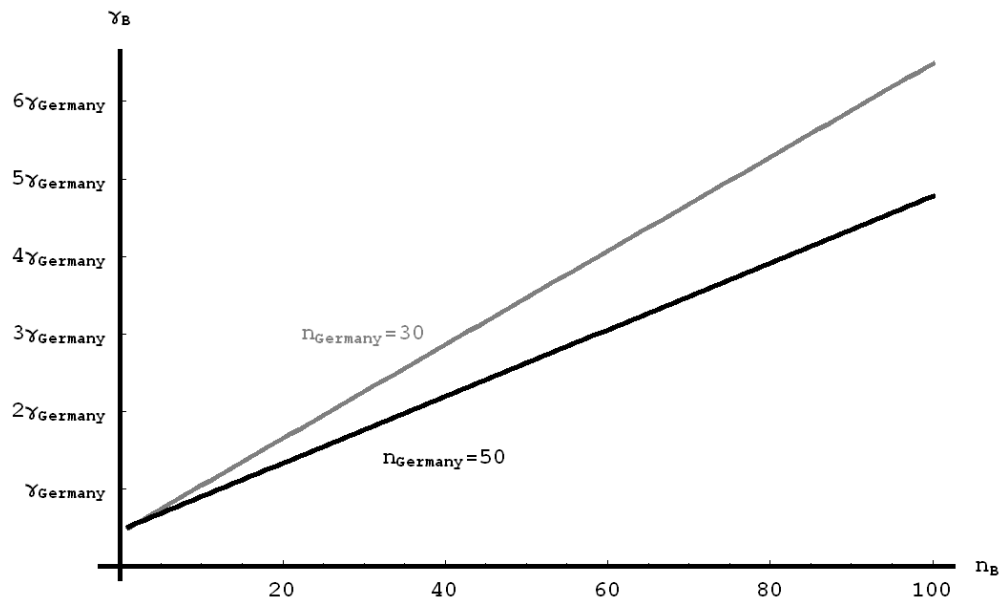


Figure C.10: Temporary supply of services in integrated Cournot markets: The maximum price for which an opening of the service market would always be profitable for German firms against the number of firms from country B

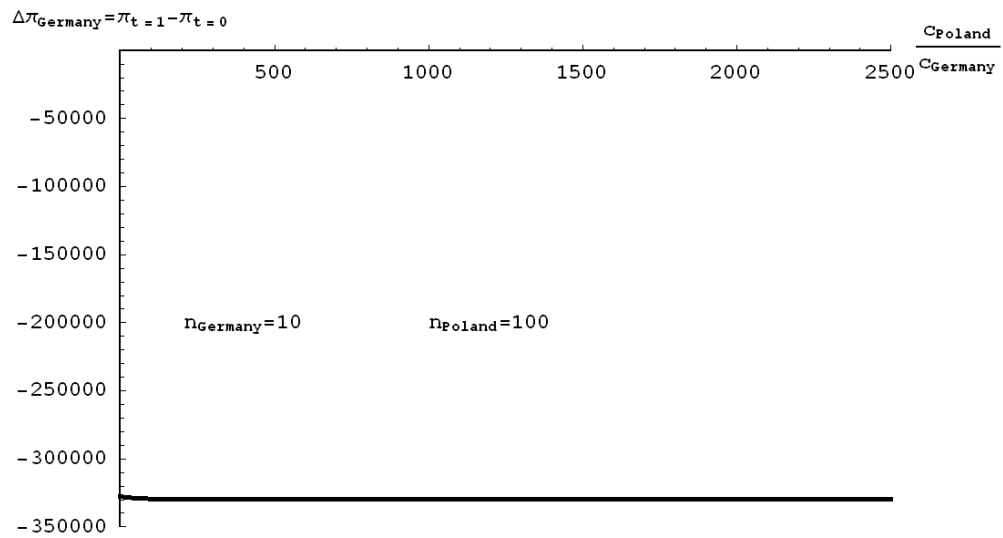


Figure C.11: Permanent supply of services in integrated Cournot markets: difference in firms' profits in Germany before and after the opening against the ratio of costs in Poland and Germany

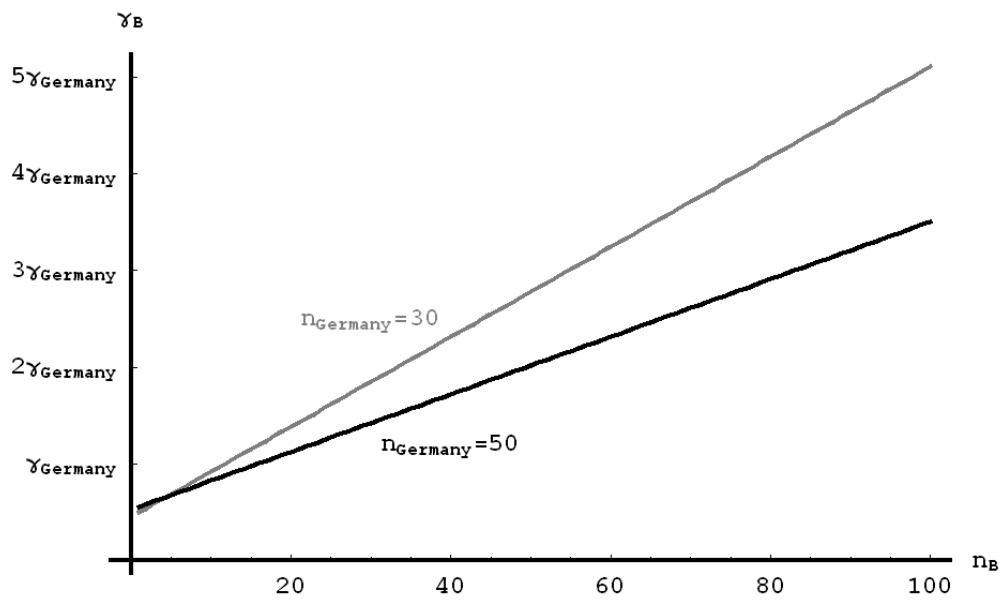


Figure C.12: Permanent supply of services in integrated Cournot markets: The maximum price for which an opening of the service market would always be profitable for German firms against the number of firms from country B

D Ratio of qualities

D.1 Temporary supply of services in segmented markets

For what ratio of the qualities in B and A ($z^t = \frac{\theta_B}{\theta_A}$) is the opening favorable for firms in country A? If $\Delta\pi_A(z^t) = \pi_{t=1}^A - \pi_{t=0}^A > 0$ the opening has a positive effect for firms in A.

$$\begin{aligned}
 \Delta\pi_A(z^t) &= 0 \\
 &\Downarrow \\
 z_{1,2}^t &= -\frac{K_B + \delta_{BA}K_A - \beta(1 + \xi)(\delta_{AB} + \delta_{BA})\theta_{AcA}}{\beta\xi(1 + \delta_{BA}^2)\theta_{AcB}} \\
 &\pm \left[\left(\frac{K_B + \delta_{BA}K_A - \beta(1 + \xi)(\delta_{AB} + \delta_{BA})\theta_{AcA}}{\beta\xi(1 + \delta_{BA}^2)\theta_{AcB}} \right)^2 \right. \\
 &\quad - \frac{(K_A - \beta(1 + \xi)\theta_{AcA})^2 + (K_B - \beta(1 + \xi)\delta_{AB}\theta_{AcA})^2}{\beta^2\xi^2(1 + \delta_{BA}^2)\theta_A^2c_B^2} \\
 &\quad + \frac{2n_A + 2n_B + 1 + (n_A + n_B)^2}{\xi^2(1 + n_A)^2} \cdot \frac{(K_A - \beta\theta_{AcA})^2}{\beta^2\theta_A^2c_B^2(1 + \delta_{BA}^2)} \\
 &\quad \left. + \frac{(n_A + n_B + 1)^2}{\beta\xi^2(1 + \delta_{BA}^2)} \cdot \frac{F_A}{\theta_{AcB}^2} \right]^{1/2} \tag{D.1}
 \end{aligned}$$

Only z_1^t is reasonable, because $z_2^t < 0$.

D.2 Permanent supply of services in segmented markets

For which $z_{1,2}^p$ is $\Delta\pi_A(z_{1,2}^p) = 0$.

$$\begin{aligned}
\Delta\pi_A(z^p) &= 0 \\
&\Downarrow \\
z_{1,2}^p &= -\frac{c_B K_B + c_A K_A - \beta(1 + \xi)\theta_A(c_A^2 + c_B^2)}{\beta\xi(c_A^2 + c_B^2)\theta_A} \\
&\pm \left[\left(\frac{c_B K_B + c_A K_A - \beta(1 + \xi)\theta_A(c_A^2 + c_B^2)}{\beta\xi(c_A^2 + c_B^2)\theta_A} \right)^2 \right. \\
&\quad - \frac{(K_B - \beta(1 + \xi)\theta_A c_B)^2 - 2\beta\xi\theta_A c_A (K_A - \beta(1 + \xi/2)\theta_A c_A)}{\beta^2\xi^2\theta_A^2(c_A^2 + c_B^2)} \\
&\quad + \frac{n_B(2n_A + n_B + 2)(K_A - \beta\theta_A c_A)^2}{\beta^2\xi^2(n_A + 1)^2\theta_A^2(c_A^2 + c_B^2)} \\
&\quad \left. + \frac{(n_A + n_B + 1)^2}{\beta\xi^2} \cdot \frac{F_B + R_B}{\theta_A(c_A^2 + c_B^2)} \right]^{1/2} \tag{D.2}
\end{aligned}$$

Again, only the first choice z_1^p is reasonable, because $z_2^p < 0$.

D.3 Temporary supply of services in integrated markets

For which $z_{1,2}^{nt}$ is $\Delta\pi_A(z_{1,2}^{nt}) = 0$:

$$\begin{aligned}
\Delta\pi_A(z^{nt}) &= 0 \\
&\Downarrow \\
z_{1,2}^{nt} &= -\frac{K_A + K_B - \beta(1 + \delta_{AB})\theta_A c_A(1 + \xi)}{\beta\xi(1 + \delta_{BA})\theta_A c_B} \\
&\pm \left[-\left(\frac{K_A - K_B}{2n_B(n_A + n_B)\beta\xi_2(1 + \delta_{BA})\theta_A c_B} \right)^2 \right. \\
&\quad + \frac{(K_A - \beta\theta_A c_A)^2}{2n_B^2(n_A + 1)^2\beta^2\xi_2^2\theta_A^2(1 + \delta_{BA})^2 c_B^2} \\
&\quad \left. + \frac{F_A}{2n_B^2\beta\xi_2^2(1 + \delta_{BA})^2\theta_A c_B^2} \right]^{1/2} \tag{D.3}
\end{aligned}$$

We drop x_2^{nt} , which is smaller than zero.

D.4 Permanent supply of services in integrated markets

$$\begin{aligned}
 \Delta\pi_A(z^{np}) &= 0 \\
 \Downarrow \\
 z_{1,2}^{np} &= -\frac{K_A + K_B - \beta(1 + \xi)\theta_A(c_A + c_B)}{\beta\xi\theta_A(c_A + c_B)} \\
 &\pm \left[-\left(\frac{K_A - K_B}{2n_B(n_A + n_B)\beta\xi_2\theta_A(c_A + c_B)}\right)^2 \right. \\
 &\quad + \frac{(K_A - \beta\theta_{AC_A})^2}{2n_B^2(n_A + 1)^2\beta^2\xi_2^2\theta_A^2(c_A + c_B)^2} \\
 &\quad \left. + \frac{F_B + R_B}{2n_B^2\beta\xi_2^2\theta_A(c_A + c_B)^2} \right]^{1/2} \tag{D.4}
 \end{aligned}$$

Again, z_2^{np} is dropped.

E Figures - Discussion

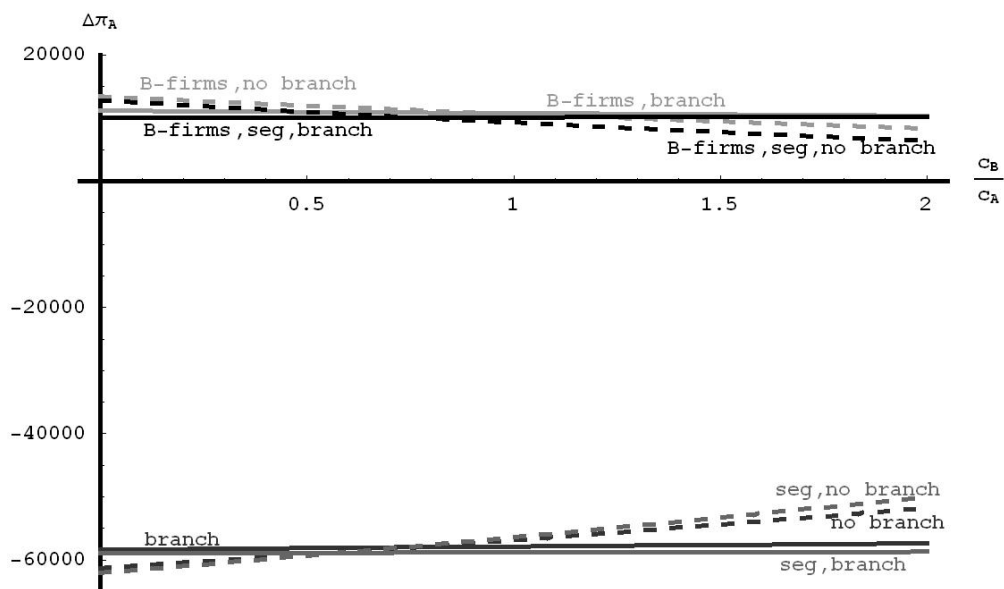


Figure E.1: Bertrand competition: The change in profits after the opening against the cost ratio $\frac{c_{Poland}}{c_{Germany}}$ for firms from Germany and Poland (B) in segmented (seg) and integrated markets supplying either temporarily ($no\ branch$) or permanently ($branch$) for $n_A = n_B = 10$

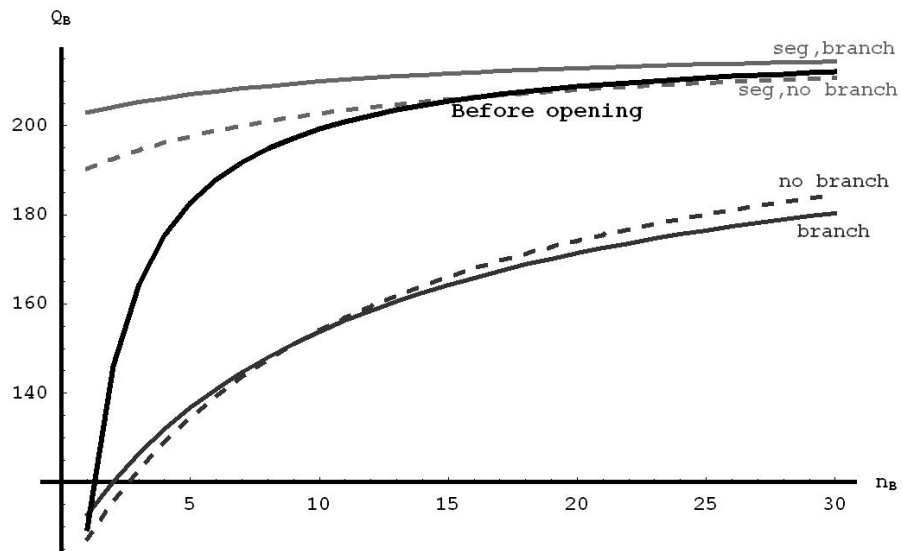


Figure E.2: Bertrand competition: Quantity offered in country B before (*Thick black line*) and after the opening against the number of firms from country B in segmented (*seg*) and integrated markets by either temporarily (*no branch*) or permanently (*branch*) supplying firms with $n_A = 10$

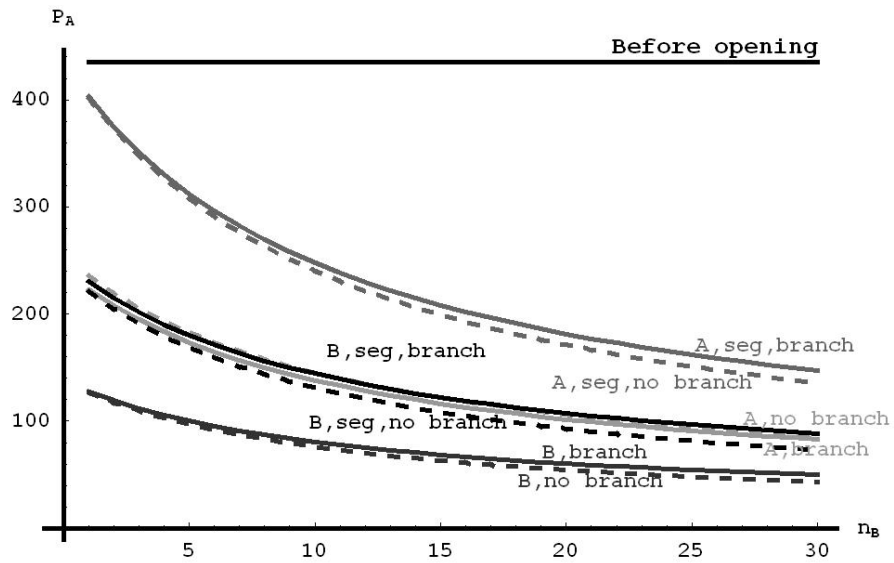


Figure E.3: Bertrand competition: Price in country A before (*Thick black line*) and after the opening against the number of firms from country B in segmented (*seg*) and integrated markets by either temporarily (*no branch*) or permanently (*branch*) supplying firms with $n_A = 10$

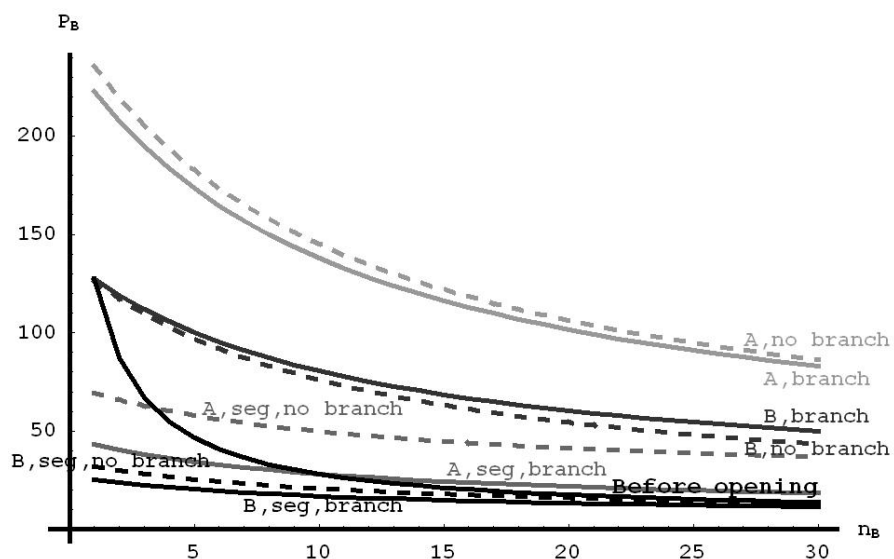


Figure E.4: Bertrand competition: Price in country B before (*Thick black line*) and after the opening against the number of firms from country B in segmented (*seg*) and integrated markets by either temporarily (*no branch*) or permanently (*branch*) supplying firms with $n_A = 10$

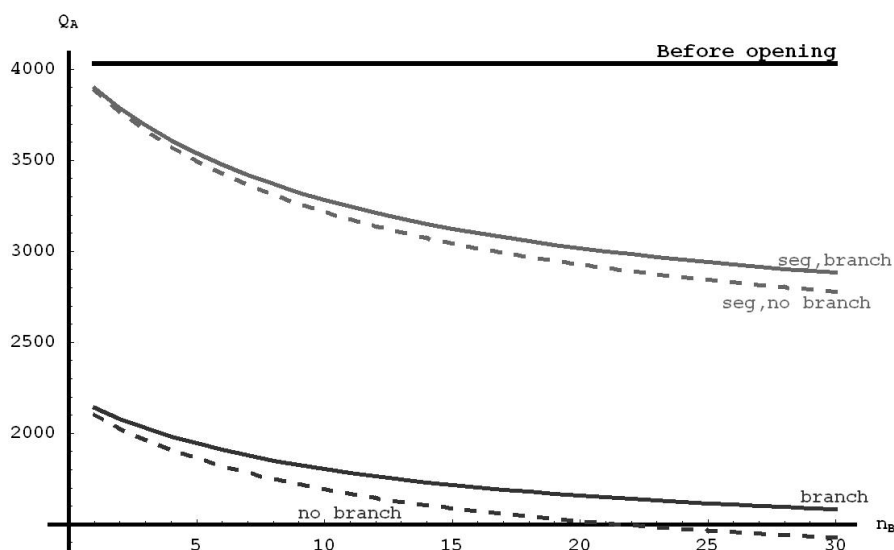


Figure E.5: Cournot competition: Quantity offered in country A before (*Thick black line*) and after the opening against the number of firms from country B in segmented (*seg*) and integrated markets by either temporarily (*no branch*) or permanently (*branch*) supplying firms with $n_A = 10$

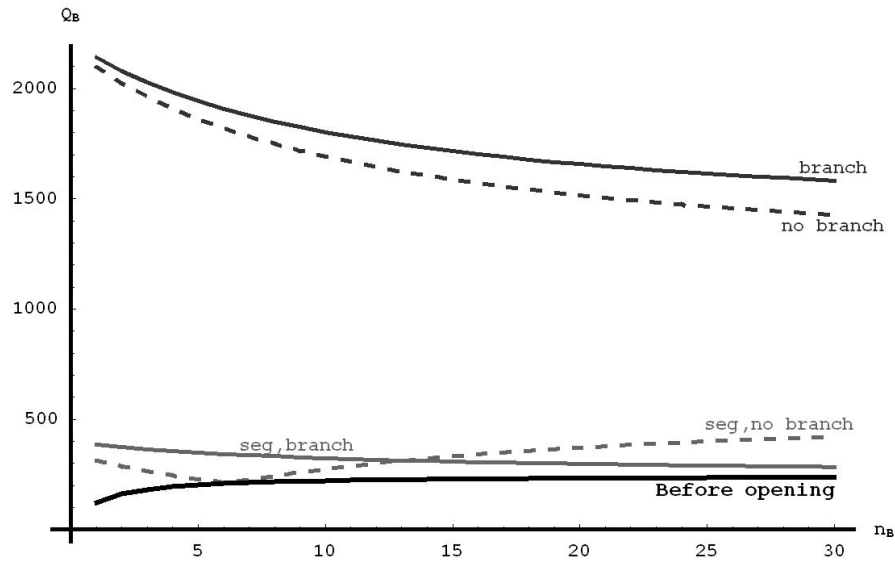


Figure E.6: Cournot competition: Quantity offered in country B before (*Thick black line*) and after the opening against the number of firms from country B in segmented (*seg*) and integrated markets by either temporarily (*no branch*) or permanently (*branch*) supplying firms with $n_A = 10$

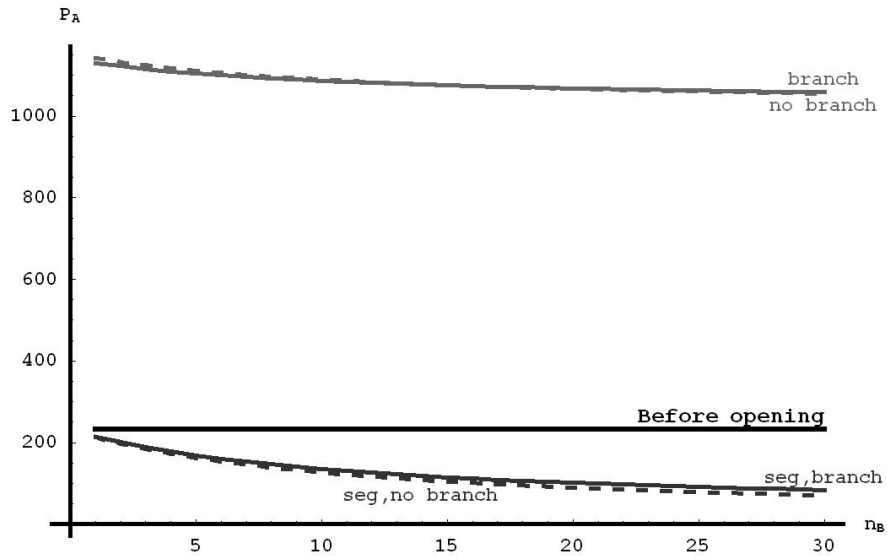


Figure E.7: Cournot competition: Price in country A before (*Thick black line*) and after the opening against the number of firms from country B in segmented (*seg*) and integrated markets by either temporarily (*no branch*) or permanently (*branch*) supplying firms with $n_A = 10$

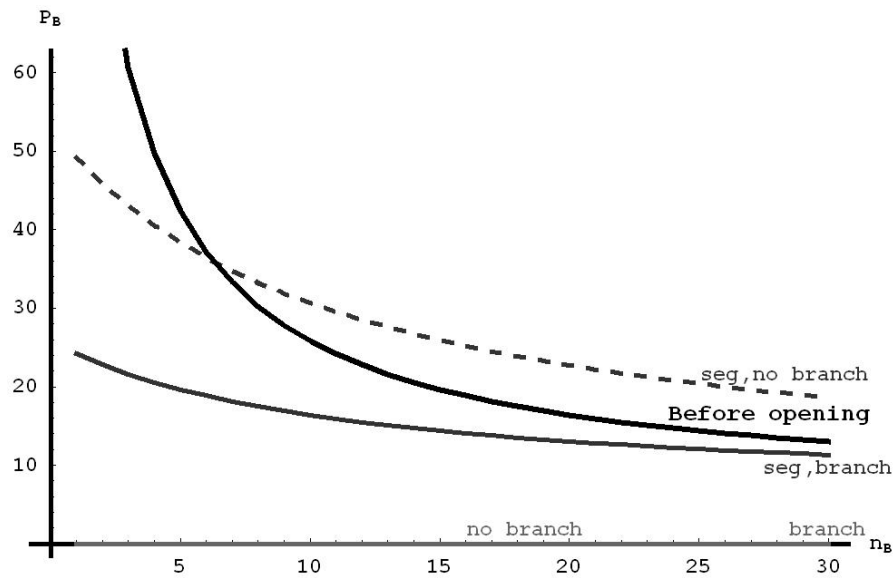


Figure E.8: Cournot competition: Price in country B before (*Thick black line*) and after the opening against the number of firms from country B in segmented (*seg*) and integrated markets by either temporarily (*no branch*) or permanently (*branch*) supplying firms with $n_A = 10$

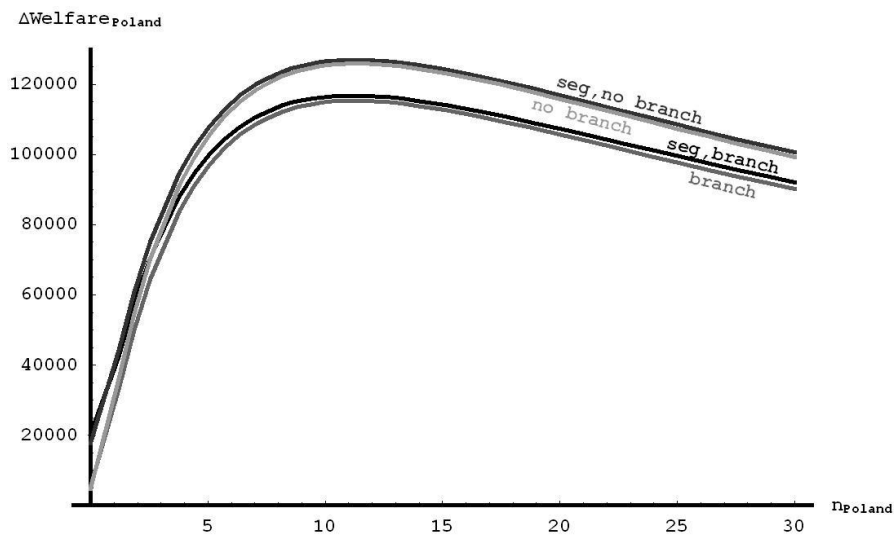


Figure E.9: Bertrand competition: Welfare difference in Poland against n_{Poland} in segmented (*seg*) and integrated markets supplying either temporarily (*no branch*) or permanently (*branch*) with $n_{Germany} = 10$

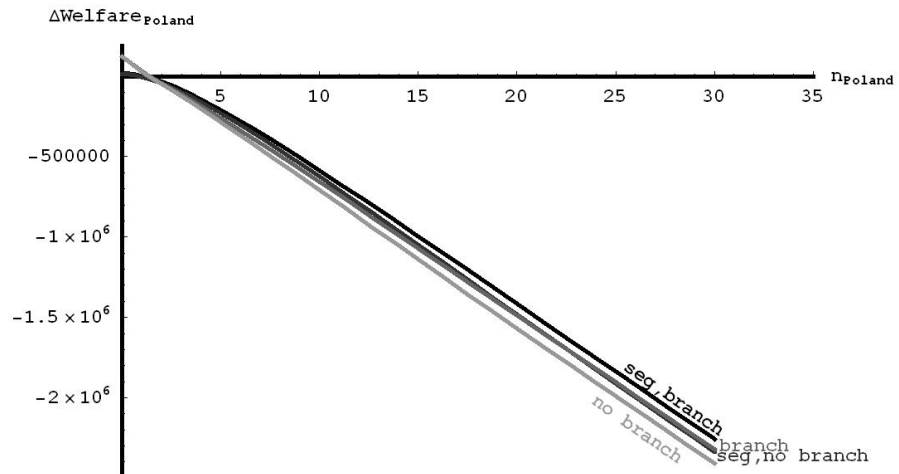


Figure E.10: Cournot competition: Welfare difference in Poland against n_{Poland} in segmented (*seg*) and integrated markets supplying either temporarily (*no branch*) or permanently (*branch*) with $n_{\text{Germany}} = 10$

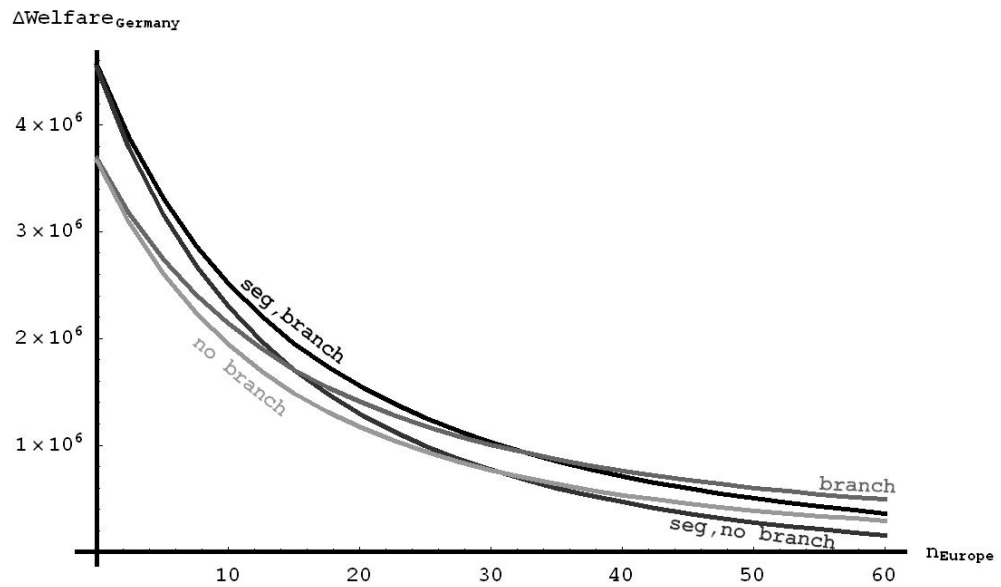


Figure E.11: Cournot competition: Welfare difference in Germany against n_{Europe} in segmented (*seg*) and integrated markets supplying either temporarily (*no branch*) or permanently (*branch*) with $n_{\text{Germany}} = 30$

F Values used in the calculations of chapter 3

$K_A = 2245.5$ [based upon GDP (in Euro) Germany 2005¹]

$$c_{i,t}^A = C_t^A * (1 + 1/2 \cdot v_i)$$

$C_{t=0}^A = w_{t=0}^A = 29.97$ [based upon gross monthly earnings (in Euro) Germany 2005²]

$$t_A = 0.5$$

$$\delta_{AB} = 1.2$$

$K_B = \frac{K_A}{10} = 224.5$ [based upon GDP (in Euro) Poland 2005³]

$K_{Europe} = 8555.2$ [based upon GDP (in Euro) of EU-25 without Germany 2005⁴]

$$c_{i,t}^B = C_t^B * (1 + 1/2 \cdot v_i)$$

$C_{t=0}^B = w_{t=0}^B = \frac{C_{t=0}^A}{5} = 5.994$ [based upon gross monthly earnings (in Euro) Poland 2005⁵]

$$t_B = 0.9$$

$\delta_{BA} = 1.986$ [Based upon the value δ_{AB} of Germany and the ratio of courts of justice (693/1147) between Poland and Germany⁶]

$$\gamma = \frac{K}{\beta}$$

$$\beta = 1$$

$$\chi = 1$$

$$v_i \in [0, 1]$$

$y^A = 5$ [Based upon the average amount the German government assigns to an unemployed worker]

¹Source: Statistisches Bundesamt Website, 2006

²Source: Statistisches Bundesamt Website, 2006

³Source: Statistisches Bundesamt Website, 2006

⁴Source: Statistisches Bundesamt Website, 2006

⁵Source: Statistisches Bundesamt Website, 2006

⁶Source: Statistisches Bundesamt Website, 2006 and de Vries [61]

F Values used in the calculations of chapter 3

$$\tau_A = 0.19 \text{ [Based upon the sales tax rate in Germany]}$$

$$\tau_B = 0.197 \text{ [Based upon the average sales tax rate in European countries]}$$

$$r_A = 0.25 \text{ [Based upon the "Körperschaftsteuersatz" in Germany]}$$

$$r_B = 0.25 \text{ [Based upon the average tax rate on profits in Europe]}$$

$$\lambda_L^A = \lambda_L^B = 0.1$$

$$\lambda_H^A = \lambda_H^B = 0.3$$

G Code

```
tmax = 100;
t = 1;

kzeta1 = 0.01;
kzeta2 = 0.03;

ggA[0] = Sum[QA0[i], {i, 1, nA}];
ggB[0] = Sum[QB0[i], {i, nA + 1, nA + nB}];

NA[0] = nA;
NB[0] = nB;

While[t <= tmax,

For[ii = 1, ii <= nA + nB,
g[ii, t] = If[Random[] < 0.4,
If[ii <= NA[0],

If[cA[ii, t - 1] < dBA*cB[ii, t - 1] &&&
cB[ii, t - 1] < dAB*cA[ii, t - 1], {1, Pi, Pi},
If[cA[ii, t - 1] > dBA*cB[ii, t - 1], {1, 0, Pi}, {1, Pi, 0}]],

If[cA[ii, t - 1] < dBA*cB[ii, t - 1] &&&
cB[ii, t - 1] < dAB*cA[ii, t - 1], {0, Pi, Pi},

If[cB[ii, t - 1] > dAB*cA[ii, t - 1], {0, Pi, 0}, {0, 0, Pi}]]], g[ii, t - 1]];
ii++];

ggB[t] = (Sum[
```

G Code

```
If[g[jj], t] == {1, Pi, Pi}, QBA[jj], t],
If[g[jj], t] == {1, 0, Pi}, QBA[jj], t] + QAA[jj], t], 0]],
{jj, 1, nA}] +
Sum[
If[g[jj], t] == {0, Pi, Pi}, QBB[jj], t],
If[g[jj], t] == {0, 0, Pi}, QBB[jj], t] + QAB[jj], t], 0]],
{jj, nA + 1, nA + nB}]);

ggA[t] = (Sum[
If[g[jj], t] == {1, Pi, Pi}, QAA[jj], t],
If[g[jj], t] == {1, Pi, 0}, QBA[jj], t] + QAA[jj], t], 0]], {jj, 1, nA}] +
Sum[
If[g[jj], t] == {0, Pi, Pi}, QAB[jj], t],
If[g[jj], t] == {0, Pi, 0}, QBB[jj], t] + QAB[jj], t], 0]], {jj, nA + 1, nA + nB}]);

CA[t + 1] =
If[CA[t] > yA + st*ggA[t], CA[t] - kzeta1*(CA[t] - (yA + st*ggA[t])), CA[t] + kzeta2*(yA
+ st*ggA[t] - CA[t])];
CB[t + 1] =
If[CB[t] > yB + st*ggB[t], CB[t] - kzeta1*(CB[t] - (yB + st*ggB[t])), CB[t] + kzeta2*(yB
+ st*ggB[t] - CB[t])];

Print[t];

t = t + 1];
```

H Figures - Cournot

In figures H.1, H.2 and H.3 we used the same values as before with the exception that the market size of country B is different ($\gamma_B = \frac{K_A}{1.1\beta}$)¹ in order to have positive prices in both countries:

Amount of services

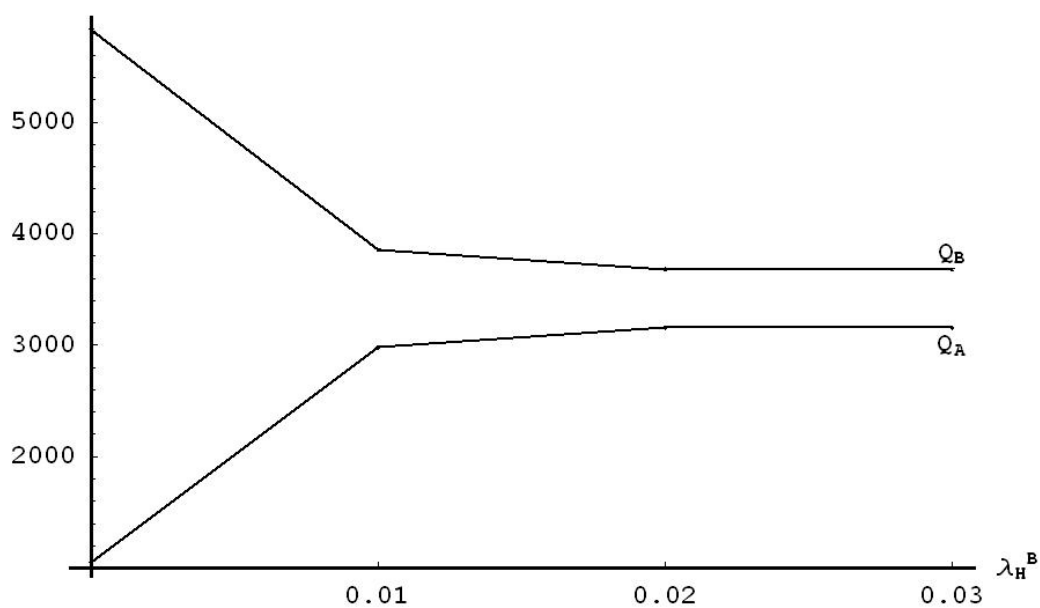


Figure H.1: The amount of services each country - Germany (A) and Poland (B) - is supplying in integrated Cournot markets in the last period $t_{max} = 80$ against the wage flexibility factor λ_H^B (different γ_B)

¹Normally, we used $\gamma_B = \frac{K_A}{10\beta}$

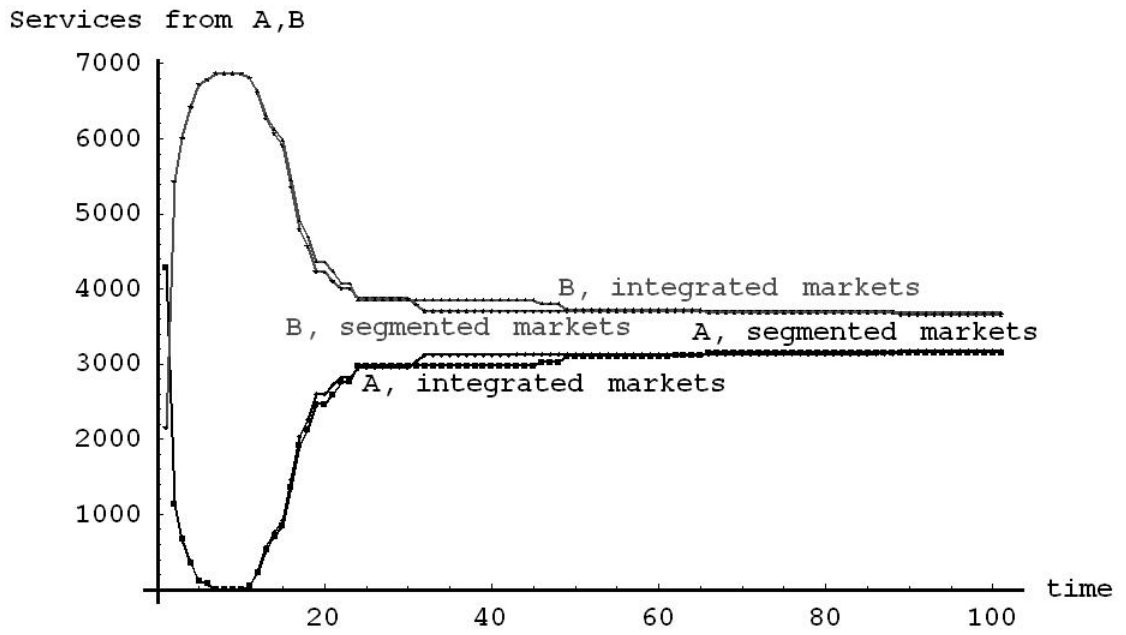


Figure H.2: Cournot competition: Amount of services supplied from countries A (Germany) and B (Poland) over time in segmented and integrated markets (different γ_B)

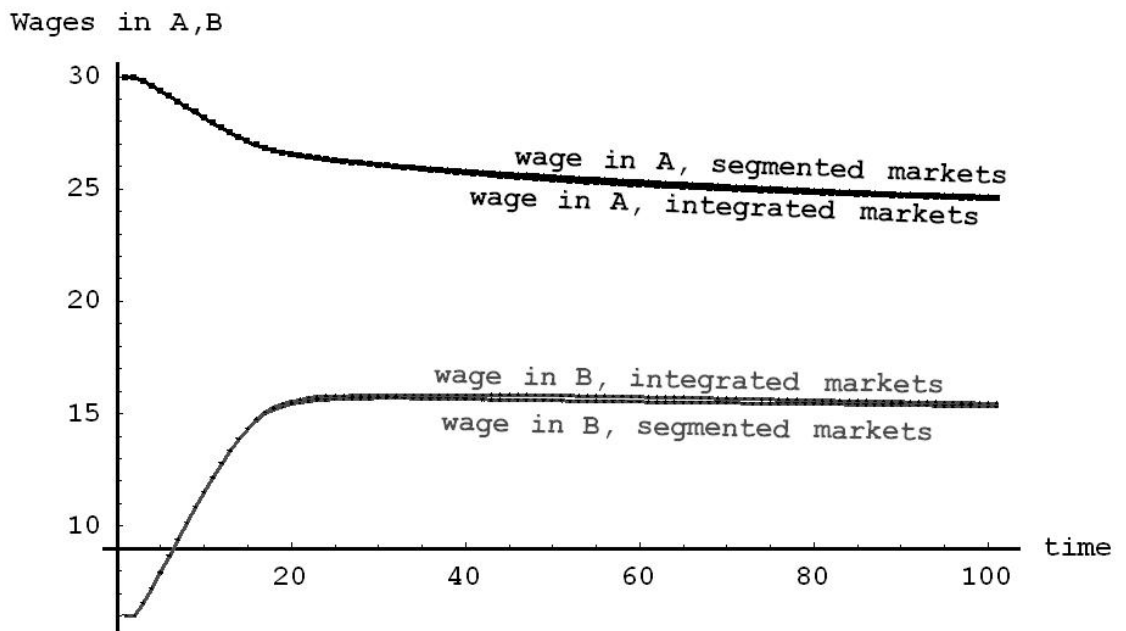


Figure H.3: Cournot competition: Wages in countries A (Germany) and B (Poland) over time in segmented and integrated markets (different γ_B)

I Figures - Comparison and Discussion

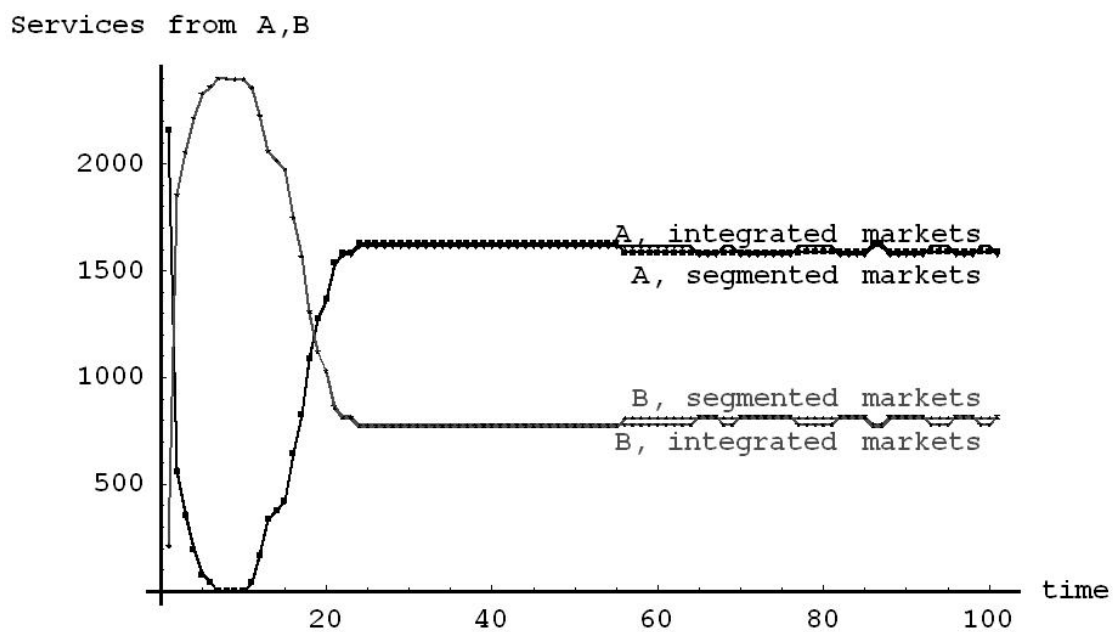


Figure I.1: Bertrand competition: Amount of services supplied from countries A (Germany) and B (Poland) over time in segmented and integrated markets

I Figures - Comparison and Discussion

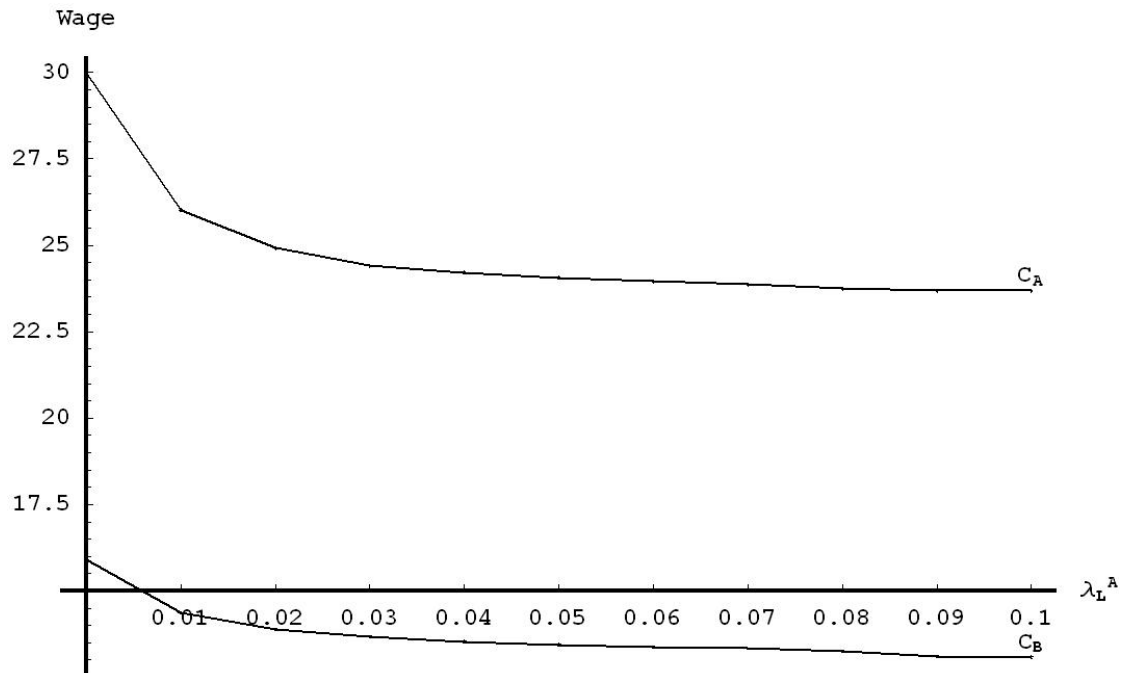


Figure I.2: Bertrand competition: The wage in Germany (A) and Poland (B) in the last period $t_{max} = 80$ against the wage flexibility factor λ_L^A

amount of services from A

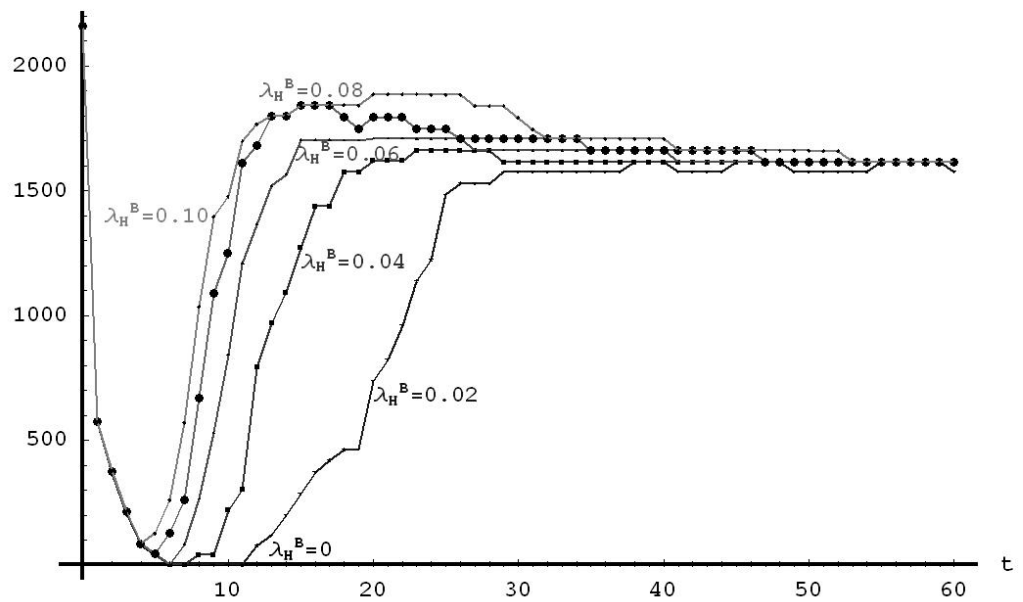


Figure I.3: Bertrand competition: Wages in country A (Germany) over time with different wage flexibility factors λ_H^B

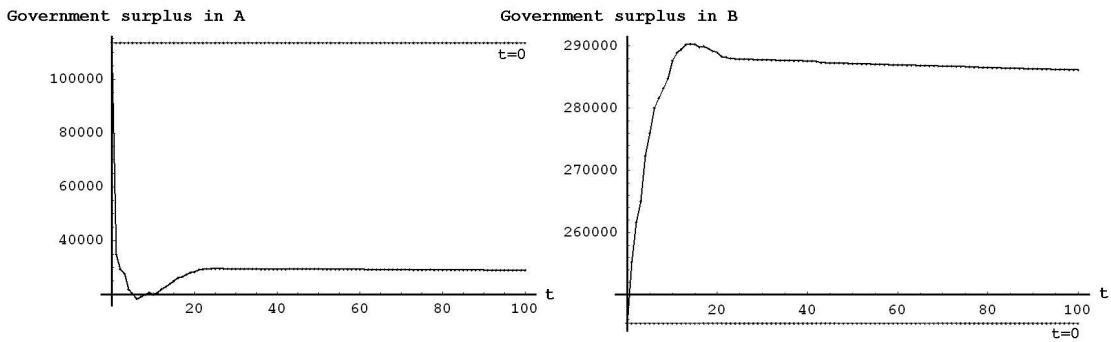


Figure I.4: Bertrand competition: Government surplus in country A (Germany) and B (rest of the EU) with taxation against time

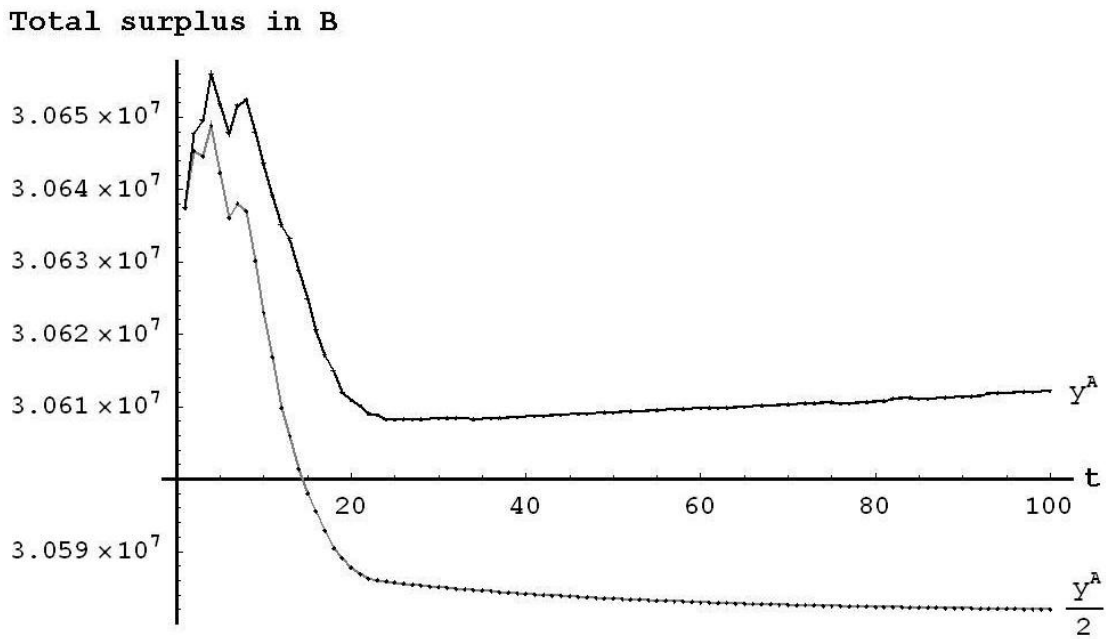


Figure I.5: Bertrand competition: Total surplus in country B (rest of the EU) against time with different "minimum wages" (y^A)

Total surplus in B

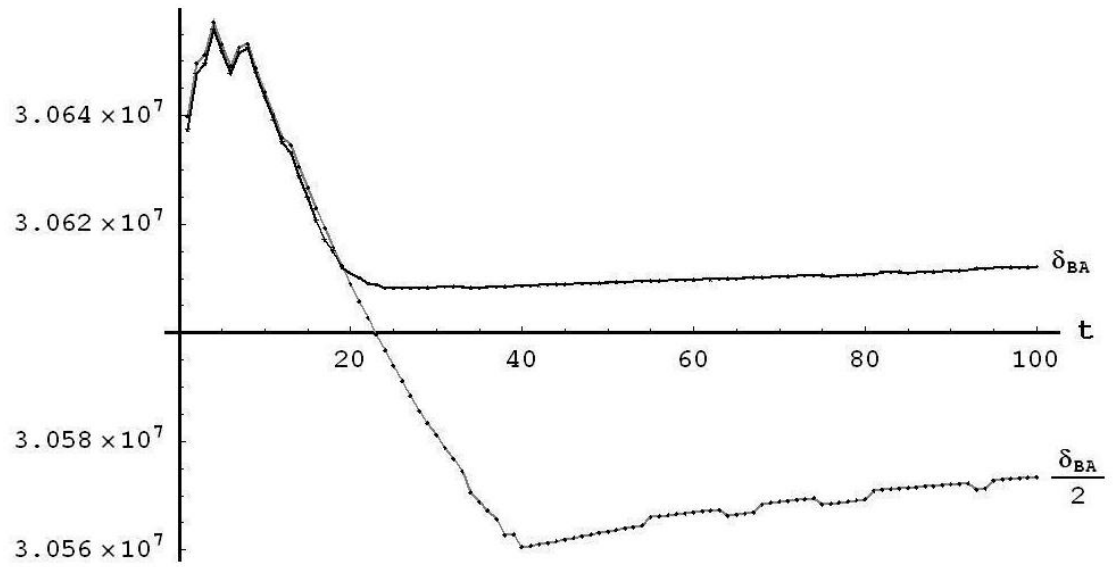


Figure I.6: Bertrand competition: Total surplus in country B (rest of the EU) against time with different transaction factors (δ_{BA})

Consumer surplus in A

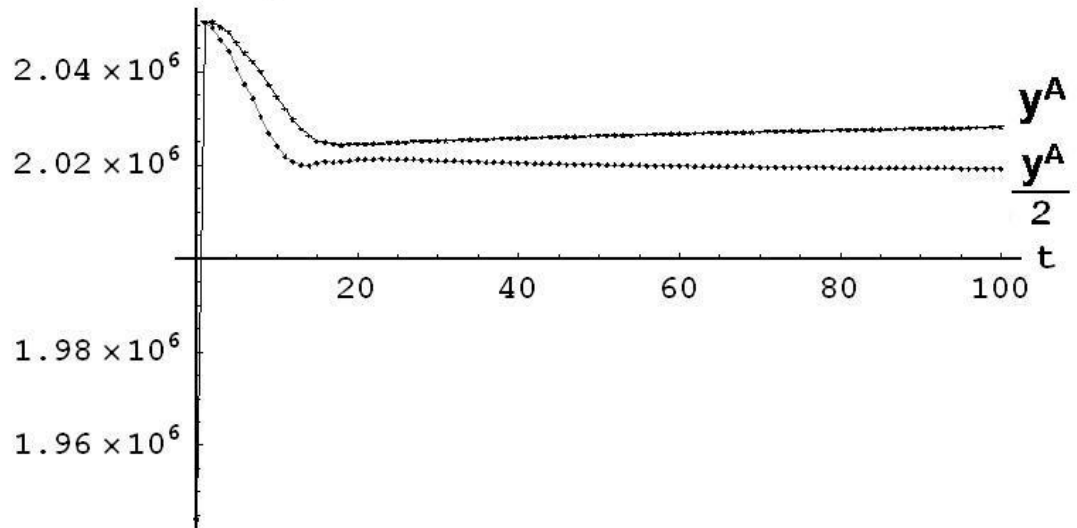


Figure I.7: Bertrand competition: Consumer surplus in country A (Germany) with different "minimum wages" (y^A) against time

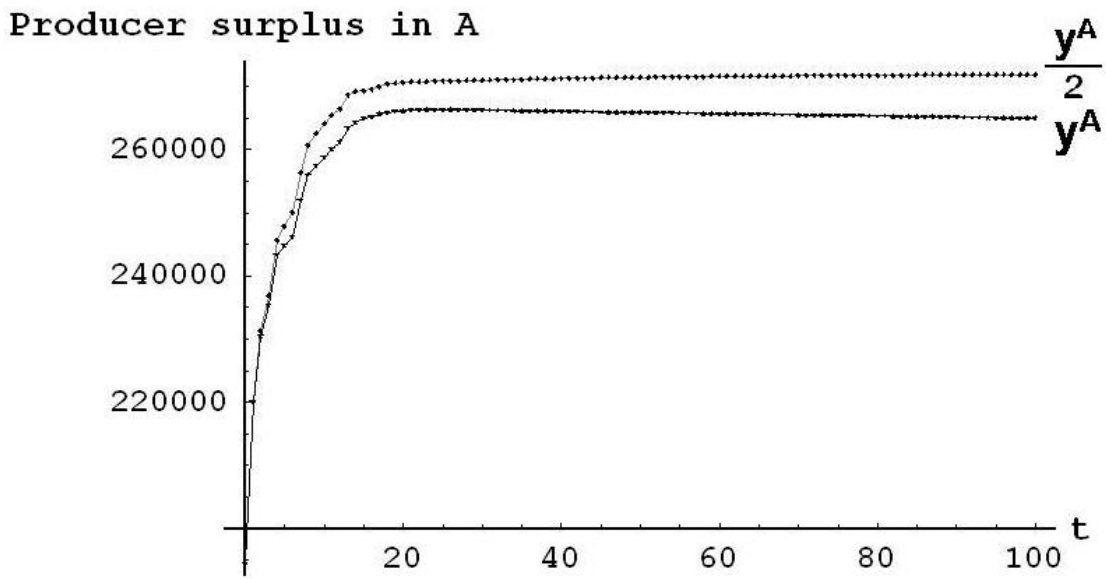


Figure I.8: Bertrand competition: Producer surplus in country A (Germany) against time with different "minimum wages" (y^A)

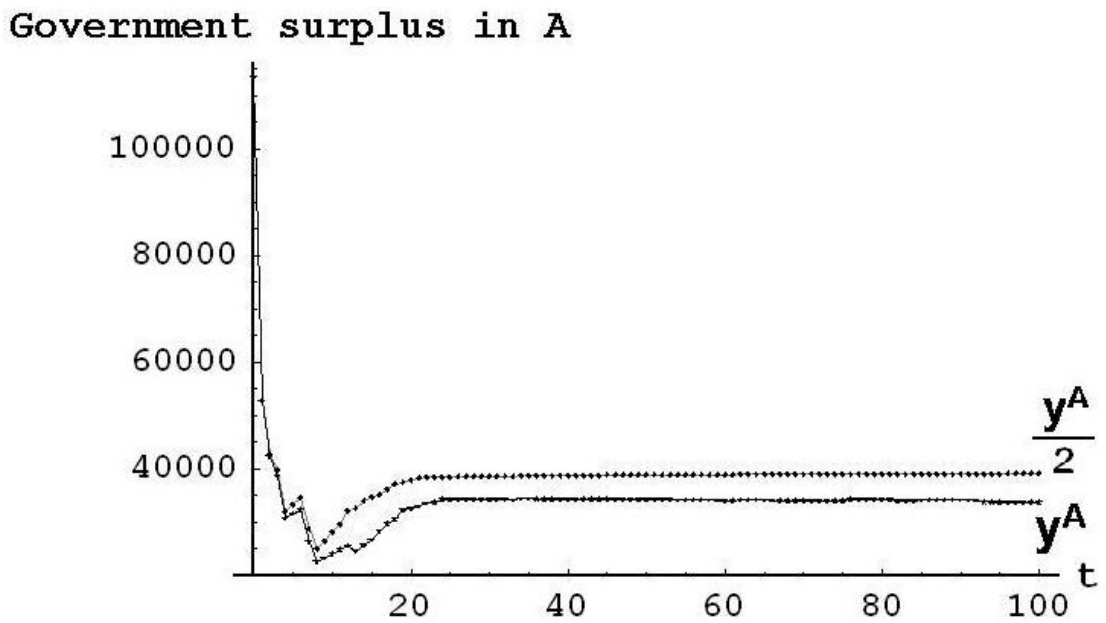


Figure I.9: Bertrand competition: Government surplus in country A (Germany) against time with different "minimum wages" (y^A)

Consumer surplus in A

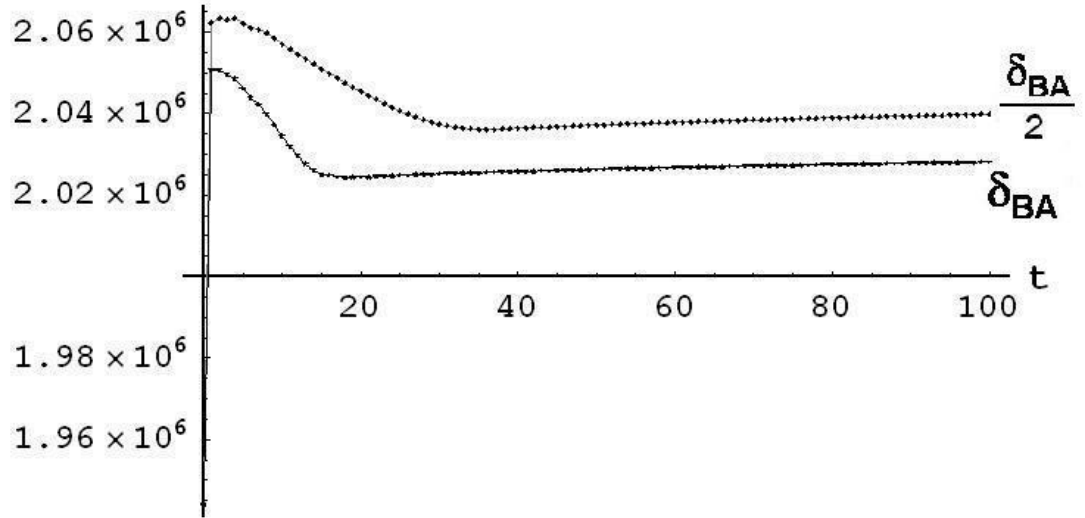


Figure I.10: Bertrand competition: Consumer surplus in country A (Germany) against time with different transaction factors (δ_{BA})

Producer surplus in A

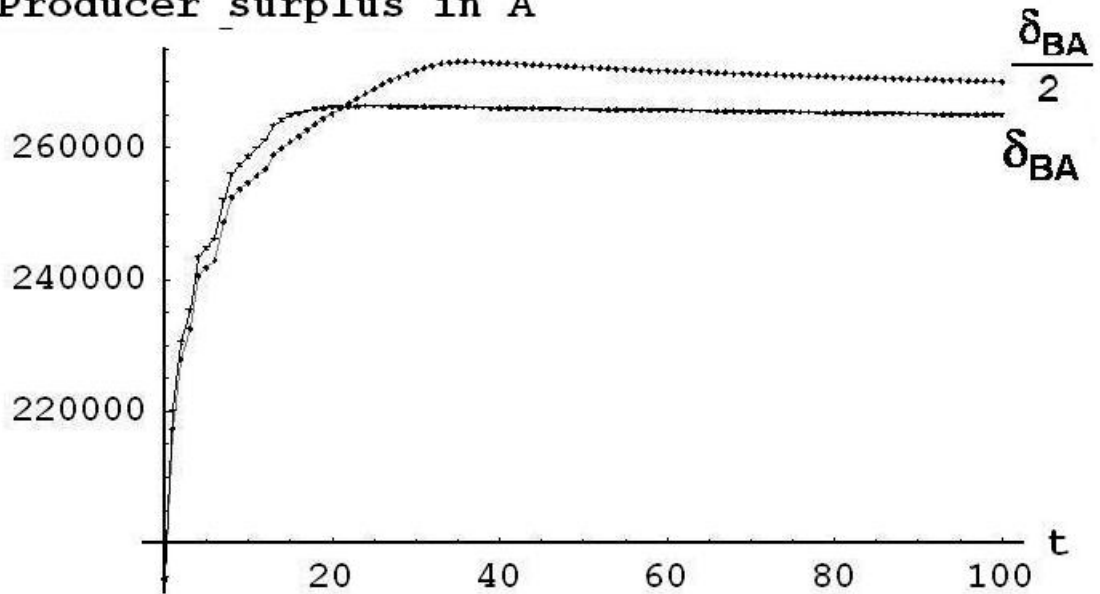


Figure I.11: Bertrand competition: Producer surplus in country A (Germany) against time with different transaction factors (δ_{BA})

Government surplus in A

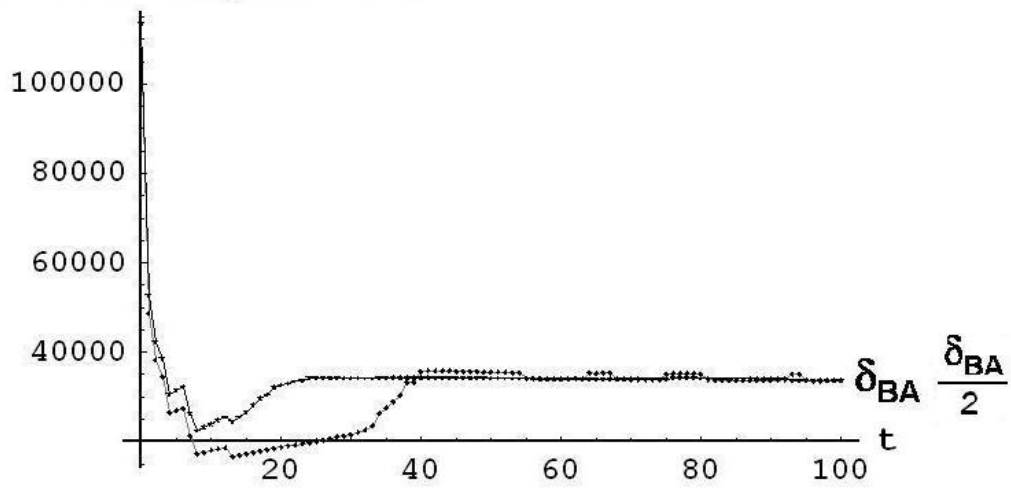


Figure I.12: Bertrand competition: Government surplus in country A (Germany) against time with different transaction factors (δ_{BA})

J Proof of corollaries

J.1 Proof of Corollaries 1-3

J.1.1 Proof of Corollary 1

$$\begin{aligned}
 \frac{\partial \pi}{\partial I_\alpha} &> \frac{\partial \pi}{\partial I_c} \\
 \Leftrightarrow \frac{2n(n+2)g_\alpha f'_\alpha(I_\alpha)}{\beta\theta(2n+1)(n+1)}q^* - 1 &> \frac{2(n^2+n+1)g_c f'_c(I_c)}{(2n+1)(n+1)}q^* - 1 \\
 \Leftrightarrow \frac{g_\alpha f'_\alpha(I_\alpha)}{g_c f'_c(I_c)} &> \frac{n^2+n+1}{n^2+2n}\beta\theta
 \end{aligned}$$

J.1.2 Proof of Corollary 2

$$\begin{aligned}
 \frac{\partial \pi}{\partial I_\alpha} &> \frac{\partial \pi}{\partial I_\theta} \\
 \Leftrightarrow \frac{2n(n+2)g_\alpha f'_\alpha(I_\alpha)}{\beta\theta(2n+1)(n+1)}q^* - 1 &> \frac{g_\theta f'_\theta(I_\theta)}{\beta\theta^2}(q^*)^2 + \frac{2(n^2+n+1)cg_\theta f'_\theta(I_\theta)}{\theta(2n+1)(n+1)}q^* - 1 \\
 \Leftrightarrow g_\alpha f'_\alpha(I_\alpha) &> \left(\frac{2n^2+3n+1}{2n^2+4n} \cdot \frac{q^*}{\theta} + \frac{2n^2+2n+2}{2n^2+4n}\beta c \right) g_\theta f'_\theta(I_\theta) \\
 \Leftrightarrow g_\alpha f'_\alpha(I_\alpha) &> \left(\frac{2n^2+3n+1}{2n^2+4n} \cdot \frac{n\alpha - \beta\theta c}{(n+1)\theta} + \frac{2n^2+2n+2}{2n^2+4n}\beta c \right) g_\theta f'_\theta(I_\theta) \\
 \Leftrightarrow g_\alpha f'_\alpha(I_\alpha) &> \left(\frac{2n+1}{2n+4} \cdot \frac{\alpha}{\theta} + \frac{2n^2+1}{2n^2+4n}\beta c \right) g_\theta f'_\theta(I_\theta) \\
 \Leftrightarrow \frac{g_\alpha f'_\alpha(I_\alpha)}{\alpha} &> \left(\frac{2n+1}{2n+4} + \frac{2n^2+1}{2n^2+4n} \cdot \frac{\beta\theta c}{\alpha} \right) \frac{g_\theta f'_\theta(I_\theta)}{\theta}
 \end{aligned}$$

J.1.3 Proof of Corollary 3

$$\begin{aligned}
 & \frac{\partial \pi}{\partial I_c} > \frac{\partial \pi}{\partial I_\theta} \\
 \Leftrightarrow & \frac{2(n^2 + n + 1)g_c f'_c(I_c)}{(2n + 1)(n + 1)} q^* - 1 > \frac{g_\theta f'_\theta(I_\theta)}{\beta \theta^2} (q^*)^2 + \frac{2(n^2 + n + 1)c g_\theta f'_\theta(I_\theta)}{\theta(2n + 1)(n + 1)} q^* - 1 \\
 \Leftrightarrow & g_c f'_c(I_c) > \left(\frac{2n^2 + 3n + 1}{2n^2 + 2n + 2} \cdot \frac{q^*}{\beta \theta^2} + \frac{c}{\theta} \right) g_\theta f'_\theta(I_\theta) \\
 \Leftrightarrow & g_c f'_c(I_c) > \left(\frac{2n^2 + 3n + 1}{2n^2 + 2n + 2} \cdot \frac{n\alpha - \beta \theta c}{\beta(n + 1)\theta^2} + \frac{c}{\theta} \right) g_\theta f'_\theta(I_\theta) \\
 \Leftrightarrow & \frac{g_c f'_c(I_c)}{g_\theta f'_\theta(I_\theta)} > \frac{2n^2 + n}{2n^2 + 2n + 2} \cdot \frac{\alpha}{\beta \theta^2} + \frac{2n^2 + 1}{2n^2 + 2n + 2} \cdot \frac{c}{\theta}
 \end{aligned}$$

J.2 Proof of Corollaries 4-6

J.2.1 Proof of Corollary 4

$$\begin{aligned}
 & \frac{\partial \pi_i}{\partial I_{c,i}} - \sum_{j \neq i}^n \frac{\partial \pi_j}{\partial I_{c,i}} > \frac{\partial \pi_i}{\partial I_{\alpha,i}} - \sum_{j \neq i}^n \frac{\partial \pi_j}{\partial I_{\alpha,i}} \\
 & \Downarrow \\
 & \frac{2(n^2 + n + 1)g_c f'_c(I_c)}{(2n + 1)(n + 1)} q^* - 1 - (n - 1) \frac{-2n\theta g_c f'_c(I_c)}{\theta(2n + 1)(n + 1)} q^* > \\
 & \frac{2n(n + 2)g_\alpha f'_\alpha(I_\alpha)}{\beta \theta(2n + 1)(n + 1)} q^* - 1 - (n - 1) \frac{2ng_\alpha f'_\alpha(I_\alpha)}{\beta \theta(2n + 1)(n + 1)} q^* \\
 & \Downarrow \\
 & (2n^2 + 1)g_c f'_c(I_c) > 3n \frac{g_\alpha f'_\alpha(I_\alpha)}{\beta \theta} \\
 \Leftrightarrow & \frac{g_c f'_c(I_c)}{g_\alpha f'_\alpha(I_\alpha)} \beta \theta > \frac{3n}{n^2 + 1}
 \end{aligned}$$

J.2.2 Proof of Corollary 5

$$\begin{aligned}
 \frac{\partial \pi_i}{\partial I_{\theta,i}} - \sum_{j \neq i}^n \frac{\partial \pi_j}{\partial I_{\theta,i}} &> \frac{\partial \pi_i}{\partial I_{\alpha,i}} - \sum_{j \neq i}^n \frac{\partial \pi_j}{\partial I_{\alpha,i}} \\
 &\Downarrow \\
 \frac{g_{\theta} f'_{\theta}(I_{\theta})}{\beta \theta^2} (q^*)^2 + \frac{2(n^2 + n + 1) c g_{\theta} f'_{\theta}(I_{\theta})}{\theta(2n + 1)(n + 1)} q^* - 1 &- (n - 1) \frac{-2n c g_{\theta} f'_{\theta}(I_{\theta})}{\theta(2n + 1)(n + 1)} q^* > \\
 \frac{2n(n + 2) g_{\alpha} f'_{\alpha}(I_{\alpha})}{\beta \theta(2n + 1)(n + 1)} q^* - 1 &- (n - 1) \frac{2n g_{\alpha} f'_{\alpha}(I_{\alpha})}{\beta \theta(2n + 1)(n + 1)} q^* \\
 &\Downarrow \\
 (2(n + 1)^2 \beta c + (2n^2 + 3n + 1) \frac{q^*}{\theta}) &> 6n \frac{g_{\alpha} f'_{\alpha}(I_{\alpha})}{g_{\theta} f'_{\theta}(I_{\theta})} \\
 \Leftrightarrow (2(n + 1)^2 \beta c + (2n^2 + 3n + 1) \cdot \frac{n\alpha - \beta \theta c}{(n + 1)\theta}) &> 6n \frac{g_{\alpha} f'_{\alpha}(I_{\alpha})}{g_{\theta} f'_{\theta}(I_{\theta})} \\
 \Leftrightarrow \frac{2n^2 + 2n + 1}{6n} \beta c + \frac{2n + 1}{6} \cdot \frac{\alpha}{\theta} &> \frac{g_{\alpha} f'_{\alpha}(I_{\alpha})}{g_{\theta} f'_{\theta}(I_{\theta})}
 \end{aligned}$$

J.2.3 Proof of Corollary 6

$$\begin{aligned}
 \frac{\partial \pi_i}{\partial I_{c,i}} - \sum_{j \neq i}^n \frac{\partial \pi_j}{\partial I_{c,i}} &> \frac{\partial \pi_i}{\partial I_{\theta,i}} - \sum_{j \neq i}^n \frac{\partial \pi_j}{\partial I_{\theta,i}} \\
 &\Downarrow \\
 \frac{2(n^2 + n + 1) g_c f'_c(I_c)}{(2n + 1)(n + 1)} q^* - 1 &- (n - 1) \frac{-2n \theta g_c f'_c(I_c)}{\theta(2n + 1)(n + 1)} q^* > \\
 \frac{g_{\theta} f'_{\theta}(I_{\theta})}{\beta \theta^2} (q^*)^2 + \frac{2(n^2 + n + 1) c g_{\theta} f'_{\theta}(I_{\theta})}{\theta(2n + 1)(n + 1)} q^* - 1 &- (n - 1) \frac{-2n c g_{\theta} f'_{\theta}(I_{\theta})}{\theta(2n + 1)(n + 1)} q^* \\
 &\Downarrow \\
 (4n^2 + 2) \frac{g_c f'_c(I_c)}{g_{\theta} f'_{\theta}(I_{\theta})} &> (2n^2 + 3n + 1) \frac{q^*}{\beta \theta^2} + (4n^2 + 2) \frac{c}{\theta} \\
 \Leftrightarrow (4n^2 + 2) \frac{g_c f'_c(I_c)}{g_{\theta} f'_{\theta}(I_{\theta})} &> (2n^2 + 3n + 1) \frac{n\alpha - \beta \theta c}{(n + 1)\beta \theta^2} + (4n^2 + 2) \frac{c}{\theta} \\
 \Leftrightarrow (4n^2 + 2) \frac{g_c f'_c(I_c)}{g_{\theta} f'_{\theta}(I_{\theta})} &> (2n^2 + n) \frac{\alpha}{\beta \theta^2} + (4n^2 - 2n + 1) \frac{c}{\theta} \\
 \Leftrightarrow \frac{g_c f'_c(I_c)}{g_{\theta} f'_{\theta}(I_{\theta})} &> \frac{2n^2 + n}{4n^2 + 2} \cdot \frac{\alpha}{\beta \theta^2} + \frac{4n^2 - 2n + 1}{4n^2 + 2} \cdot \frac{c}{\theta}
 \end{aligned}$$

J.3 Proof of Corollaries 7-10

In order to prove these corollaries we just have to show that $\frac{\partial \alpha}{\partial I_\alpha} = g_\alpha f'_\alpha(I_\alpha)$ becomes $\frac{\partial \alpha}{\partial I_\xi} = \frac{\Omega(n-1)}{\xi n^2} g_\xi f'_\xi(I_\xi)$ and by inserting it into the Corollaries 1, 2, 4 and 5 we will end up with Corollaries 9, 10, 11 and 12. As we have identical firms, we can write:

$$\begin{aligned}
 \frac{\partial \alpha}{\partial I_\xi} &= \Omega \cdot \frac{\sum_{j \neq i}^n \xi_j}{(\sum_{j=i}^n \xi_j)^2} \cdot g_\xi f'_\xi(I_\xi) \\
 &= \Omega \cdot \frac{\xi(n-1)}{(\xi \cdot n)^2} \cdot g_\xi f'_\xi(I_\xi) \\
 &= \Omega \cdot \frac{(n-1)}{\xi \cdot n^2} g_\xi f'_\xi(I_\xi) \\
 \Leftrightarrow g_\alpha f'_\alpha(I_\alpha) &\longrightarrow \Omega \cdot \frac{(n-1)}{\xi \cdot n^2} g_\xi f'_\xi(I_\xi)
 \end{aligned}$$

J.4 Proof of Corollaries 11 and 12

J.4.1 Proof of Corollary 11

$$m \in \{c, A\}$$

$$\begin{aligned}
 \frac{\partial \pi}{\partial I_m} &> \frac{\partial \pi}{\partial I_\theta} \\
 \Leftrightarrow \frac{2ng_m f'_m(I_m)}{n+1} q^* - 1 &> Bg_\theta f'_\theta(I_\theta) (q^*)^2 - 1 \\
 \Leftrightarrow \frac{2ng_m f'_m(I_m)}{n+1} &> Bg_\theta f'_\theta(I_\theta) \frac{A-c}{B\theta(n+1)} \\
 \Leftrightarrow \frac{g_m f'_m(I_m)}{g_\theta f'_\theta(I_\theta)} &> \frac{1}{2n} \cdot \frac{A-c}{\theta}
 \end{aligned}$$

J.4.2 Proof of Corollary 12

$$m \in \{c, A\}$$

$$\begin{aligned}
 \frac{\partial \pi_i}{\partial I_{m,i}} - \sum_{j \neq i}^n \frac{\partial \pi_j}{\partial I_{m,i}} &> \frac{\partial \pi_i}{\partial I_{\theta,i}} - \sum_{j \neq i}^n \frac{\partial \pi_j}{\partial I_{\theta,i}} \\
 &\Downarrow \\
 \frac{2ng_m f'_m(I_m)}{n+1} q^* - 1 + (n-1) \frac{2g_m f'_m(I_m)}{n+1} q^* &> Bg_{\theta} f'_{\theta}(I_{\theta})(q^*)^2 - 1 - (n-1) \cdot 0 \\
 &\Downarrow \\
 (4n-2)g_m f'_m(I_m) &> (n+1)Bg_{\theta} f'_{\theta}(I_{\theta}) \frac{A-c}{B\theta(n+1)} \\
 \Leftrightarrow \frac{g_m f'_m(I_m)}{g_{\theta} f'_{\theta}(I_{\theta})} &> \frac{1}{4n-2} \cdot \frac{A-c}{\theta}
 \end{aligned}$$

K Values used in the calculations of chapter 4

K.1 Values used for the variables with independent maximal market demand

$$\beta = 0.5$$

$$c_i = 200$$

$$\alpha_i = 300$$

$$\theta_i = 1$$

$$f_m(I) = 1 - e^{-\delta_m I}$$

$$\delta_c = 0.00008$$

$$\delta_\alpha = 0.00004$$

$$\delta_\theta = 0.00004$$

$$g_{c,i} = 150$$

$$g_{\alpha,i} = 1000$$

$$g_{\theta,i} = 0.5$$

$$\epsilon^c \in [0, 2]$$

$$\epsilon^\alpha \in [0, 3]$$

$$\epsilon^\theta \in [0, 0.01]$$

K Values used in the calculations of chapter 4

K.2 Values used for the variables with interdependent maximal market demand

$$\beta = 0.5$$

$$c_i = 200$$

$$\xi_i = 1$$

$$\theta_i = 1$$

$$f_m(I) = 1 - e^{-\delta_m I}$$

$$\delta_c = 0.00008$$

$$\delta_\xi = 0.00004$$

$$\delta_\theta = 0.00004$$

$$g_{c,i} = 150$$

$$g_{\xi,i} = 10$$

$$g_{\theta,i} = 0.5$$

$$\epsilon^c \in [0, 2]$$

$$\epsilon^\xi \in [0, 0.01]$$

$$\epsilon^\theta \in [0, 0.01]$$

K.3 Underlying industry life cycle

Number of firms

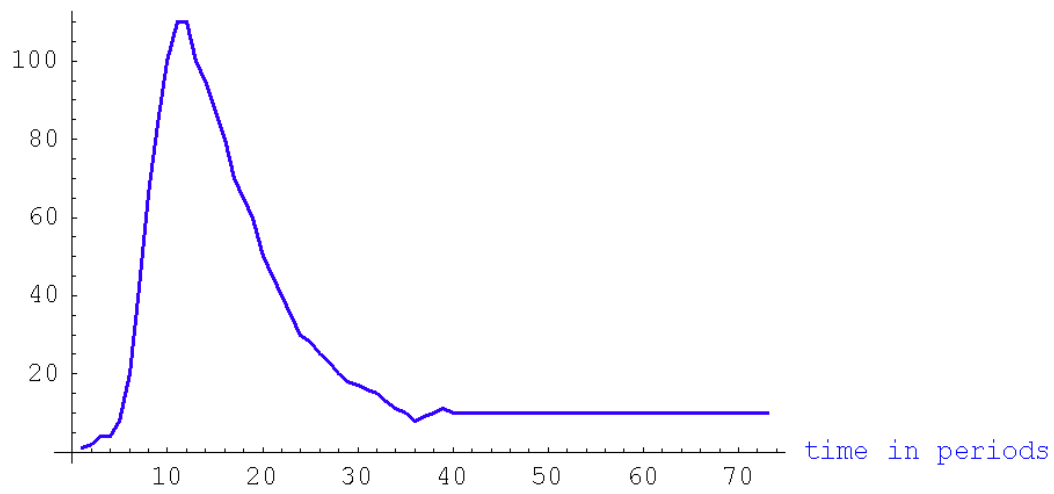


Figure K.1: Typical run of an industry life cycle which was used to calculate the type of investment a firm will choose over time

L General industry life cycle

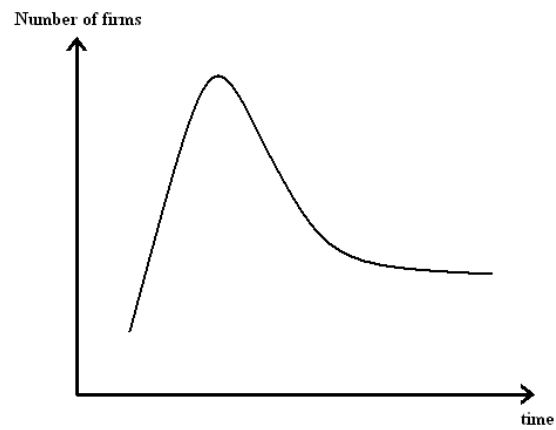


Figure L.1: Typical run of an industry life cycle

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