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Abstract

Firm size and firm growth rates are important economic measures which affect people's live around the world. The reasons for firm entry, growth and exit are influencing employment levels, their understanding is therefore crucial to make economic predictions and give policy advices.

This thesis reviewed in a first step the existing literature on firm size and growth. The basic work of Robert Gibrat on the Law of Proportional Effect was discussed, as well as several other explanatory approaches like the Bound approach by Herbert Simon, the learning model of Jovanovic and a popular paper summarizing the historical literature by John Sutton.

Provided with the theoretical foundation, empirical studies on important influencers on firm size and growth were introduced. First, a study on European multinational firms showed that firm size has a negative impact on growth and thus do not support Gibrat's law of proportional effect. It further showed that firm age has a negative impact on growth and that growth rates differ between industries. Second, studies performed on Portuguese and Italian firms also did not support Gibrat's law, showing a highly right skewed distribution which gets flatter with firm age. Furthermore, it was shown that financial constraints are strongest for young entrepreneurs as well as for young firms, that financially constrained firms have on average less employees and show a lower growth rate than firms that are not financially constrained. Third, the important fields of globalization and productivity, related to concepts of comparative advantage, monopolistic competition, import/export, foreign direct investment and M&A were discussed in detail. It was shown that an integrated (globalized) market leads to a reduction in the total number of firm, to increased competition and thus higher requirements on the productivity levels of individual firms. Further empirical studies showed that selection and learning effects account for observed import and export patterns, showing that according to a firm's productivity level, different trading strategies are chosen. All potential influencers of firm size and growth that were introduced were summarized in a comprehensive table at the end of Chapter 3.

The last chapter of this work applied the introduced concepts and potential influencers to existing OECD and Eurostat data sources. Available variables of several data sources have been reviewed and were used to perform new analysis on firm size and growth. Productivity calculations based on the OECD Structural Demographic Business Statistics data base outlined that productivity levels across Europe are highly heterogeneous, also differing by firm size classes and sectors. Furthermore, the OECD data showed that the size distribution for various sectors is highly right skewed, again showing notably differences between the sectors. Eurostat data were used to calculate firm survival rates across European countries, showing that the one- to five-year survival rates differ strongly between countries. Finally, the work covers future economic perspectives. Therefore an Eurostat survey, including 25 000 firms in 20 member states, was

used to show that in total more that 20% of the polled firms stated that the 'general economic outlook' will be one of their top-five growth limiting factors between 2010 and 2013, followed by Price competition/small margins; Limited demand in the local/domestic markets and High cost of labour. The work concludes by linking and summarizing the introduced concepts and studies, pointing out difficulties and possible directions of future research.

Kurzfassung

Unternehmensgröße und Unternehmenswachstum sind bedeutende Faktoren, welche die Beschäftigungssituation und somit grundlegende Lebensbedingungen vieler Menschen auf der Welt beeinflussen. Um valide ökonomische Vorhersagen und Politikempfehlungen treffen zu können ist es notwendig, die Ursachen für Unternehmensgründungen, Unternehmenswachstum und Unternehmensschließungen zu untersuchen.

Der erste Teil dieser Arbeit behandelt Teile der bisher existenten Literatur zu Unternehmensgröße und Unternehmenswachstum. Behandelt wurden die grundlegende Arbeit von Robert Gibrat und das von ihm beschriebene Konzept des *Law of Proportional Effect*; der von Herbert Simon weitereintwickelte Ansatz des *Bound Approach*; Erklärungsansätze aufgrund von Lern-Modellen durch Jovanovic sowie eine bedeutsame zusammenfassende Arbeit von John Sutton.

Auf Grundlage dieser theoretischen Konzepte wurden im zweiten Teil verschiedene empirische Studien zu wichtigen Einflussfaktoren auf Unternehmensgröße und Unternehmenswachstum besprochen. Die erste behandelte Studie prüfte die Gültigkeit des proportionalen Gesetzes von Gibrat anhand europäischer, multinationaler Konzerne und fand diesbezüglich keine Bestätigung sondern zeigte stattdessen einen negativen Zusammenhang zwischen Unternehmensalter und Unternehmenswachstum. Im zweiten behandelten Themengebiet wurde auf Grundlage von Studien portugisischer und italienischer Unternehmen die Schrägheit der Größenverteilung von Unternehmen gezeigt, welche sich mit zunehmendem Unternehmensalter reduziert. Weiters wurde gezeigt dass finanziell Beschränkungen am stärksten junge Unternehmer betreffen, und betroffene Unternehmen durchschnittlich weniger Mitarbeiter und geringeres Wachstum aufweisen. Das dritte Themengebiet behandelt die wichtigen Einflussfaktoren Globalisierung und Produktivität, sowie zugehörige Konzepte wie komparativer Vorteil, monopolistische Konkurrenz, Import/Export, ausländische Direktinvestitionen und Fusions- und Übernahmegeschäfte. Es wurde gezeigt dass Marktintegration und Globalisierung zu einer Reduktion der Unternehmenszahl führt, den Wettbewerb steigert sowie höhere Ansprüche an die Produktivitätsniveaus einzelner Firmen stellt. Weitere Studien diskutierten den Einfluss von Lern- und Selektionsmechanismen auf Produktivitätsniveaus und das daraus resultierende Import- und Exportverhalten von Unternehmen. Die Einflussfaktoren und Zusammenhänge bezüglich Unternehmensgröße und Unternehmenswachstum wurden abschließend in einer umfangreichen Tabelle am Ende des Kapitels zusammengefasst.

Das letzte Kapitel wendete die eingeführten theoretischen Konzepte und die in den empirischen Studien beschriebenen Zusammenhänge auf verfügbare OECD und Eurostat Datenquellen an. Hierfür wurden Variablen der verschiedenen Datenquellen herangezogen um neue

Auswertungen zu Unternehmensgröße und Unternehmenswachstum zu generieren. Produktivitätsberechnungen anhand der OECD Datenbank *Structural Demographic Business Statistic* wurden berechnet und zeigten gewichtige Unterschiede zwischen den einzelnen europäischen Ländern, zwischen Sektoren als auch zwischen unterschiedlichen Unternehmensgrößenklassen auf. Weitere Auswertungen stellten die Schiefheit der Unternehmensgrößenverteilung dar, welche ebenfalls durch deutliche sektorale Unterschiede charakterisiert ist. Anhand von Daten der Eurostat wurden die fünfjährigen Überlebensraten verschiedener europäischer Länder gegenübergestellt und mit Wachstumsdaten und der Gesamtzahl der Firmen ergänzt dargestellt. Im Abschluss der Arbeit wurde eine 25 000 Unternehmen umfassende Eurostat Umfrage aufbereitet welche aufzeigt, dass der allgemeine ökonomische Ausblick für mehr als 20% der europäischen Firmen als einer der größten wachstumshemmenden Faktoren zwischen 2010 und 2013 bewertet wird, gefolgt von Preiswettbewerb/geringe Gewinnmargen; Eingeschränkter Nachfrage im lokalen Markt sowie hohen Lohnkosten. Die Arbeit schließt mit einer Zusammenfassung der behandelten theoretischen und empirischen Studien und zeigt mögliche Ansätze für zukünftige Forschung auf.

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CHAPTER 1

Introduction

1.1 Motivation

From the early nineteenth century on, market and firm structure raised the interest of researchers. One of the first who performed considerable research in this field was Robert Gibrat (1904-1980) with his book Inégalités Économiques, published 1931 in Paris. His most important finding in empirical studies was that the size of a firm has no influence on its probability to grow. This means, according to Gibrat, the probability of a 10% growth in a given period is the same for small as for large firms. What was called *Gibrat's Law* or *Law of Proportional Effect* from now on did trigger heavy research in the area of firm size distribution. During the next decades, researchers performed more enhanced studies, also using larger and more accurate data sets. It turned out that Gibrat's Law is not supported empirically by earlier research - nevertheless, his initial research characterized the starting point for a period of extensive investigation of the underlying principles of firm size and growth. For the motivation of this diploma thesis the question why it is *important* to study and understand the mechanisms of firm size and growth has to be asked. First, one important player in what we call an „economy" are firms - we call this an economic entity. More specifically, firms (according to the historic notation, the term 'firm' will be used instead of 'company' in this work) act in a market economy, in a profit-oriented and self-determined way [11]. Entrepreneurs launch firms to participate in the market via producing, buying or selling goods and services. Austria, for example, has had 297 484 operating firms in 2009 which employed a total of 2 662 853 people [3]. Due to the fact that people are employed by firms, and that employment is one crucial part in a country's economic and social stability, the investigation of firm structure and size is important. By understanding why firms grow, under which circumstances this growth takes place, and which factors lead to entry and exit of firms, we can make policy suggestions and anticipate the economic and labour market development better and earlier.

1.2 Problem Statement

Given the huge amount of published research in the field of firm structure, there exist different and sometimes contradicting empirical findings due to the quality of the available data and the used evaluation methods. Not having a comprehensive overview about the literature, these contradicting findings make it hard to gain a quick and accurate overview of the current scientific knowledge on firm structure. Furthermore, available studies are often based on relatively old data sources. In the light of a more and more globalized world, recent and accurate data will be needed to test historical findings based on our new and changed economy. Some effort has to be taken to investigate historically findings on firm size/growth mechanisms first, and in a second step to link them to existing data sources to proof if they are still valid.

1.3 Aim and structure of the Work

First, this master thesis will give an overview about the historical development of research in the field of firm size and growth. The reader should understand the beginning in this research area performed by John Gibrat, Herbert Simon and the discussion of historical research by John Sutton.
Second, remarkable empirical studies which investigated influence factors on firm size/growth, and their theoretical foundations, will be described. The thesis will set the focus on topics that have turned out to be part of the most influential factors:

1. Gibrat's Law for European Multinational Enterprises. As the historical section will give a detailed overview about skew distributions and the law of proportionate effect, the bridge to empirical results for the proof of one of the concepts will be made by analyzing Gibrat's Law for European Multinational Enterprises. Therefore, a very recent study performed by the FIW[1] [17] will be investigated, using the AMADEUS firm-level-database, and will show that Gibrat's approach is not supported by current empirical results.

2. Financial Constraints. Based on research of Luís Cabral [6] and Paolo Angelini [2] it will be shown how firms facing financial constraints are limited in growth and size. Different implications of financial constraints, depending if a firm is relatively young or old, will be analyzed. This financial limitation has found to be an important influence factor on the overall firm size distribution. This part is of special interest in the face of the current financial crisis and budget consolidation (restriction) activities.

3. Globalization and Productivity. In a world where flow of information and exchange of tradable goods is possible at low costs, in a short period of time, globalization became one of the key concepts in todays economy. This thesis will not try to judge if globalization is enhancing total welfare or leads to a fair wealth distribution, which is doubted

[1] Forschungszentrum Internationale Wirtschaft. The FIW, a collaboration of the 'Österreichisches Institut für Wirtschaftsforschung' (WIFO), has the objective to (a) develop a systematic research program to support foreign-policy decisions; (b) create an easy and transparent access to relevant databases and to (c) extend and advocate Austrian political know-how in foreign economics.

under some circumstances and would of course be an interesting topic to study, especially considering today's political trends and rumors. Instead, this thesis will focus on the economic concepts of globalization since they seem to have an important impact on firm size distribution. Theories of external and internal economies of scale, firm direct investment, selection and learning models will be studied and their findings will be linked to observed size distributions.

Third, the empirical part of this master thesis will cover available data sets of OECD and Eurostat statistics. Therefore, up-to-date data extractions from the mentioned data bases will be performed. The available measurements on firm size and structure will be described to provide an overview of possible analysis on the theories and hypothesis of the literature that has been introduced in the theoretical part. Furthermore, own analysis and graphical representations of the extracted data will be performed in this master thesis to give an overview of the existing data sources and its respective parameters.

CHAPTER 2

Historical background of firm structure analysis

This section will cover the development of research in the field of firm size and growth. It will build the basis to understand the early findings, their impact on future research and gives an overview of the approaches and paradigms that exist in this area.

2.1 Law of Proportional Effect

As described in the introduction, the law of proportional effect was introduced by Robert Gibrat and is commonly known as Gibrat's Law. His work goes back on Jacobus Kateyn who was an astronomer and studied skew distributions, which we will see are relevant in firm size distribution. The law of proportional effect states that the size of a firm doesn't influence the expected percentage growth of a firm in a given period. Picking an intuitive example from Simon [34, p. 609], two randomly selected firms - one with a billion dollars in assets, one with a million - have the same probability of growing 20% in a given period. Gibrat stated that there is a statistical regularity on firm growth - they usually follow a log-normal distribution. Visualizing the log-normal distribution in Figure 2.1 will help to understand the principle. Note that varying the scale parameter σ leads to a changed skewness of the distribution. Generally speaking, if we inspect a random variable X which is log-normally distributed, then $\log X$ is normally-distributed. Log-normal distributed variables also occur naturally in biology (size/weight distribution in population, recover time from illness) [22] as well as in the distributions of city sizes, where Gibrat's law is also applied. To better understand why the law of proportional effect lead to a log-normal distribution in the end, the following visualization invented by Francis Galton will help. Figure 2.2 show a construction where, in each row, balls will randomly take the left/right path with equal probability of 0.5. This is the classical example for showing a binomial-distribution. The binomial-distribution converges against the normal-distribution for large numbers of repetitions (or, expressed in the context of a technical application: for a large number of electrical

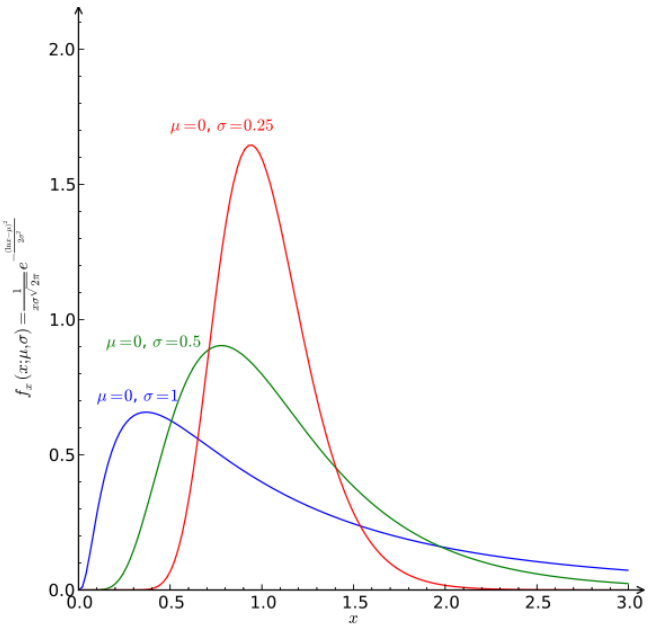

Figure 2.1: Exemplary log-normal distributions with different parameters [18]

inferences, which each influences a measured value either positively/negatively with the same probability). Note that these observed effects are additive, they sum up, but the size of the effect does not depend on the value of the measurement. But coming back to Gibrat's Law, he postulates that firm growth rates are multiplicative - they are *proportional* to firm size. We now adopt this board to one where the side length of the triangles are proportional to their position. This is shown in Figure 2.3. To see the link to firm size distribution, consider the vertical axis as firm size, increasing from left to right. Each row (decision) can be interpreted as one business year (or more general - a defined time period t in which a firm either grows or shrinks. Now the effect is, according to Gibrat's law, proportional thus multiplicative to firm size. Formally,

$$X_t = X_{t-1} \times (1 + a)$$

in a growth period, or

$$X_t = X_{t-1} \times (1 - a)$$

when shrinking respectively.[1]

[1] invention of first log-normal machine by J.C. Kapteyn. To be precise, the shown machine in 2.3 is based on growth/shrink rates of $X_t = X_{t-1} \times a$ (growth period) and $X_t = X_{t-1} \div a$ (shrink period). This leads to the advantage that the median doesn't shift to the left but stays below the ball's entry point. The implications are the same, both formulas are multiplicative and lead to a log-normal distribution. Furthermore, this graphical representation is just a simplification. Here, a firm has a 50/50 chance to either grow or shrink. In the real world, of course, different possibilities occur for different growth rates. What is important is that each firm has the *same* probability of growing x per cent - this condition leads to the log-normal distribution, therefore the graphical simplification can be made without loss of generality.

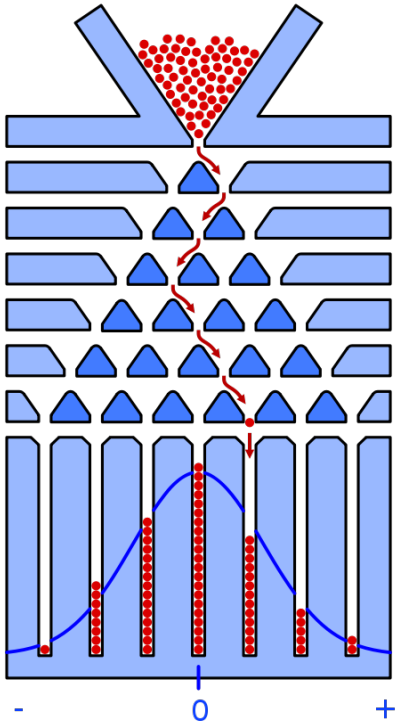

Figure 2.2: Visualization of a Galton Board [33]

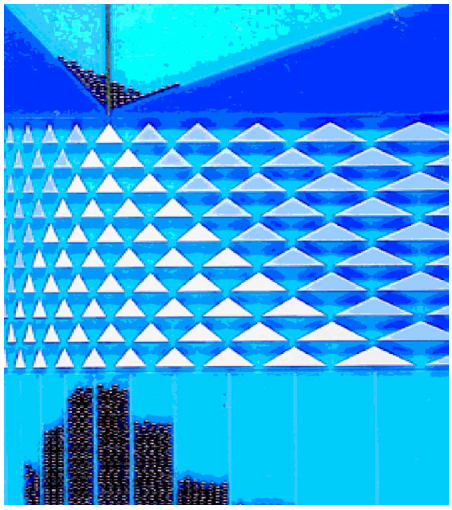

Figure 2.3: Visualization of a log-normal Galton Board [22]

2.2 The Yule-Simon distribution

Related to the log-normal distribution, Simon and Udny Yule studied a probability function which is called the *Yule-Simon distribution*[2] [34]. The underlying theory assumes that „new firms are being 'born' in the smallest-size class at a relatively constant rate“ [34, p. 610]. We can look at this also from a different perspective: Regularly, new business opportunities occur. The probability, that an opportunity is taken up by a new entrant is constant over time [36]. If there wouldn't be a constant entry of new firms, the distribution would be log-normal. But under the condition of new-born firms, the Yule-distribution is obtained. For a better understanding it is now reasonable to consider the following game: Balls are added to urns at a constant rate , and the probability that a ball is added to a specific urn U_x is proportional to the number of balls which are already contained in U_x. Therefore, the more balls already are in urn U_x, the higher the probability is that a new ball will be added to it. We now interpret the urns as firms; and balls as business opportunities to again see what is called Gibrat's law. But now having the additional condition formulated by Simon, it is possible that a business opportunity is taken up by a new entrant - meaning new urns will be added at a constant rate. The probability that a new entrant takes a business opportunity is, in contrast to existing firms, constant over time. This additional condition leads to the Yule distribution. In the literature, conditions like the one explained for Gibrat's law or the Yule-distribution are often denoted as *preferential attachment process*, or more generally as *power law*. These distributions can also be observed in city size distributions (many small cities, few large), the wealth of individuals (as measured by the Pareto-index or Gini-coefficient) and so on. Simon postulates that "Whether sales, assets, numbers of employees, value added or profits are used as the size measure, the observed distribution always belong to the class of highly skewed distributions that include the log-normal and the Yule." [34, p. 611]. Based on the characteristics of the Yule-distribution, Simon points out that an increase of the entry rate of new firms would of course reduce the skewness of the distribution, meaning that the degree of concentration will be reduced. (cf. [34], [36])

2.3 Mansfield's investigations on firm exit

Testing Gibrat's law for a larger number of firms, Mansfield [24] recognized the necessity of a definition, how firm exit should be treated.
First, we consider all firms, also firms that leave the industry in the observed period. The size of the leaving firm will then be treated as 0. Mansfield's data set rejected Gibrat's law in this case. The law did fail to hold, and one reason Mansfield identified was that the probability of a firm's death *is not* independent of its size. Smaller firms were more likely to exit [24, pp. 1031-1032].
Second, we consider only firms that survive and exclude the exiting firms from the analysis. Using this definition, in four out of ten samples used by Mansfield, Gibrat's law was rejected. He moreover found that "smaller firms often tend to have higher and more variable growth rates than larger firms." [24, p. 1044]. A possible explanation he suggested is related to the idea that large firms can be split up into smaller components (i.e. single plants), each having independent growth rates. It follows that the growth rate of large firms consisting of many single plants will

[2] in this work, the term Yule-distribution will be used, as it is used in the studies by Herbert Simon

have a lower standard deviation than a single small firm has.[3]
Third, we interpret Gibrat's law in a way that it only holds for firms that are above a minimum efficiency size. This idea was already formulated by Simon and arises from the idea that we have high unit costs below some minimum firm size. Taking into account that in these times plants were investigated primary, this seems to be a reasonable example. Since plants are related with high fixed costs, which lead to high unit costs if the number of produced units are low, the average cost curve is (inversely) J-shaped. Also in this setting, Gibrat's law did not hold in six out of ten samples. (cf. [24])

2.4 Evan's studies on U.S census data in the 1980's

The findings of Mansfield have influenced the research of the 1980s, especially the question how to deal with exiting firms, respectively how to correctly perform sample censoring. The next large data analysis was performed by Evans in 1987 and was based on a large dataset of U.S. manufacturing firms. The focus of his and other studies in the 1980s were mainly two questions: (1) Which conditions influence the probability of survival of a firm? (2) Which conditions influence the probability distribution of firm's growth? Regarding (1) it was found that larger firms have a higher probability to survive, for (2) it was found that the proportional growth rate decreases with firm size. Additionally, some 'life-cycle' regularities have been identified: older firms face lower growth rates, but have a higher probability to survive. The studies also distinguished between single-plant and multi-plant firms. Note that the findings from (1) and (2) influence growth in two different directions: The net-growth rate within a given firm size class falls with size and age - an decreasing factor on growth within the size class. On the other hand, the survival rate gets higher with size and age - an increasing factor on growth. It was found that for single-plant firms the negative aspects (2) overweighted the aspects from (1). For multi-plant firms, the opposite was found meaning the positive aspects dominated which lead to an increased net growth rate with size/age. (cf. [36])

2.5 The learning model of Jovanovic

One attempt to explain these increased exit rates in small size firms goes back on what is called the *learning model*, introduced by Boyan Jovanovic. Here the idea is that new firms do not know their efficiency level on start-up, and therefore cannot estimate their competitiveness adequately. Once they enter the market, their efficiency level unfolds, and if they cannot compete due to other firms which habe a relatively higher efficiency level, they choose to exit the market. This is one approach to explain why firms choose to exit, others coming from studies performed on the sociology of organizations are for example: "bad initial judgments of market opportunities, managerial incompetence, or simply the fact that the entrant set up a business which had only modest prospects of survival, as an alternative to entering the labor market, where opportunities were poor." [36, p. 47] (cf. [36])

[3] Mansfield made the comment that of course single plants of a large company are somehow related because of their proximity and other conditions, therefore growth rates are not completely independent.

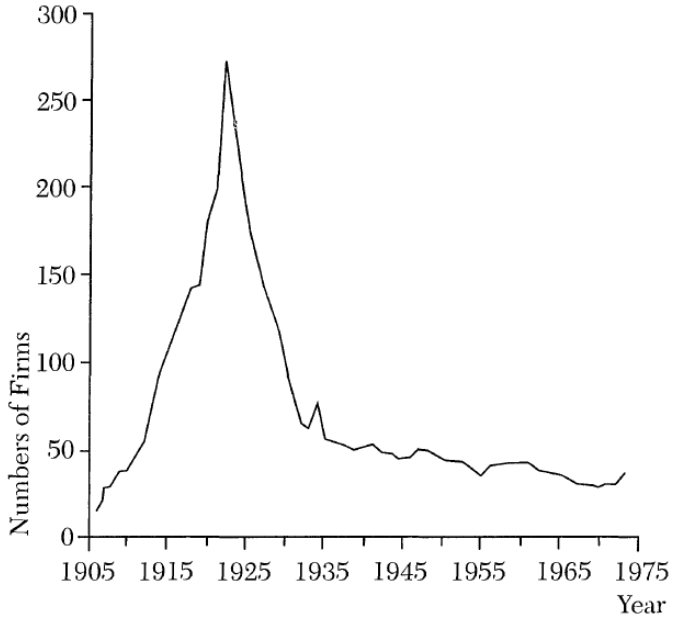

Figure 2.4: Firm Numbers in the U.S. Tire Industry [36, p. 48]

2.6 Steven Klepper on innovation

Another dimension to explain firm size and growth was added through studies performed by Steven Klepper and is called *shakeout*. In his research he found that typically, the number of firms rise in the beginning (of a product life-cycle) and falls to some lower level afterwards. An example from the U.S. Tire Industry is given in Figure 2.4. One possible explanation suggested is that innovators (firms that enter an industry first) invent and employ a technology. This technology is outdated and replaced by a new one after some time.[4] The new technology leads to an increase in efficiency, which is reflected by a higher output per firm. Therefore, the new firms, less in absolute numbers because of the improved technology, replace some old ones which are not competitive anymore [36]. Another perception is well known from innovation theory and refers to the fact that a process innovation is valuable especially if a large number of units are affected. With a process innovation leading to a higher efficiency (lower production costs per unit), large firms benefit more compared to small firms. Therefore, large firms have a higher incentive to develop process innovations, while small firms will focus more an product innovation. If large firms can successfully lower their unit costs, this leads to a higher competitive pressure on small firms, who might exit the market. It is worth noting that this behavior has beneficial effects for small firms too. They face what is called an *attackers advantage* in newly invented technology which has the potential to substitute an old one. One representative example is found in the disk drive industry. As typical for the ICT sector it is characterized by very short product

[4]Note that the old firms now face what is typically called 'sunk costs', since their initial investments are now outperformed by a new invention

		Number of firms offering one or more models of the new product architecture							
		First year		Second year		Third year		Fourth year	
		No. of firms	Percent	No. of firms	Percent	No. of firms	Percent	No. of firms	Percent
8-inch drives	Entrants	1	100	4	67	6	55	8	62
(1978)	Established	0		2	33	5	45	5	38
	Total	1	100	6	100	11	100	13	100
5.25-inch drives	Entrants	1	50	8	80	8	50	13	54
(1980)	Established	1	50	2	20	8	50	11	46
	Total	2	100	10	100	16	100	24	100
3.5-inch drives	Entrants	1	100	2	67	3	75	4	50
(1983)	Established	0		1	33	1	25	4	50
	Total	1	100	3	100	4	100	8	100

Figure 2.5: Analysis of disk/trend report data [7, p. 245]

life-cycles and a high degree of innovation. Figure 2.5 shows that in the very beginning of a new innovation, entrant firms are coming up with the product innovation having the attackers advantage, and over time, established firms catch up on the new technology. (cf. [7], [36])

2.7 The modification of Gibrat's Law: Bound approach by Herbert Simon

In his paper, Sutton also proposed a modified variant of Gibrat's law. He invented a condition stating "The probability that the next market opportunity is filled by any currently active firm is nondecreasing in the size of that firm." [36, p. 49]. Note that this is a relaxation of Gibrat's law, since with this condition it is not depending on the *size* of that firm, but on its *rank* within the industry. The condition here would be violated if a smaller company is more likely to take up a new business opportunity. Furthermore, the least skew distribution can be obtained if all firms have the same probability to take up a new business opportunity. For his calculations he made use of the binomial-distribution. He therefore assumes that no strategic interdependencies between businesses exist.[5] His model is also based on the assumption made by Simon [34] which state that new business opportunities occur at a constant rate over time. The binomial-function looks as follows [35, p. 8]:

$$Prob(N_t = N) = \binom{t-1}{N-1} p^{N-1}(1-p)^{t-N}$$

N_t denotes the number of firms at time t. In every period one opportunity occurs, each opportunity being of the same size and yields to exactly one firm. The probability that the new opportunity is taken up by a new firm is p; while each existing firm takes up the new opportunity with a probability of $(1-p)/N_{t-1}$. As said, there are three possibilities in each period t:

- Case (a): entry occurs, a new firm takes up the possibility: n_1 (the number of firms with size 1) rises by one unit.

[5] this is because of the nature of the binomial-distribution, which calculates a distribution for *independent* events

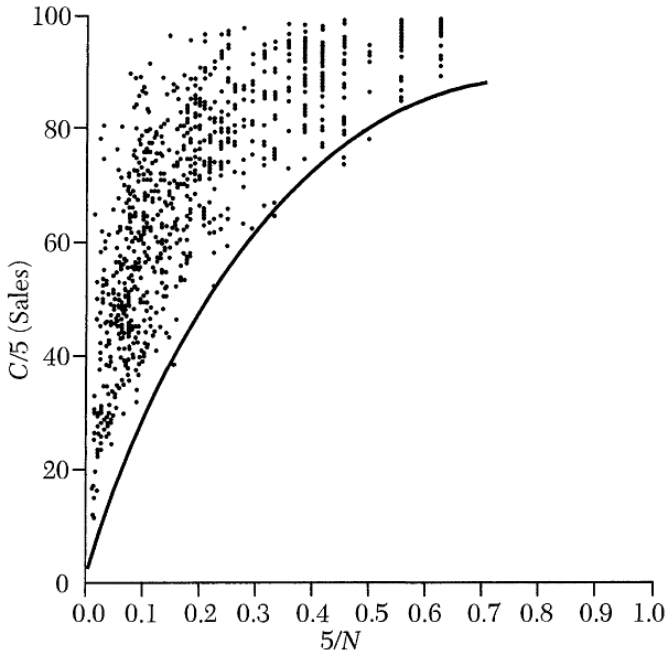

Figure 2.6: Five-firm Sales Concentration Ratios for U.K. Product Markets, 1997

- Case (b): no entry occurs, a firm of size 1 takes the opportunity with a probability of $n_{1,t}/N_t$ (same probability for each firm): then, n_1 falls by one unit since one firm grows from size class 1 to size class 2.
- Case (c): no entry occurs, a firm of size $\neq$ 1 takes the new opportunity, therefore n_1 remains unchanged (the number of firms with size 1 stays the same).

In his calculation Sutton showed that the limiting boundary of this distribution will lead to a *Lorenz-curve*, which is often used to describe income/wealth distributions. In this case, it describes the concentration ratio of opportunities (which can be interpreted as 'sales') captured by the k largest firms. His calculations lead to a Lorenz-curve which is least skew, based on the relaxed condition of Sutton that the probability of taking up a new opportunity is nondecreasing in firm size. This equation thus results under the condition that all firms have an equal probability of taking up a new business opportunity. Growth, as described by Sutton, is therefore not proportionally depending on the firm size, although it is non-decreasing in firm size. One important attribute of his method is that the bound given by the Lorenz-curve is independent of the entry parameter p, which is the probability that a new possibility is taken up by a new entrant [35, p. 16]. This is different to other approaches, like the ones performed by Simon. Sutton also tested his theory empirically for U.K. Product Markets, which is shown in Figure 2.6 and holds very well for the year 1977. Each point corresponds to a different industry. The horizontal axis shows the ratio of the 5 top-ranked firms on the whole industry. For example, if an industry consists out of 20 firms, the 5 firms make up for 25% of the overall industry. The curve now shows that in such an industry, these 5 firms should account for at least appx. 50% of the sales (vertical

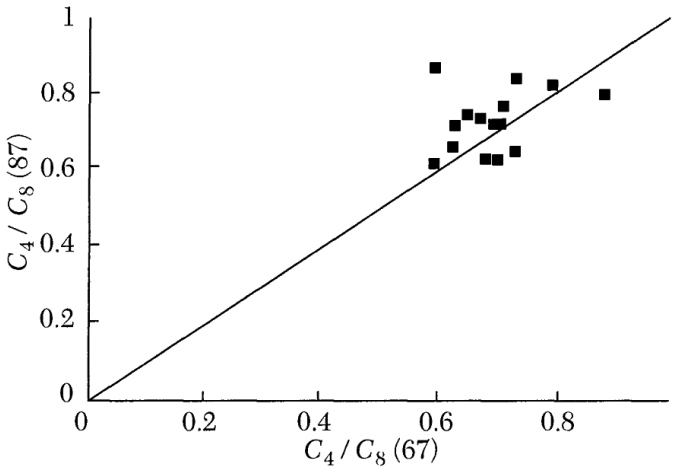

Figure 2.7: 4-firms sales concentration ratio of 8-firms sales concentration ratio - in 1967 (horizontal axis) and 1987 (vertical axis) [36, p. 55]

axis, lorenz-curve as solid line). Again, note that this denotes an inequality in size (here: sales) distribution. In fact, the data from 1977 are consistent with the calculations of Sutton since all points lie above his calculated Lorenz-curve. (cf. [36], [35], [34])

2.8 The correlation of gross entry and exit rates

To describe firm size distribution, another dimension which is called *Turbulence* should be investigated. Empirical studies found that gross entry and exit rates are positive correlated, and this so called "churning" varies between industries. Comprehensive country comparisons showed that turbulence-levels of industries are (weakly) correlated cross-national which might imply industry-specific effects. Sutton names three possible reasons to explain the observed effects: change of demand across product varieties or plant locations; displacement of existing technologies (enhanced modes of production) or displacement of existing products. These effects can vary in intensity among industries. Research also showed that this turbulence has only little effects on the largest firms in an industry. (cf. [36])

2.9 Studies on decline and exit of firms

The last dimension which will be added and has been investigated in the early literature is the one of *decline and exit*. Sutton also covers this topic and stated that "as industry declines, firm numbers tend to fall and reported concentration ratios show a weak tendency to rise." [36, p. 55] It is now interesting to somehow reverse Gibrat's law and ask if large firms shrink proportionally to their size (therefore, shrink faster in absolute terms). Sutton plotted a scatter diagram to compare U.S. manufacturing industries that have faced a decline in firm numbers of more than 40% between 1967 and 1987, this is illustrated in Figure 2.7. If large firms shrink proportionally

faster, the ratio of C_4/C_8 (which means the relative sales share of the 4 top-ranked companies in an industry compared to the sales of the 8 top-ranked) should decrease. For example, a point that lies at 0,6 at the horizontal axis (year 1967) should fall below 0,6 on the vertical axis (year 1987) if the top-4 firms did shrink faster. As one can see in the figure, this is not the case for the observed years and industries. Therefore it was suggested to look at industries which can decrease their unit costs at a constant rate of average costs[6] - under these circumstances it is reasonable that larger firms decrease their capacity first, until they are equal in size to the next-largest plant, and so forth. Empirical examples on the soda-ash industry in U.S. showed that this pattern can be observed in reality. In contrast, another interesting pattern was observed by Charles Baden-Fuller in 1989: he found that "firms that were diversified and financially strong were more likely to close plants. (...) Analysis of managers' views suggested that, in these firms, there were fewer internal conflicts between owners, debt holders, and managers" [36, p. 56].

Via different dimensions, this section described how the firm size and growth distributions have been studied by the early literature. The research has been done based on statistical effects (i.e. the models of Gibrat and Simon) and was based on economic mechanisms. As this section was supposed to equip the reader with the theoretical foundations, the next section will more heavily investigate the empirical support of some of the theories described here. The additional effect of financial constraints on the skewness of distributions will be introduced based on an empirical example, and the important effects of international trade and productivity will be studied.

[6] this implies that the unit costs are constant and that fixed costs are proportionate to plant capacity

CHAPTER 3

Empirical Results on European Multinationals, Financial Constraints and Globalization Impact

As the theoretic foundation of firm size and growth has been presented in Chapter 2, this chapter will now investigate empirical findings for these theories. Therefore, the accuracy of Gibrat's law will first be tested for European multinational enterprises. Since the recent literature agrees that Gibrat's law has to be rejected for many of todays observations on firm level data, we will then consider other approaches that have been empirically tested. One approach investigates the impact of financial constraints which have potential negative effects on firms. Especially due to the current financial situation in Europe this will be a relevant topic, and results for Portuguese manufacturing firms as well as a study based on a dataset of Italian firms will be presented. Since globalization changed the game of economics in our recent history, we will investigate the theory on firms' import and export decisions; firm direct investments abroad and the increased competition that firms are confronted with. It will be of special interest for this work how the productivity of firms comes into play when internationalization is relevant, and what this means to firms' market decisions (especially entry, exit and export).

3.1 Gibrat's Law for European Multinational Enterprises

Overview

The study which is presented here was performed by the FIW on behalf of the Austrian Federal Ministry of Economics and Labor (BMWA) and uses a comprehensive dataset of about 20.000 firms for the period 2000-2004 to study if Gibrat's Law is applicable for European multinational firms. For this study it is of interest how firm size and growth are related, and how this differs across countries and industries. As we have seen in Chapter 2, Gibrat's law was not supported

well by empiric data, and Sutton [36] already presented a relaxed approach where firm size and growth are not proportionally related. However, it was shown in one study in 2004 that Gibrat's law did hold for a large sample of European firms with a minimum of 100 employees, but the majority of studies did not confirm this [16]. Falk states that the number of studies in the field of European multinational firms is limited, especially the ones which consider specific sectors. This study should contribute by proofing the relationship between size and growth, which was measured in terms of employment and turnover. (cf. [16])

Data set

Before introducing the empirical model, some words have to be said about the underlying data. The data used in this study were taken from the 'AMADEUS' database of company accounts. The database is owned by the Bureau Van Dijk and contains about 19 million companies across Europe. As it is one goal of this diploma thesis to highlight available data sources and possible applications for analysis (cf. Chapter 1), the containing attributes of the AMADEUS database are listed here, cited according to [9]:

- Company information for both Western and Eastern Europe, with a focus on private company information
- Company financials in a standard format to allow comparison across borders
- Financial strength indicators
- Directors
- Images of report and accounts for listed companies
- Stock prices for listed companies
- Detailed corporate structures
- Market research
- Business and company-related news
- M&A deals and rumors
- Maps

The dataset covers the countries Albania, Austria, Belarus, Belgium, Bosnia-Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Rep. of Macedonia, Malta, Rep. of Moldova, Monaco, Montenegro, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Serbia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine and United Kingdom. (cf. [9])

	Median average annual percent. growth in turnover 2000 - 2004	Median average turnover in 2000 (1,000 €)	Median average annual percent. growth in employm. 2000 - 2004	Median average employment in 2000	Median year of foundation of foreign affiliates
Austria	4.3	29,360	0.0	115	1994
Belgium	2.9	10,413	0.0	37	1988
Switzerland	1.4	129,842	0.2	370	1981
Germany	2.0	31,400	0.0	135	1989
Spain	6.2	8,446	1.9	50	1991
Finland	4.7	16,358	1.5	85	1992
France	3.6	15,113	1.1	82	1988
United Kingdom	1.9	56,992	1.6	258	1990
Greece	8.0	9,742	0.0	70	1997
Ireland	8.3	41,042	0.0	60	1995
Italy	3.9	25,196	0.4	99	1988
Netherlands	3.2	74,934	0.5	205	1986
Norway	4.2	4,289	0.0	25	1995
Portugal	2.4	18,307	-1.9	193	1992
Sweden	3.8	6,055	0.8	28	1989
Total sample	3.8	17,360	0.5	81	1990

Figure 3.1: Descriptive statistics by country [16, p. 8]

Falk additionally used a second database called 'BANKSCOPE' from Bureau Van Dijk which includes "balance sheet and income and loss statements of EU banks, that are not included in the AMADEUS database." [16, p. 7]. As the details of the BANKSCOPE database will not be listed here, a list of attributes can be found in [10]. Using both databases, all European companies holding at least a 10 percent[1] share in another European country are considered for the analysis. The dataset used by Falk includes 15 OECD countries: Austria, Belgium, Switzerland, Germany, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Netherlands, Norway, Portugal and Sweden [16, p. 7]. To provide an overview of the used data, which shows the advantage that values are pretty actual for a period before the financial crisis appeared, some descriptive statistics are taken from the report and are presented in Figure 3.1 and Figure 3.2. Special attention should be given to the high turnover rates in Greece and Ireland which both show a median growth rate of about 8%. Given the low tax rates of these countries, it could be assumed that firms try to shift profits via FDI etc. to these colloquially called 'tax havens'. OECD writes in this regard that "With one of the OECD's smallest and most open economies, Ireland welcomes foreign direct investment (FDI) and offers grants and tax incentives to attract investors. Direct investment plays a unique role in the Irish economy, accounting for a larger part of its manufacturing output, employment and exports than in most other OECD countries. (...) questions have been raised about whether too much emphasis has gone to promoting foreign investment and not enough to developing local enterprises." [30] Also note, the Austrian

[1] this 10 percent rule is often used for defining multinational enterprises (MNEs); an alternative definition would be, for example, a domestic parent company having affiliated companies in foreign countries.

	Median average annual percent. growth in turnover 2000 – 2004	Median average turnover in 2000 (1,000 €)	Median average annual percent. growth in employm. 2000 - 2004	Median average employment in 2000	Median year of foundation of foreign affiliates
Mining & energy	5.6	25,423	0.4	122	1990
Consumer manufacturing	2.2	29,533	0.0	117	1988
Intermediate manufacturing	2.7	33,634	0.0	150	1989
Investment manufacturing	3.1	29,641	0.0	170	1989
Distributive trade	3.7	24,388	1.4	54	1989
Transp. & financial intermed.	5.4	11,769	1.6	40	1990
Business services	4.1	7,901	0.4	35	1990

Figure 3.2: Descriptive statistics by industry [16, p. 8]

average growth rate was above the EU-average for the observed period. Due to the banking sector in Switzerland and large international companies related to it, Switzerland has the highest median of employees per company. Also note Switzerland and the Netherlands who have an median year of foundation of 1981 and 1986, hence their companies are the oldest ones across the countries. (cf. [16])

Methodology

Having discussed the data source, the empirical model described by Falk looks as follows: [2]

$$\Delta S_i = \beta \ln S_i + \alpha \ln AGE_i + v_i$$

The variable i stands for a specific firm, S denotes the size of the firm (in turnover or employment) for the year 2000. ΔS_i therefore denotes the average annual change of turnover/employment between 2000 and 2004. β denotes the speed of convergence and v_i denotes an normally-distributed error term. The average year of foundation is denoted by $\ln AGE_i$ with a weighting parameter α which will also be subject to estimation by the regression analysis.

Now focus on the parameter β: If firm size does not influence the growth, and growth is therefore independent of size, we expect $\beta = 0$. Otherwise, if $\beta < 0$, firm size has a negative influence on average growth ΔS_i and Gibrat's law will be rejected. An example should be given to make that clear. Table 3.1 shows the impact of firm size at an exemplary chosen β value of -0.005. As the table shows, the impact on growth for a firm of size 100 is -0.02, while it is -0.06 for a firm of size 100 000. Therefore, if the regression analysis results show support for a negative β value, large firms grow slower and Gibrat's law could be rejected.

The regression also contained dummy-variables for the industry and country, and separate regressions have been performed for seven industries:

- mining & energy

[2] The original formula which was described by Falk in his paper did include the parameter AGE_i. Obviously, after clarification with Dr. Falk, this seems to be an mistake and therefore the correct parameter $\ln AGE_i$ is used in this formula.

firm-size S_i	β	**Impact on avg. annual growth** $\beta \ln S_i$
100	-0.005	-0.02
1 000	-0.005	-0.03
10 000	-0.005	-0.05
100 000	-0.005	-0.06

Table 3.1: Decreasing outcomes of average annual growth rates at an exemplary β value of -0.005

- consumer manufacturing
- intermediate manufacturing
- investment manufacturing
- distributive trade
- transport
- financial intermediation and business services

Falk stated that instead of using an OLS[3] analysis to estimate the parameters α and β, he applied the robust regression method for his estimations. The advantage here is that violations in the data generation/gathering process do not that heavily influence the results as it would be the case with OLS regression. Especially when analyzing firm level data from different data sources, an OLS test would have its limitations since wrong input data or outliers would have a strong influence on the outcome.[4] As Falk uses a weighted robust regression method, which means observations with large residuals are given less weight, the model avoids this problem.

Results

The results of the estimated β parameter based on turnover are illustrated in Figure 3.3. To stay space-saving in this work, the results based on employment are only given for the overall β estimation in Figure 3.4, estimations of dummy variables on country and industry level can be found in [16, p.13]. The columns show the estimated parameters of the iterated robust regression test. We see that for the total sample an β estimation of -0.004 was found in the turnover setting, and -0.005 in the employment setting, both on the 1% significance level. The implication, as explained, is that firm size has a negative impact on firm growth and Gibrat's law can be rejected for the given sampe. It was also found that the average year of foundation has a positive impact on annual percentage growth, since estimated parameters are positive: 0.698 in the turnover setting and 0,666 in the employment setting. This means that firms with younger foreign afiliates are growing faster, while growth decreases for older firms. Falk also performed

[3] ordinary least square. Used to estimate parameters in a linear regression model via minimizing the sum of squared vertical distances between observed values (samples) and the regression line.

[4] an OLS regression is therefore 'non-robust' to outliers

	(i)			(ii)			(iii)		
	Coeff.		t	Coeff.		t	Coeff.		t
log turnover in 2000				-0.004	***	-11.55	-0.004	***	-10.95
Aver. year of foundation of foreign affil.							0.698	***	7.70
Country dummy variables (ref France):									
Austria	0.012	*	1.84	0.013	**	2.04	0.011	*	1.75
Belgium	-0.006	*	-1.87	-0.010	***	-2.78	-0.010	***	-2.86
Switzerland	-0.026	***	-3.75	-0.017	**	-2.37	-0.014	*	-1.91
Germany	-0.010	***	-3.46	-0.008	***	-2.72	-0.007	**	-2.47
Spain	0.026	***	10.09	0.023	***	8.73	0.023	***	8.52
Finland	0.012	**	2.07	0.012	**	2.01	0.011	*	1.85
United Kingdom	-0.020	***	-6.09	-0.014	***	-4.19	-0.013	***	-4.00
Greece	0.037	***	5.90	0.035	***	5.46	0.031	***	4.76
Ireland	0.016		1.17	0.021		1.53	0.020		1.48
Italy	0.013	***	4.62	0.013	***	4.56	0.010	***	3.03
The Netherlands	-0.002		-0.49	0.004		0.81	0.005		1.05
Norway	-0.001		-0.12	-0.005		-1.02	-0.008		-1.63
Portugal	-0.005		-0.74	-0.005		-0.73	-0.007		-0.96
Sweden	0.003		0.73	-0.001		-0.28	-0.001		-0.22
Industry dummy variables (ref consumer manufacturing):									
Mining & energy	0.037	***	9.77	0.036	***	9.53	0.034	***	8.75
Intermediate manufacturing	0.008	**	2.18	0.008		2.28	0.008		2.13
Investment manufacturing	0.011	***	2.92	0.010	***	2.78	0.010	***	2.64
Distributive trade	0.018	***	5.32	0.017	***	5.13	0.016	***	4.82
Transport & financial intermediation	0.028	***	8.33	0.023	***	6.95	0.022	***	6.51
Business services	0.022	***	6.57	0.017	***	4.79	0.015	***	4.23
Constant	0.017	***	4.97	0.063	***	12.18	-5.239	***	-7.61
Number of observations	23,488			23,488			22,714		

Figure 3.3: Robust regression estimates of the determinants of turnover growth [16, p. 11]

	(i)		(ii)			(iii)		
	Coeff.	t	Coeff.		t	Coeff.		t
log employment in 2000			-0.005	***	-13.77	-0.005	***	-14.46
Aver. year of found. of the foreign affil.			0.666	***	9.24			

Figure 3.4: Robust regression estimates of the determinants of employment growth [16, p. 13]

some analysis on the industry level and found that "growth rate of turnover is highest in the transport and banking & insurance sector, as well as in the other production sector" [16, p. 10]. (cf. [16])

Summary

Concluding on the first subject of investigation of this thesis, Gibrat's law for European multinational enterprises, evidence based on a large dataset has been found and showed that

- Firm size has a negative impact on firm growth. This represents a contradiction to Gibrat's law of proportional effect which is therefore rejected for the given dataset.
- Firm age has a negative impact on firm growth. Younger firms show higher growth rates than older firms.
- Growth rates differ between industries. Firms in specific industries have a tendency for higher/lower growth rates than comparable firms in other industries.[5]

3.2 The influence of financial constraints on firm size and growth

This section will review studies that have investigated the influence of financial constraints on the growth and size of firms. They will also differentiate between young and old firms and test if financial constraints have different impacts depending on firm age. The studies are performed for countries where financial constraints seem to be a very realistic case due to the financial crisis and high efforts in budget consolidation: The first study will investigate Portuguese manufacturing firms, while the second one will focus on Italian manufacturing firms.

Impact of financial constraints on Portuguese manufacturing firms

Overview

As we have already seen in Section 3.1, Gibrat's law does not seem to hold empirically if a large data set of firms is investigated. The study of Cabral and Mata [6] enhances analysis as we have seen them in the example for European multinational firms since it adds another dimension of investigation: It does focus on different age groups of firms. This allows to identify which age groups have the strongest influence on the typical skewness of the overall distribution. Splitting the firms into age groups also allows to identify which firms are most limited in growth when it comes to financial constraints.

Data set

First, the data set under investigation will be presented. The authors used two different data sets of operating Portuguese manufacturing firms in 1991. One was provided by a private firm

[5] this means: keeping all other variables like age, size, etc. constant; acting in industry x has an positive/negative effect on growth compared to a similar firm acting in industry y

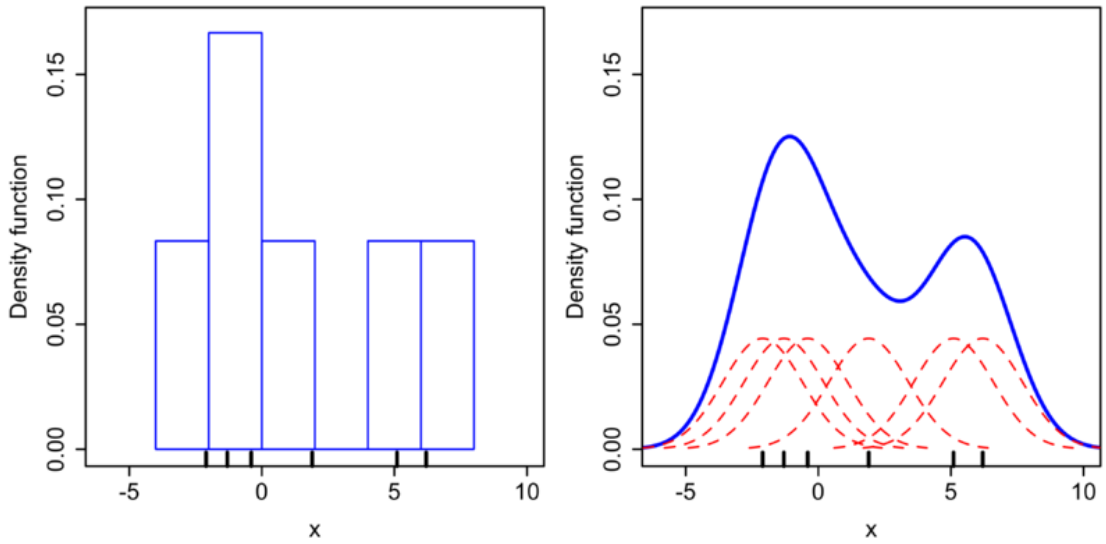

Figure 3.5: Comparison between a standard histogram (left) and a normal distribution kernel density smoothing function (right) [26]

called IF4, the other one was provided by the Portuguese Ministry of Employment - Quadros do Pessoal (QP). The selection of firms differs between these two sources. The data included in the IF4 set consists of balance sheet data of firms that need to report these data publicly. As Cabral notes, these are "typically the largest firms in the economy" [6, p. 1076]. Since only the data which include information on employment are of value for this study, 587 firms have been selected that fit that criteria. The data set from the official authority QP is based on a survey that includes all firms that employ paid labour in Portugal. This data set is very comprehensive, it includes 33 678 firms and also provides information on employment. (cf. [6])

Methodology - Size Distribution

Having knowledge about the underlying data source, the methods of analyzing these data are as follows. To plot the density curves of the firms of these two data sets, kernel density smoothing was used. This method is appropriate if the 'real' distribution of a random variable should be estimated and when having only knowledge about a finite number of samples.

As it should be made clear how the density functions presented in this section were produced, the method of kernel density smoothing will shortly be explained using Figure 3.5. The histogram on the left side consists of six samples, their values are marked at the bottom of the horizontal axis. The common approach for the histogram should be quite clear - here the values were grouped into 6 bins, each of size 2. On the right side, the process of kernel density smoothening is shown on the basis of a normal distribution. Above each of the six values, a normal-distribution is set in place. Now, the kernels are summed up which leads to the blue solid line. Therefore, the kernel density function takes into account the samples of the neighbor-

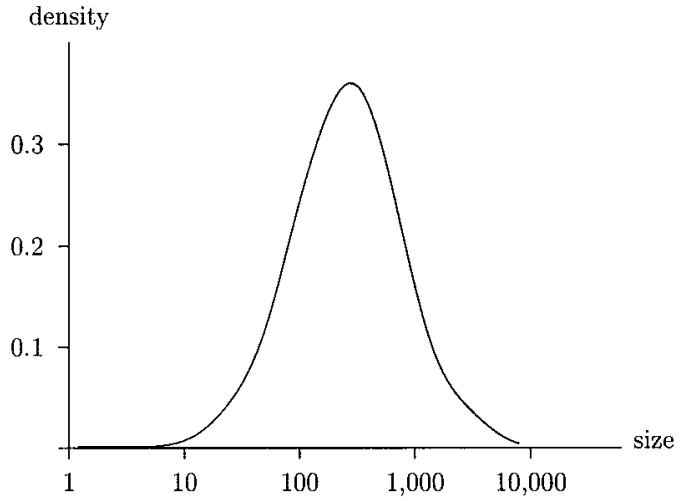

Figure 3.6: Firm size distribution, based on employment data from the IF4 data set [6, p. 1077]

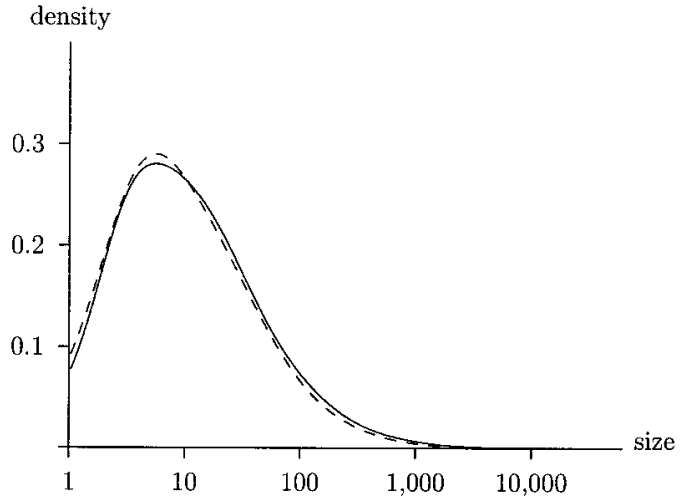

Figure 3.7: Firm size distribution in 1983 (solid line) and 1991 (dashed line), based on employment data from the quadros do pessoal data set [6, p. 1077]

hood (values from the horizontal axis in our example) and thereby 'smoothens' the distribution. This clearly is an advantage if some values are missing or values are supposed to be outliers.

Results - Size Distribution

Now knowing how the distributions were created by Cabral, the curves of the two data sets are shown in Figure 3.6 and Figure 3.7. As one can see, the distributions of the two different data

sources differ strongly. While the IF4 data set in Figure 3.6 shows an almost normal distribution[6] [38] (as the horizontal axis is on a logarithmic scale, the data are distributed log-normal) of firms, the firm structure in Figure 3.7 is highly skewed to the right. Note that these findings have been made in the previous literature. Even Gibrat built his law on his findings about the log-normal distribution, which is here supported by the IF4 sample (cf. Chapter 2). But, receiving an log-normal distribution in firm size does not necessarily mean that it evolves because of the law of proportional effect. Instead, if we compare the normal-distributed curve with Figure 3.7 we see that for a more complete data set, the distribution is highly skewed to the right on the logarithmic x-axis. One can conclude that when the entire population of firms is considered, the distribution is not log-normal any more but is highly skewed. Cabral concluded on that finding that the IF4 data set shows a bias since firms were not selected randomly, but with an higher probability for large firms - which is reasonable because these should be the firms that are required to publicly report their accounts. One additional conclusion one can draw out of the Figure 3.7 is that the size distribution seems very stable over time. The dotted line shows 1983 and the solid line firms in 1991 - these very distant periods show nearly the same size distributions. This is of special interest because as Cabral stated, "most firms existing in 1991 did not exist in 1983" [6, p. 1077] - although, the distributions look quite similar. (cf. [6])

Having investigated the firm size distribution, the distribution should now be analyzed in terms of age. Unfortunately the data set used by Cabral did not include information on firm age, therefore they used 'longest tenure in the firm' as a proxy. This can be viewed as the minimal estimation of firm age, since a firm will not be younger than its employee with the longest tenure. The age groups were divided into 1, 2-4, 5-9, 10-19, 20-29 and 30+. The size distribution of these six age groups are shown in Figure 3.8 and one can see that the younger a firm is (short dash sizes), the skewer the distribution is. Young firms show a strong concentration on the small-size fraction on the left. The older the firms are, the more the distribution is shifted to the right - meaning less skewed and a higher proportion of large firms. Cabral also performed tests on the distribution of 30-year-old firms and found that also these old firms do not show a log-normal distribution, since their left tail is still thicker than the right one. (cf. [6])

As the distribution of age was now inspected by comparing firms due to their age class, another different approach can be taken. A defined sample of firms can be observed through its aging process, which shows the advantage that, in each year, the same firms are observed. This sample will be much smaller since only some firms were included in the data set for a long time period. Cabral identified 2 651 firms that were new in 1984, from which 1 031 were still active in 1991. The evolvement over time is shown in Figure 3.9. In Figure 3.8 it is shown that over time, the distribution of firms in 1984 that survived until 1991 (given by curve '1984S') is far more skewed than their size distribution in 1991. But given that curves, another effect can be studied. The curve '1984' shows all new firms of 1984; while '1984S' shows only the firms that survived until 1991. One can now ask if the surviving firms show special characteristics. When considering the models of learning mechanisms studied by Jovanovic (cf. Section 2.5) and the studies

[6]Cabral was testing for normal distribution with a Jarque-Bera-Test. This test is using the kurtosis and skewness to proof if a distribution is normally-distributed. A value of 0.719 was computed for the IF4 data set. This value is tested against a $\chi^2_{(2)}$ distribution; normal-distribution can be accepted at the 99% confidence level if the value lies below 9,21. As the calculated value is 0.719 this shows a strong support for normal-distribution.

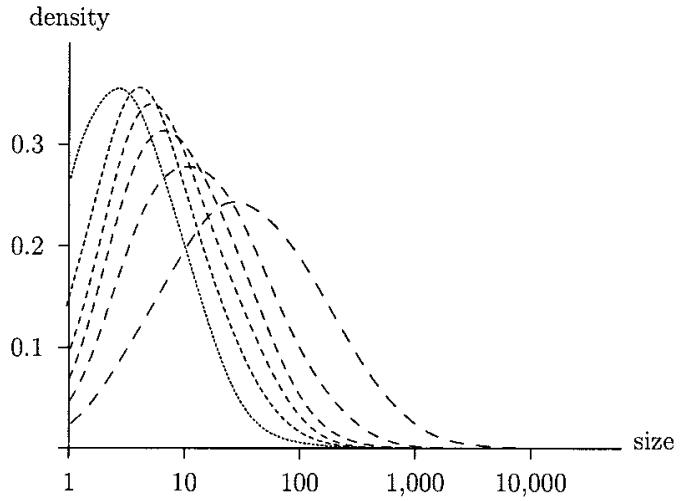

Figure 3.8: Firm size distribution by age groups, based on employment data from the quadros do pessoal data set [6, p. 1078]

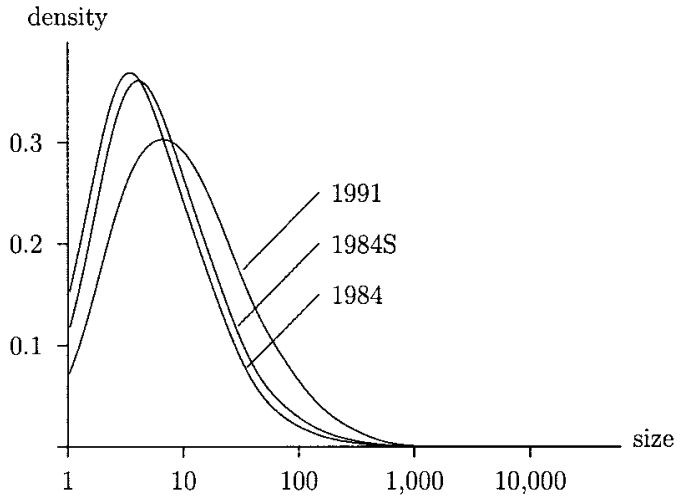

Figure 3.9: Size distribution of the 1984 cohort of entrants: density based on 1984 and 1991 data as well as 1984 data for the firms that survived through 1991 (shown by the 1984S curve) [6, p. 1079]

performed by Evans (cf. Section 2.4) we assumed that smaller firms are more likely to exit and larger firms have a higher probability to survive. These findings are compared to Figure 3.9 and show only a small difference between the '1984' curve and the '1984S' curve. This means, the size distribution of surviving firms did not heavily differ from the whole sample of new firms in 1984. Cabral therefore stated that "selection explains a very small part of the evolution of the firm size distribution. We believe this to be an important result, especially considering how much the theoretical literature, beginning with Boyan Jovanovic (1982), relies on selection as a main determinant of industry evolution." [6, p. 1079] One might want to question these findings regarding the time period of investigation, country effects, industry effects and the productivity of competitors. It might would be feasible that industries with a high competitive pressure and economies of scale would favor larger firms, leading to a higher shakeout of new entrants who do not know their productivity level (according to the Jovanovic learning model). However, the Portugal example shows that, in the whole industry, there is only a weak preference for larger firms being selected to survive until 1991. (cf. [6])

Methodology - Financial Constraints

We will now come to the main topic of interest in this section which is *financial constraints*. As Cabral states, evidence on this topic has already been found by Evans and Jovanovic in 1989 as well as by Steven Fazzari in 1988. They found that financial constraints are correlated with firms investment decisions, and the study of Cabral will now investigate this relationship too. In the underlying data set, no information was available for a firms wealth, therefore proxies had to be found. Cabral used the entrepreneurs' age as a proxy for wealth, with the idea, that wealth does not necessarily increase with age, but age can help to reach a desired output level based on family or personal contacts, etc. As Cabral also stated, a good proxy for estimating the financial constraints should be a parameter that can explain the output level for young firms, but not for old ones - since based on the assumption, older firms are not financially constrained in the model. Based on this idea they considered industry variables, entrepreneur's education level and age. The entrepreneur's education had an impact both at time of birth and afterwards, while age has showed the largest effect at birth. According to Cabral, one reason can also be the influence of age on labor market experience. Another hypothesis is that older entrepreneurs have higher general business experience. As the firm grows older, the firm specific knowledge becomes more relevant than general experience, and the effect of the entrepreneurs age diminishes. The size of a firm based on financial constraints (age used as proxy) is defined in a model and given by equation 3.1:

$$s_i^{84} = \min\{s_i^*, w(a_i, \epsilon_i)\} \tag{3.1}$$

$$s_i^{91} = s_i^* \tag{3.2}$$

Each firm/entrepreneur has an initial wealth of $w(a_i, \epsilon_i)$ which depends on the entrepreneurs age a_i and random shocks ϵ_i. The optimal and desired size of a firm is given by s_i^*. In the first measured period in 1984, the equation 3.1 states that a firms size is the minimum of the optimal size and the limiting size given by the entrepreneur's wealth. Cabral now makes an assumption for 1991 which states that firm size in 1991 is not subject to financial constraints any more - this

Age at firm start-up	Probability of being constrained	Expected size if constrained
20	1.00	1.8
30	0.87	4.2
40	0.65	7.4
50	0.52	11.5
60	0.44	16.6
70	0.37	22.6
80	0.33	29.5

Figure 3.10: Entrepreneur's age and financing constraints according to calibrated model [6, p. 1082]

is represented in equation 3.2 where firm size is given by the optimal size. The basis for this assumptions is the already noted evidence that younger firms are stronger influenced by financial constraints. This model now only contains firms that were new in 1984, therefore the firms in 1984 are limited by financial constraints in the model, while this is not the case any more in 1991. The model is calibrated so that in 1984 the firm reaches a size according to equation 3.1 with a probability of α/a_i, and a size of s_i^* as given by equation 3.2 with probability $1 - \alpha/a_i$ (which means, with probability of $1 - \alpha/a_i$ the firm can realize it's desired size and is not financially constrained). (cf. [6])

Results - Financial Constraints

The simulation was performed by calibrating the variables according to the 1984 distribution and showed the influences of entrepreneur's age at startup as shown in Figure 3.10. Here, an entrepreneur being 20 years old at startup has a 100% chance of being financially constrained - while at age 80 the probability is only 33%. Also, the 20 years old leads a firm with estimated 1.8 employees, while the firm size measured in employees for the 80 years old entrepreneur is 29.5. (cf. [6])

Summary

Concluding on the Portuguese example, the main findings in this section were that

- Firm size distribution of this large data set does not follow a log-normal distribution. The overall distribution is highly skewed to the right - Gibrat's law is not supported by the given evidence.
- The size distribution is less skewed for the group of older firms. It shows the highest skewness for young firms.
- The size distribution of firms that were founded in 1984, and the subgroup of them who survived until 1991, does not differ much. Here, no support was found that smaller firms have a higher probability of exit, as it would be suggested by learning models.

- Entrepreneurs age can be used as a proxy for financial constraints. This holds under the assumption that financial constraints are strong for young firms, and weak for old firms. Entrepreneur's age shows a high explanatory power of size for young firms, and low explanatory power for old firms.[7].

- The model is able to closely approximate the size distribution of the given data set. The estimated parameters show a high probability of financial constraints for young entrepreneurs at firm startup. Start-ups performed by older entrepreneurs shows a much lower probability of being financially constrained.

Impact of financial constraints on Italian manufacturing firms

Overview

In Section 3.2 the impact of financial constraints on Portuguese manufacturing firms was analyzed. This section will investigate similar questions related to size and growth under financial constraints for Italian manufacturing firms. We will see that for the Italian data set, more information on the financial situation of the firms are available, which helps to make even more concrete statements.

Before the quality of the data set will be explained in detail, two general statements of Angelini about financial constraints are worth noting. First, he cites studies that already investigated institutional factors like corruption and insufficient protection of property rights and showed that these factors also have negative impacts on firm entry and growth. This is true especially in developing countries [2, p. 426]. Second, it is possible that the impact of financial constraints on the skewness of the distribution is overestimated. If financial constraints are reduced, existing firms will grow faster, but also new firms have an incentive to participate on the market. If one assumes that this theory is appropriate, the overall skewness of the firm size distribution will not change much if the level of financial constraints decreases. (cf. [2])

Data set / Classification Methodology

Coming to the underlying data set, two different sources were used. First, a survey from the years 1992, 1995, 1998 and 2001 was performed by the Italian bank 'Mediocredito'. The data set consisted of a representative sample of over 4 000 manufacturing firms with more than 10 employees.[8] Because of the survey method, some firms were replaced every time the survey was run, and finally continuous data of 1 800 firms between 1992-1995 and 1 100 firms between 1998-2001 were used for this study. The survey did include questions directly linked to financial constraints, like difficulties in financing the last investment project including the reasons for the difficulties (insufficient cash flow, lack of collateral, insufficient long-term finance, high cost of debt, other) [2, p. 427]. This is a clear advantage compared to the dataset of the Portuguese

[7] specifically, after firms are aged 7, entrepreneurs age does not influence size anymore.

[8] Therefore, an earlier paper of Angelini comparing firm size to the Portuguese data set shows that modal size in the Portuguese example is 10 employees, while it is 35 employees in this study. This is mainly because only firms with more than 10 employees are considered here. (cf. [1])

example. Furthermore, the survey of 1998 and 2001 asked if the firms *wanted* additional financing, which has the advantage that firms could state 'yes' here without having applied for a credit. This definition is more accurate, since also firms are covered who didn't apply because they might have thought they would not have a chance to obtain the credit. Additionally to the Mediocredito data set, balance sheet data were combined with these data. Balance sheet data included parameters that were able to serve as a proxy for financial constraints. A fist proxy which was used was firms ability to repay debt, calculated as

$$\frac{financial\ expenses}{financial\ expenses + profits}$$

The argument here is that firms which are able to create funds should be less affected by financial constraints. A second proxy was calculated as

$$\frac{fixed\ assets}{total\ assets}$$

Here, the argument is that firms having more collateral are less likely to be financially constrained, because the probability for a negative debt decision is lower. The setting by Angeline was that "firms in the top quartile of the ratio between financial expenses and financial expenses plus profits (bottom quartile of the ratio between fixed and total assets) are constrained" [2, p. 433]. As the first data set came from the Mediocredit bank, a second data source was the WBES[9] (cf. [8]). As Angelini stated, the two data sources complement each other in different ways. First, WBES questions are broader and do not refer to a specific year. Therefore, firms can be considered as being persistently constrained, and since the questions are broader they might cover other aspects of financial constraints (e.g. an inefficient banking system) which were not covered with the specific Mediocredit survey. Second, since the WBES data sheet includes many countries, it can be used to cross-check the validity of results for firms outside Italy and for developing countries. (cf. [2])

Results - Firm Size

Knowing the data set used for this analysis, the resulting size distribution is presented in Figure 3.11. As it was shown by Cabral in the Portuguese sample (cf. Section 3.2), the skewness of the size distribution is much stronger for younger firms than it is for older firms.[10] The Kolmogorov-Smirnov test[11] rejected equality for each of the distributions, which is also shown in Figure 3.11. Some basic statistics of the data set are shown in Figure 3.12. One can see here

[9] World Business Environment Survey. "Questions in the survey focused on the quality of the investment climate as shaped by domestic economic policy; governance; regulatory, infrastructure, and financial impediments; and assessments of the quality of public services". The survey was administered to more than 10 000 firms in 80 countries in 1999/2000.

[10] as used by Cabral and explained in the last section, a kernel density smoothing function with a bandwidth of 0.7 was used for the estimation of the plotted curves.

[11] Kolmogorov Smirnov test by Andrei Nikolajewitsch Kolmogorow and Wladimir Iwanowitsch Smirnow used to proof equality of two probability distributions. For each value, the difference of the relative frequency of the two distributions is calculated. After calculating the differences for each value, equality is rejected if the maximum difference (value with the highest deviance to the compared distribution) is above a defined critical value (depending on the significance level)

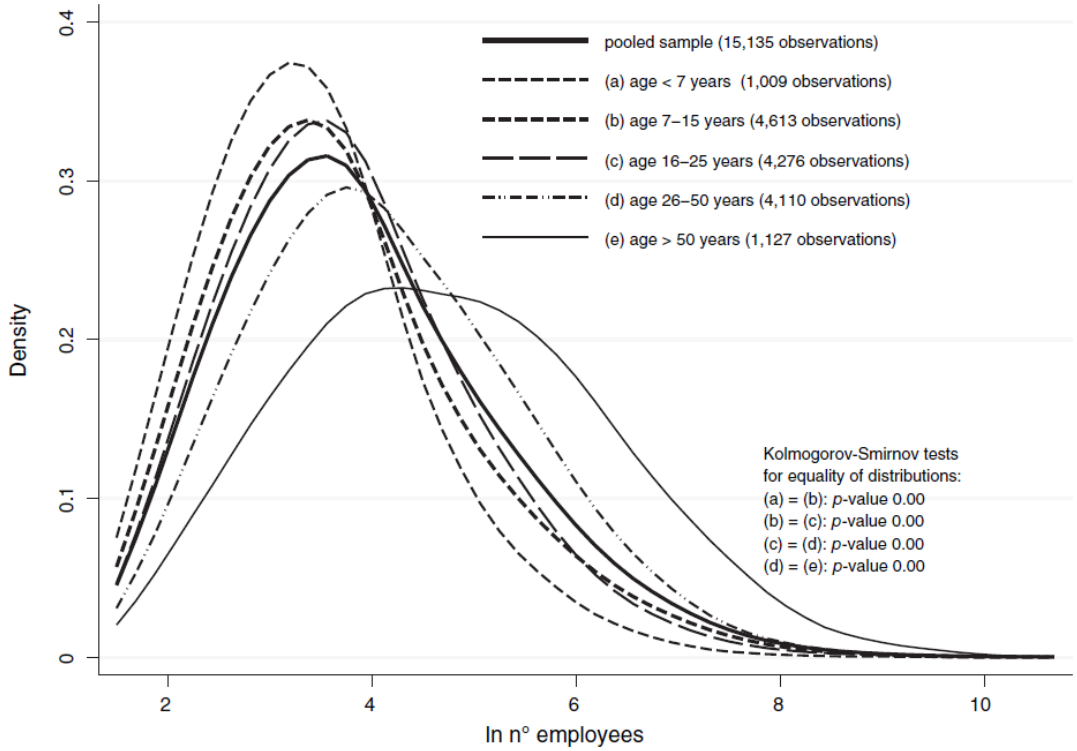

Figure 3.11: Firm size distribution and firm's age in the mediocredito data set [2, p. 429]

that a maximum of 5.8% asked for bank credit and didn't succeed (which is given in the age class of ≤ 6 year old firms, column 'c') , this represents a very small fraction of the firms. But, considering firms that desired more credit (column 'd'), a much larger fraction of 21.2% was affected by this financial constraint. In these colums one can also see that financial constraints are strongest for young firms, and weaker for older firms. Also, firms that are financially constrained (young firms) have typically less employees than firms that are less constrained (old firms). Now it it worth taking a look on the firm size distribution diagram, which is shown in Figure 3.13. The purpose of this figure is to test if there is a difference between the size distribution of financially constrained firms and those who are not constrained. Second, the figure helps to identify if there is a difference between the size distribution of non-constrained firms compared to the overall sample. As Angelini stated, this is important because it shows if the effect of constrained firms (i.e. a more skewed distribution) has an influence on the overall sample. Therefore, Figure 3.13 shows 4 distributions: total (solid line); financially constrained firms (dotted line); persistently financially constrained (reporting financial constraints in two consecutive periods; long-dashed line) and that of non-financially constrained (short-dashed line). As one can see and as it was expected, the distribution for the financially constrained, and especially for persistently financially constrained, firms shows a skewer distribution than the non-constrained firms and the overall

Firm's age (years)	Pooled 1992–2001 surveys				Pooled 1998–2001 surveys			
			Financially constrained firms (baseline definition)				Firms desiring more credit	
	Number of observations	Number of employees: average (median)	Number of observations (percentage of 1992–2001 sample)	Number of employees: average (median)	Number of observations	Number of employees: average (median)	Number of observations (percentage of 1998–2001 sample)	Number of employees: average (median)
	a	b	c	d	e	f	g	h
≤ 6	1,009	55 (24)	59 (5.8)	45 (25)	476	37 (22)	101 (21.2)	40 (21)
7–15	4,613	101 (30)	242 (5.2)	68 (30)	2,404	65 (25)	484 (20.1)	47 (22)
16–25	4,276	103 (34)	201 (4.7)	87 (37)	2,572	73 (27)	403 (15.7)	49 (25)
26–50	4,110	162 (54)	175 (4.3)	109 (57)	2,411	119 (35)	349 (14.5)	66 (31)
> 50	1,127	343 (111)	59 (5.2)	331 (128)	556	223 (53)	81 (14.6)	65 (47)
Total	15,135	133 (37)	736 (4.9)	102 (38)	8,419	92 (29)	1,418 (16.8)	53 (25)

Figure 3.12: Financially constrained firms by age class in the mediocredito data set [2, p. 430]

sample.[12] The graphic therefore shows that firms that face financial constraints are smaller in terms of employees than their non-constrained counterparts. Again, Kolmogorov-Smirnov test was used to proof for equality of the distributions. As already visually expected, the distribution of financially constrained firms is significantly different. But, comparing non-constrained firms to the overall sample, Kolmogorov-Smirnov test did not show a difference between the two distributions. That means, although a significant effect on the size distribution of financially constrained firms exists, the overall impact seems to be low. This is reasonable, since as shown in Figure 3.13, financially constrained firms account for only 4.9 percent of the overall sample. (cf. [2])

Methodology - Firm Growth

Until now, influences of financial constraints on firm *size* for the Italian manufacturing firms has been studied, while the *growth* should be studied by introducing the following regression model [2, p. 432]:

$$\begin{aligned} &\ln(n^o employees_t) - \ln(n^o employees_{t-1}) = \\ &\alpha_0 + \alpha_1 D_1^{fc} + \alpha_2 D_t^{fc} D_t^{young} + \alpha_3 D_t^{fc} D_t^{small} \\ &+ \alpha_4 \ln(age_t) + \alpha_5 (ROA_{t-1}) + \beta_t D_t^{year} + \sum_j \gamma_j D_{j,t}^{sector} + \epsilon_t \end{aligned} \tag{3.3}$$

[12] Note that the graphic states that only 17 firms were persistently financially constrained

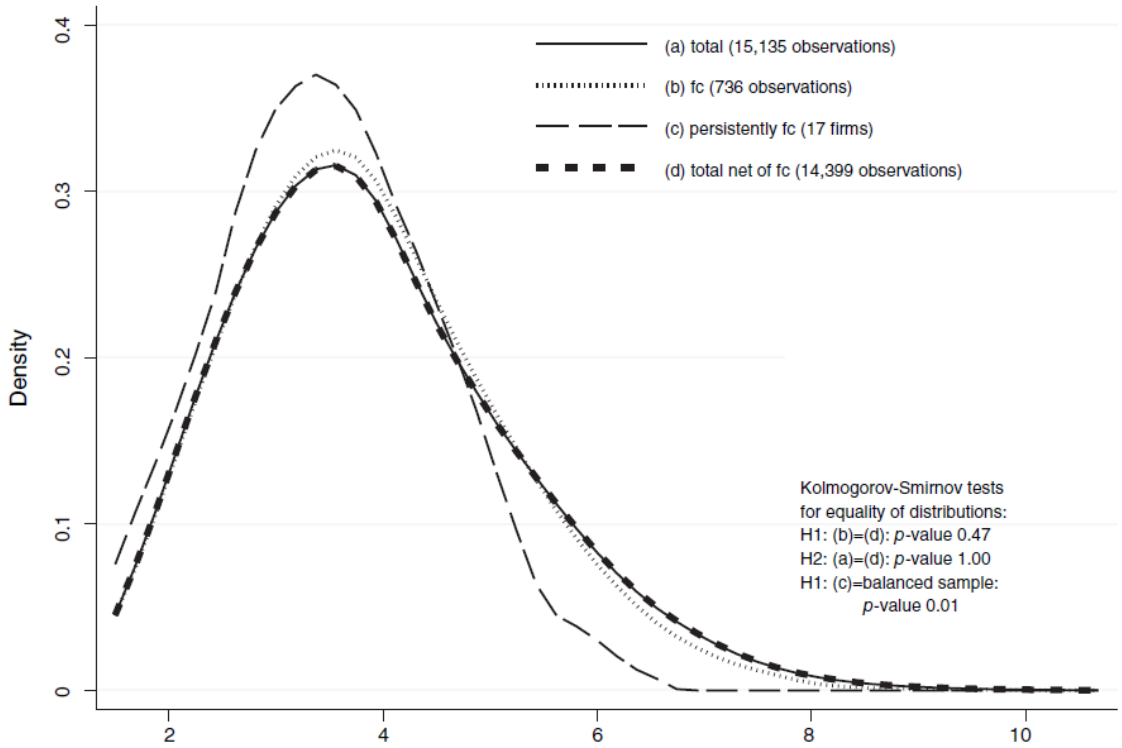

Figure 3.13: FSD and financial constraints: baseline definition of financial constraints, entire sample [2, p. 431]

Equation 3.3 calculates the change in employees between t and $t-1$ (dependent variable), explained by variables on the right-hand side. The dummy variables D are defined as follows: If a firm is financially constrained, $D^{fc} = 1$, otherwise $D^{fc} = 0$. For young firms (up to 6 years) $D^{young} = 1$ and for small firms (less than 50 employees) $D^{small} = 1$. Time and industry effects are considered by the dummy variables D^{year} and D^{sector}. ROA is "defined as earnings before interest and taxes over total assets serving as a proxy for profitability." [1, p. 18]. The results which were estimated by the regression model are given in Figure 3.14 show interesting insights.

Results - Firm Growth

The results are split up in the baseline condition (firms that applied for, but failed to obtain, a credit - column 'a' and 'b'); the more relaxed condition of firms who desired a credit (independent if they applied for it - column 'c') and more robust estimations performed via GMM[13] regression (column 'd' and 'e'). What one can see from Figure 3.12 in column 'a' is that being

[13] generalized method of moments, introduced by Hanson in 1982. If heteroskedasticity (some sub-groups of measurements show different variances) is present, heteroskedastic-consistent (robust) estimations like GMM estimation are appropriate tools.

	Proxies of financial constraints				
	Survey-based definitions			Balance sheet–based definitions	
	Baseline definition		Desiring more credit	Low interest coverage	Low collateral
	OLS		OLS	GMM	GMM
	a	b	c	d	e
Between t and $t-1$ firm is:					
Financially constrained (0,1)	−1.4*	−0.3	2.2**	−0.8*	0.4
	(0.6)	(0.8)	(0.7)	(0.4)	(0.3)
Young and financially constrained (0,1)	0.6	1.0	1.2	1.2	0.7
	(1.9)	(1.9)	(1.6)	(1.2)	(0.9)
Small and financially constrained (0,1)	—	−1.9	−3.5**	−1.3**	−2.0**
	—	(1.1)	(0.8)	(0.5)	(0.4)
ln (number of employees at $t-1$)	—	—	—	−1.1**	−0.7**
	—	—	—	(0.2)	(0.1)
Lagged dependent variable	—	—	—	0.02	0.03
	—	—	—	(0.02)	(0.02)
ln (age at t)	−2.0**	−2.0**	−1.9**	−1.4**	−1.5**
	(0.1)	(0.1)	(0.2)	(0.2)	(0.1)
ROA (percent)[b]	0.14**	0.14**	0.13**	0.03	0.06*
	(0.01)	(0.01)	(0.02)	(0.03)	(0.03)
Number of observations	10,923	10,923	7,305	15,005	15,046
R^2	0.04	0.04	0.03	—	—
Hansen test of overidentifying restrictions (p-value)	—	—	—	0.07	0.12
Arellano-Bond test for 2nd order serial correlation (p-value)	—	—	—	0.19	0.17

Figure 3.14: Regression model results. Dependent variable: percentage change in number of employment between t and t-1 [2, p. 434]

financially constrained (that is, $D_t^{fc} = 1$) has a negative impact on growth. Specifically, the model estimates an 1.4 percentage points lower growth on employees if a firm is financially constrained. This effect comes from 'small and financially constrained firms', which are firms with less than 50 employees. The figure doesn't show support for the hypothesis that 'young and financially constrained' has a negative impact on employee growth. Looking at the row 'ROA (percent)', one can see the positive impact of profitability on growth. Also, the age of the company has a negative impact on employee growth. As noted in the data set introduction, proxies calculated from balance sheet data also have been used to test for effects of financial constraints. These were tested with GMM regression in columns 'd' and 'e'. It is shown that, with the calculated proxies, similar results can be achieved. (cf. [2])

Comparison with WBES data

The results have also been compared to the WBES data set to proof the explanatory power for other countries. The firm size distribution, split up by firm's age, shows a similar pattern as in Figure 3.11. The curves for OECD and non-OECD countries are more symmetric, a possible

reason for that is given by Angelini and states that it might be because of a different size measure, which here was (log) dollars of annual sales. Especially for non-OECD countries it was shown that the difference between constrained and non constrained firms is larger. The size distribution for constrained firms is much more skewed to the right than for non-constrained firms. Angelini states that "this suggests that financial constraints are a relatively more serious problem in developing countries, a view supported by a body of empirical literature" [2, p. 435]. (cf. [2])

Summary

Compared to the Portuguese data set, the Italian data allowed to investigate firms financial constraints *directly*, because of availability of survey and balance sheet data. The findings in this extensive data set were that:

- Size distribution shows highest skewness for young firms. Skewness tends to diminish for age-group of older firms.
- Financial constraints have their highest share in young firms. Older firms are less financially constrained than young firms. Firm size distribution therefore shows the highest skewness for financial constrained firms.
- Firms that face financial constraints have less employees than those who are not constrained.
- The average number of employees grows with firm age. Young firms ($\leq$ 6 years) have lowest employee numbers, while older ones have more employees on average.
- Size distribution for non-constrained firms is similar to overall size distribution. Because of less share of financially constrained firms in total population (5% asked for credit and were rejected; 17% desired more credit), the impact of constraints on the overall size distribution is not significant.
- Financial constraints have a negative impact on growth in a given period.
- A significant negative impact on growth for small firms ($\leq$ 50 employees) which are financially constrained was identified. This effect was not significant for young firms which were financially constrained.
- Positive profitability measured in ROA shows a positive impact on firm growth.
- Growth rate is negatively influenced by firm's age. Older firms grow slower than young firms.

3.3 Globalization and Productivity: Theories, concepts and empiric implications related to firm size and growth

The last section already highlighted many relevant and different influence factors on firm size and growth. Starting from Gibrat's early estimations about a log-normal distribution, we have

already seen a lot of evidence for a highly skewed size distributions. Possible explanations were given based on firms age, entrepreneurs age and the impact of financial constraints. This section will add another dimension which is of high importance when trying to understand todays economy and firm size distribution: International trade, a concept steadily gaining relevance in todays society. Thinking of the *European Economic Community* which was founded in 1957, trade between European countries has become much easier. Or thinking about the North American Free Trade Agreement (NAFTA) between the United States, Canada and Mexico. Or, as a last example, think about the Asian export market - all these examples underline the importance of understanding the challenges that countries and firms face when international trade comes into play.

Comparative advantage / External economies of scale

Before investigating the implications of globalization and productivity for firm size and firm growth, the general theory will be explained. The concepts introduced here will serve as a basis for understanding and evaluating empirical findings that will also be presented in this section.

Generally, there are different reasons why countries start trading with each other. First, resources or technology which might not be available in one country makes international trade necessary. Second, firms specialize in things they do relatively well. (cf. [21], [23]) This concept is called 'comparative advantage' and means that each country should specialize in the production of goods that imply the lowest opportunity costs compared to other countries. This model is called the Ricardian-Model, goes back on David Ricardo who explained it in 1817. Since it should be common knowledge for Economists, only a short example will be given in Table 3.2. Suppose that Greece can produce either 30 000 tulips or 1 000 liters of olive oil. Suppose that

Country	**Olive Oil (liter)**	**Tulips (pieces)**
Holland	$-$ 1 000	$+$ 50 000
Greece	$+$ 1 000	$-$ 30 000
Total	0	$+$ 20 000

Table 3.2: Comparative advantage of Holland (Greece) in Tulips (Olive Oil). Specializing leads to an increase of total output. With trade, both countries are better off.

Holland is better in producing tulips and can therefore produce either 50 000 tulips or 1 000 liters of olive oil. That is, Holland has lower opportunity costs and a comparative advantage in producing tulips. Table 3.2 shows what happens if Holland specializes in tulips, and Greece specializes in olive oil.

Third, economies of scale make it beneficial for countries to specialize in specific products. The idea is that the more units are produced, the less average costs per unit occur. We will see that under the presence of economies of scale, large firms can have an advantage over small firms, which is therefore important for the main topic of interest - firm size and firm growth. For the first step, a distinction between internal and external economies of scale should be made. *External economies of scale* exist when economies of scale occur on the industry level, while *internal economies of scale* exist when economies of scale occur on the individual firm level.

It will now be shown theoretically that external economies of scale increase productivity; while internal economies of scale additionally favor large firms and can lead to mono- and oligopolies. (cf. [21])

External economies of scale

General, economies of scale represent a decrease in unit costs, when output is increased. Therefore, an increase of output of 50% does lead to an increase of input of less than 50%. This is exemplarily shown in Table 3.3. If two countries, A and B, produce the same good x, it would

Output	Input	Average labor input (input/output)
5	10	2
10 (+100%)	15 (+50%)	1.5
15 (+50%)	20 (+33%)	1.33
20 (+33%)	25 (+25%)	1.25
25 (+25%)	30 (+20%)	1.20

Table 3.3: Economies of scale in an exemplary industry (cf. [21, p. 168])

be beneficial that the production gets concentrated in only one country, for example country A. Then, A produces a larger amount of good x, which leads to economies of scale and makes the production cheaper. International trade is then necessary to trade good x with country B. Since in this example, country B gives up the production of good x, it has free labor capacity and will specialize in the production of other goods, which will also be subject to international trade. The example has shown that if economies of scale occur, it would be beneficial for each country and the overall economy[14] to specialize in specific products, produce a large amount of these products and then trade them with other countries. (cf. [21])

External economies of scale occur if the increase of the overall industry, this means the *number* of firms, not the *size* of each single firm leads to lower unit costs. The idea goes back on Alfred Marshall (1842-1924) who was interested by the phenomenon of 'industrial districts' - geographically near clusters of firms of the same industry. For example, this can be observed in so called 'industrial parks', like the famous examples of Silicon Valley or the film industry in Hollywood. According to Krugman [21, p. 170], Marshall identified the following reasons why these industry effects occur:

- Specialized suppliers
- Labor market pooling
- Knowledge spillovers

The idea of these effects should be shortly summarized:

[14] until now, we do not cover side effects which of course occur, including transport costs and pollution, etc.

Specialized suppliers Specialized suppliers, who produce special equipment (as in Silicon Valley) or services (as in the Banking sector of London or New York) need a large market to be cost-effective. In an industrial cluster, many buyers (which are firms since it is about intermediate products) build a large market which enables many different specialized suppliers to co-exist in this area. Therefore, specialized suppliers can be cost efficient, and buyers can choose from a large variety of products / services, at a high availability and because of competition of specialized suppliers, at lower prices. Firms therefore benefit from establishing industrial clusters, since they attract specialized suppliers. This leads to an competitive advantage of the firms within the cluster, compared to firms not included in a cluster which have to pay higher prices or produce specialized products themselves. (cf. [21])

Labor market pooling Industry clusters seem to be advantageous if specialized labor skills are needed by the industry. Again taking the example of Silicon Valley, many small firms arise and shut down in short time intervals - if the industry is clustered it would be easier for workers to find a new and close workplace. Using the different example from the film industry, Table 3.4 shows the exemplary need for Stuntmen/Stuntwomen. Because of different films that

Company	**2012**	**2013**
DreamWorks SKG	50	20
20th Century Fox	30	60
Total	80	80

Table 3.4: Exemplary demand for Stuntmen/Stuntwomen by Hollywood production companies in 2012 and 2013

were planned for 2012 and 2013, the firms will have a different need for labor in each year. From a 20th Century Fox's perspective, it will be easier to cover the labor demand in 2013 if the firm is included in an industry cluster of production firms. Then, the Stuntmen/Stuntwomen who are not needed by DreamWorks in 2013 could easily work for 20th Century Fox. If both production companies would have been far away from each other, it is more likely that the decreased demand of DreamWorks will produce unemployment; while it is likely that 20th Century Fox will have problems to find appropriate labor. Summarizing, the theory postulates that if firms build an industry cluster, specialized labor would also settle in the area and both, firms and labor would be better of. The high number of firms demanding the same specialized labor 'smoothens' differences in order situations (labor demand). (cf. [21])

Knowledge spillovers As industries can increase their productivity through process improvements, a close geographically location of different firms enables them to stay up-to-date and exchange information which can improve the competitiveness of the whole industry. As some information of course will not be subject to share with other firms, to assure the firm's own advantage, general directions for the industry and synergy effects will be discussed more intensive and more frequent if firms are close to each other. The firms within an industry cluster are included in the information flow, while firms that are geographically far away will face a

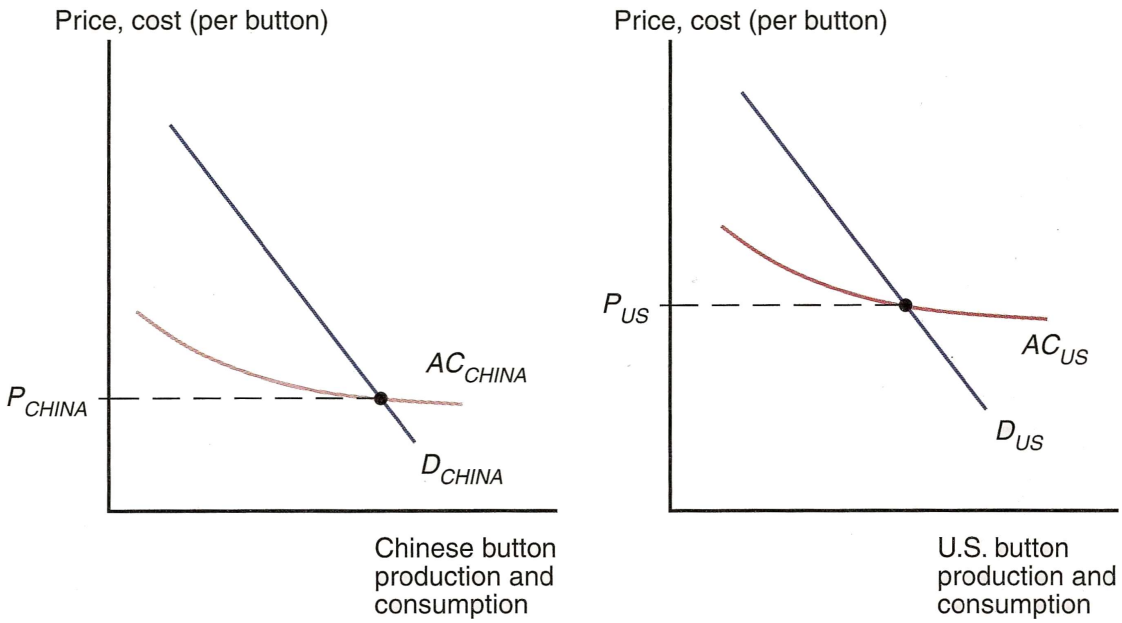

Figure 3.15: External Economies Before Trade [21, p. 174]

competitive disadvantage. Especially highly innovative industries, like again the example of Silicon Valley, profit highly from formal an informal information flows and synchronization of the businesses. (cf. [21])

Positive and negative effects of external economies of scale on prices and welfare As it was already explained, external economies of scale lead to decreased unit costs if the industry size is large. A short example of the Chinese and U.S. button industry shows the effects of international trade on quantity and prices. Figure 3.15 shows the average cost (supply)- and the demand curve for both countries. The average cost curves are forward-falling because of economies of scale. This example is abstracted from reality, but in fact the button Industry is concentrated in China and unit costs are cheaper than in the U.S. Given such a pattern, it can be shown[15] that both countries are better off if the whole button Industry would be concentrated in China; and the U.S. industry would focus on other goods. Figure 3.16 shows what happens if the whole button industry is placed in China. Since China now produces buttons for two countries, the produced units are increased. Due to economies of scale, average unit costs decrease, and buttons for both countries can now be offered at a lower price level. (cf. [21])

To show that economies of scale do not necessary leave all countries better off, two more statements on the effects of trade should be made here. First, it is of course possible that for example Vietnam has a lower average cost curve. Comparing to Figure 3.16, this means Vietnam would show an average cost (AC) curve which lies below the curve of China. Vietnam could

[15] Again, this model abstracts the real world and shows theoretical possibilities. Many influences which are important for policies, welfare and environment are not included in this simplified model. Although, it helps to understand the idea of international trade and potential benefits.

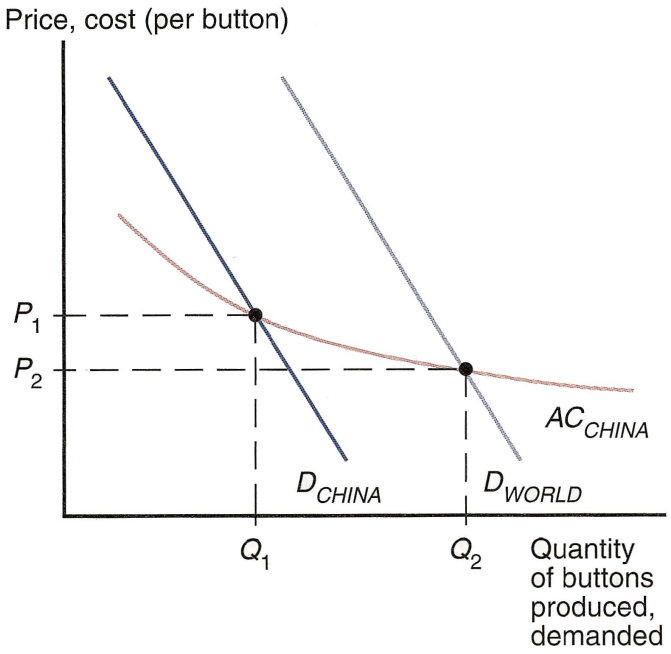

Figure 3.16: Concentrated button industry. China produces demand of China and U.S. [21, p. 175]

therefore produce each quantity of buttons at a cheaper price than China. One could now imagine that for historical reasons, China already produces Q_2 units of buttons (as it is shown in the Figure). Although Vietnam's curve is lower, it has to start the production of buttons at C_0, the very left of the horizontal axis. Of course, for low quantities the unit costs are higher than the costs that China already faces for the world demand. Therefore, China is called to be 'locked-in', and even though Vietnam can be cheaper at world-demand level, it would face very high initial costs when starting to produce low amounts of buttons. (cf. [21])

Second, and that is somehow related to the first statement, Vietnam would have to pay a higher price for imported buttons, although it could produce them cheaper within the country. Again this is because the high initial (low quantity) unit costs when starting the production, which would in the beginning be higher than the imported buttons from China (which are produced in high quantity). Vietnam would therefore have an incentive to protect, e.g. by import tariffs, the home button industry from international trade. (cf. [21])

Summary and the relationship with firm size/growth As the theory on external economies of scale has been presented, the implications should now be linked to the main focus of this work which is firm size and growth. The theories of external economies of scale have shown that

- External economies of scale do not favor large firms, since they apply on the industry level.

- Overall productivity of firms can be increased through external economies of scale. This can lead to positive effects on size and growth for firms included in industrial clusters. Firms who are not included in industry clusters may be subject to competitive disadvantages.
- Firms can be prevented from entry if industry clusters (which show external economies of scale) exist in other countries or areas.

Internal economies of scale

As in the last section the effects of external economies of scale have been identified, this part will now focus on effects that apply on the individual firm level and not on the industry level.

Average costs and monopolistic price setting When talking about internal economies of scale, it means that a firm faces a downward sloping average (total) cost curve. That is, if a firm increases the quantity of units produced, average costs are reduced. Therefore, firms that produce a large amount of a specific good have an advantage over smaller firms that produce a lower amount. This entry hurdle for small firms can lead to monopolies or monopolistic competition. For example, a town's water supplier will have high initial (fixed) costs - which is the construction of a pipeline network, etc. Marginal costs of one liter of water are relatively low. This leads to high average costs for low quantities produced, and decreasing average costs for each additional liter of water produced. Figure 3.17 should shortly refresh one's knowledge on the theoretic concept of monopolistic price setting which is crucial for this section. As just explained, the average cost (AC) curve converges against the marginal cost (MC) curve, which is constant in this example. Also, marginal revenue (MR) is alway lower than demand (D) in the monopolistic concept. That is, contrasting to perfect competition, a monopoly firm is a *price setter* since it is the sole producer of a good. The demand curve therefore represents the market demand, which decreases with higher prices. For each additional unit sold, the monopoly firm has to lower the price for *all* units sold - this will decrease the marginal revenue. A monopoly firm will set the price where $MR = MC$, since after Q_M each additional unit produced will decreased the overall profits. (cf. [21], [23])

Implications of monopolistic competition As monopolies exist only rarely in reality, the weaker form of *monopolistic (thus imperfect) competition*[16] can often be observed instead. A pure monopoly is often not achieved since high profits in the monopoly setting give competitors strong incentives to participate and split up the market. Therefore, if firms face internal economies of scale, often several large firms that each are able to affect prices (price setters) split up a market that is large enough - this is then called an *oligopoly*. Now, three different implications of the monopolistic competition will shortly be explained.

[16] When explaining this model here, few assumptions are made for simplicity reasons. The price setting of firms is assumed to be independent: It is assumed that firms differentiate products from each other and can therefore set independent prices. Second, the price setting of one firm will not influence or trigger price setting of other firms. Therefore, each firm acts as a monopoly. Even though this are rather unrealistic assumptions, the model will serve as a basic foundation of understanding impacts of internal economies of scale.

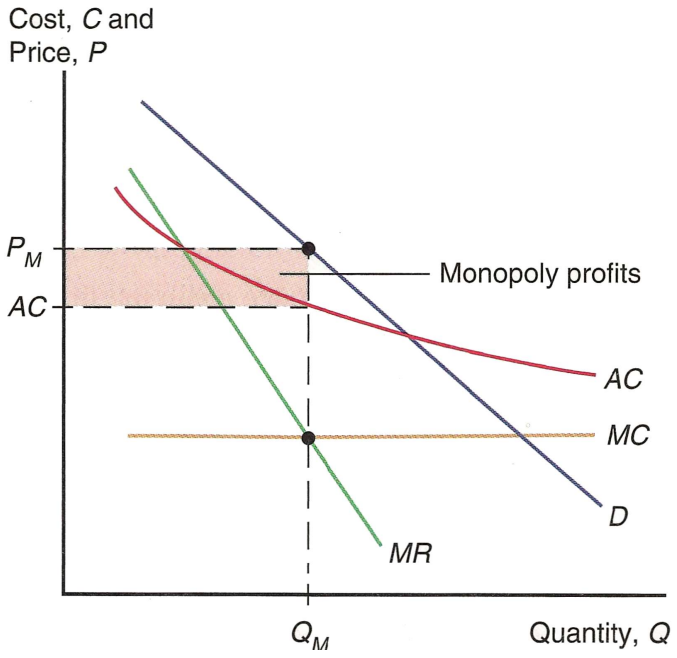

Figure 3.17: Monopolistic Pricing and Production Decisions [21]

1. Relationship between number of firms and average costs: If all firms have the same properties (they are called to be *symmetric*), each firm will have a market share of S/n, where S is the total output of the industry and n are the active firms in the industry. But, as explained, average costs decline for higher units produced. Therefore, if more firms are active in an industry, average costs for each firm will be higher than if a smaller amount of firms would be present.

2. Relationship between number of firms and price: As competition increases with the number of active firms in an industry, each firm has to lower its price because it can only charge a lower markup over the marginal costs. If new firms enter the market, the market share of firm x deceases. That means, the demand-curve for firm x, which is shown in Figure 3.17, shifts inwards. It follows that the marginal revenue curve is also shifted inwards. Therefore, the price and profit that a firm can now charge is decreased.

3. Resulting equilibrium number of firms: We now saw that average costs increase with the number of active firms on the one hand; and price decreases with the number of active firms on the other hand. The model implies that in the long-run an equilibrium can (theoretically) be reached where the price that firms charge is equal to the average costs of the firms. If firms would charge a higher price, new firms would enter the market and competition increases; if firms would charge a lower price the average costs would not be covered and unprofitable firms would leave the market.

(cf. [21], [23])

Gains from trade based on monopolistic competition To come to the benefits gained from trade, this can be analyzed by considering two different markets (or countries); for example Austria and Germany. For the market size we assume that $S_{Austria} < S_{Germany}$. As with internal economies of scale (and thus monopolistic competition) in place, the cost curve of Germany will lie below the Austrian's curve because of the larger market: The larger market leads to a higher output per firm, which thereby decreases average costs for each firm. Firms in a larger market can thus provide a higher quantity at a lower price. Krugman [21] shows an exemplary car industry of two countries and assumes that cars could be traded without cost. An integrated market would then lead to lower prices for each country. That is, again, because of the decreasing average costs that occur for large markets (i.e. large market shares for each firm). The implications are shown in Table 3.5. In the given example, each firm has to decide to produce its cars either

Measure	Home	Foreign	Integrated Market
Output (No. cars produced)	900 000	1 600 000	2 500 000
Number of firms	6	8	10
Output per firm	150 000	200 000	250 000
Average cost	10 000	8 750	8 000
Price (monopolistic comp.)	10 000	8 750	8 000

Table 3.5: Hypothetical example of gains from market integration [21, p. 198]

in the home- or in the foreign country. Consider firm A produces specific cars in Austria, while firm B produces other cars in Germany. Both firms will produce the amount needed by both countries. Therefore, A will have to export some of its cars to Germany, while Austria will need to import some of the cars produced by company B. This is known as intra-industry trade. Also, since the larger market enables more firms to survive, a greater variety of goods will be offered to customers: In the example given in Table 3.5, the integrated market supports 10 firms, while without trade there were only 6 firms in 'Home', and 8 firms in 'Foreign' respectively. But, referring to firm size and growth, an integrated market supports, *in total*, less firms than would have existed without trade (that is, $6 + 8 = 14 > 10$ in the example). To outline the importance of intra-industry trade, according to Krugman "intra-industry trade accounts for one-quarter to nearly one-half of all world trade flows. Intra-industry trade plays an even more prominent role in the trade of manufactured goods among advanced industrial nations, which accounts for the majority of world trade" [21, p. 199]. A measurement for intra-industry trade within a specific industry is given by equation 3.4.

$$I = \frac{\min\{exports, imports\}}{(exports + imports)/2} \tag{3.4}$$

The minimum value represents trade which is reflected in both, imports and exports - which is then expressed as share of imports and exports average. (cf. [21])

Firm performance and exit decisions due to pressure of international trade As it was shown in the the example of car trade in Table 3.5, the overall size of firms in the integrated

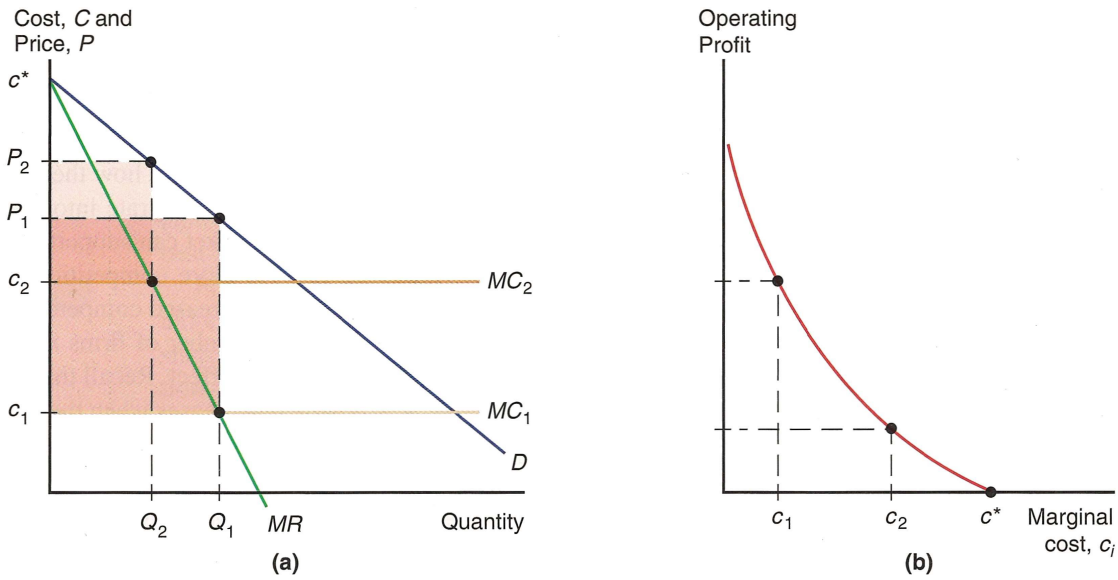

Figure 3.18: Performance (marginal costs) differences across two exemplary firms [21, p. 203]

market declined from 14 (before trade) to 10 firms. Until now it was not explained through a theoretical framework, how the selection process is performed. As this thesis' main focus is firm structure and size/growth influencers, it is of special interest to explain *which* firms will survive in the face of international trade and competition, and which firms will most likely exit the market. Therefore, Figure 3.18 shows an exemplary market with monopolistic competition. As explained, demand curve and marginal revenue curve are downward sloping. Marginal costs are assumed to be constant, that implies that internal economies of scale (an decreasing average cost curve) must come from fixed costs that already occur at Q_0. In picture (a) of Figure 3.18 the marginal cost curves (MC_1, MC_2) for two exemplary firms are given. That is, firm 1 is able to produce at lower unit costs and has therefore a higher productivity than firm 2. Respectively, firm 1 can produce a higher quantity at a lower price compared to firm 2. The operating profits for both firms are given by the shaded areas, and of course firm 1 will earn a higher profit. Picture (b) of Figure 3.18 now translates this insight into a graph that shows the explained relationship between marginal costs and operating profit: Lower marginal costs (thus a higher productivity) lead to higher operating profit; less productivity will lead to a lower operating profit. The marginal cost level marked as c^* represents the level where a firm makes no operating profit any more - above this level, operating profit would be negative and firms would decide to shut down. We should now compare this theoretical model to the learning model of Jovanovic given in Section 2.5. According to Jovanovic, firms do not know their productivity level at the time they enter the market. After entry, their productivity level will unfold and it will turn out if they are competitive enough or not. In the theoretical model of Figure 3.18 this means they show enough productivity (and thus can earn positive operating profit) at levels below c^*, and will decide to exit the market if marginal costs lie above c^*. (cf. [21])

These insights should now be analyzed for the case of a market increase. As in the car

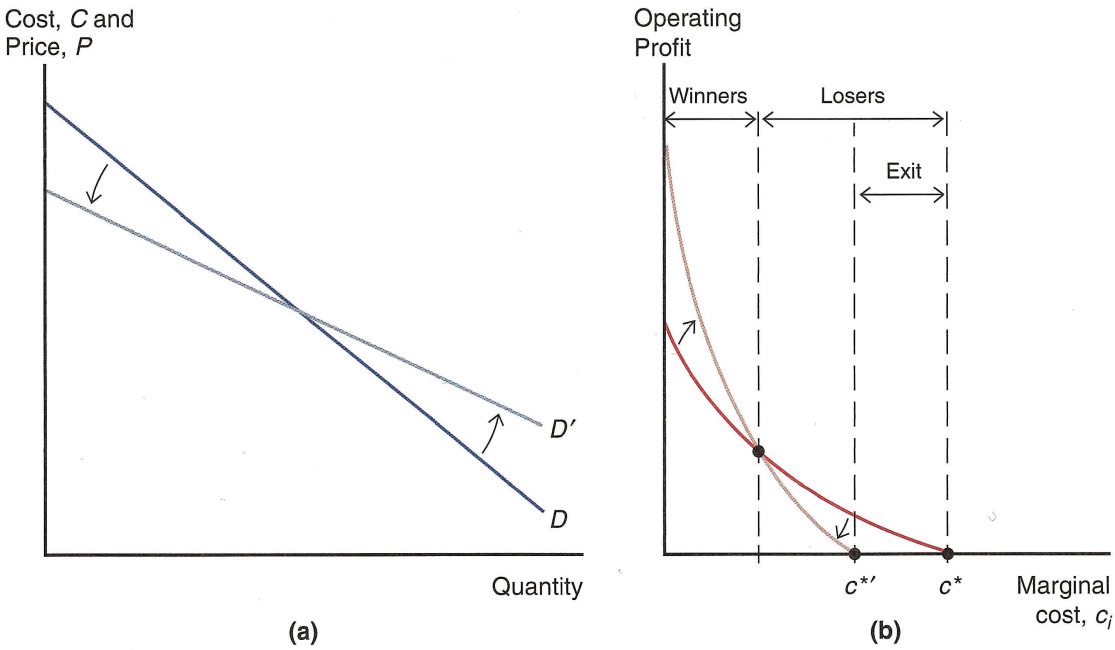

Figure 3.19: Winners and losers from economic integration [21, p. 205]

example in Table 3.5, market increase means that two smaller markets get integrated into one larger market. As this larger market is now viewed as one (competitive) single market, the implications were already explained: (1) due to economies of scale, a larger market leads to a larger market share - and thus decreased average costs. (2) These decreased costs would lead to higher profits and therefore attract the entry of competitors until monopoly profit is competed away (that is, when $P = AC$). (3) Due to lower average costs, the result is a higher number of firms and a lower price. The effect of an increase of the market size for an exemplary individual firm is shown in Figure 3.19. Picture (a) shows a shift in the demand curve, which can be explained as follows. As with increased competition (only firms with a lower AC-curve stay competitive), the maximum price a firm can achieve also decreases - this is shown by the lower intercept at Q_0. But on the other hand, because of the increased market size, lowering the price leads to a higher market share (in total units). Due to the facts just mentioned, the demand curve gets flatter and is shifted to a lower level at Q_0. This has some serious implications for individual firms, depending on their productivity level. These implications are shown in picture (b) of Figure 3.19. Firms that have a lower productivity also face lower outputs, this connection was shown in Figure 3.18. As for these smaller firms, demand decreased again as showed in picture (a) of Figure 3.19 and some of them will not be profitable any more. It is shown in picture (b) that the minimum level of marginal costs is now shifted to $c^{*'}$. Firms that did have higher marginal cost rates are now forced to exit the market, since they would generate negative operating profit[17]. Contrariwise, firms with low marginal costs (thus high profitability) will

[17]In the examples that are given in this theoretic framework, it is assumed that all firms face the same fixed

increase their profits by selling a larger number of units. As Krugman stated, "these effects tend to be most pronounced for smaller countries that integrate with larger ones, but it is not limited to those small countries. Even for a big economy such as the United States, increased integration via lower trade costs leads to important composition effects and productivity gains." [21, p. 205]. (cf. [21])

Firm's export decisions The car example in Table 3.5 showed how the integration of two different markets into one decreases the price and increases product varieties. This theoretical example is quite intuitive, although it does not reflect reality in most of the cases, since trade costs were neglected. Therefore, each firm which participated in the market was able to provide products to foreign countries at the same price as for the home country. In fact, trade costs occur and influence the individual export decisions of firms. Again, the introduced concept of profitability will influence a firm's export decisions. Consider again Figure 3.18 where two firms with different marginal costs (MC_1 and MC_2) did achieve different profits. Firm 1 has lower marginal costs and can thus reach a higher operating profit. Now, with trade costs in place, the firms will differentiate the price between home country and foreign country. The price for the home country will stay as it is illustrated in Figure 3.18. Since trade costs occur when exporting to a foreign country, the firm will have to charge a premium t, and marginal costs will then be MC_1+t for firm 1; MC_2+t for firm 2 respectively. For exports, the MC curve for both firms is shifted upwards to a higher price level. The higher marginal cost level will lead to an intersection of marginal revenue and marginal costs which is at a higher price. This higher price will reduce demand, which then reduces the profit of the companies. While in this example it is reasonable that firm 1 will still make some positive profits, the situation for firm 2 can be different. If $MC_2 + t$ will lie above the demand curve at c^*, the firm would not be able to achieve a positive operating profit and would therefore decide not to export but stay in the home country. Again, it is profitability that drives export decisions: Highly profitable firms (which have a higher market share as seen in Figure 3.18) have a higher chance to stay profitable in export markets than firms with low profitability. (cf. [21])

Summary and the relationship with firm size/growth This section has shown why internal economies of scale lead to imperfect competition (monopolistic competition) and that international trade could decrease average costs, which leads to lower unit costs and a higher variety in goods. Specially related to firm size and growth, it was shown that

- An integrated market (international trade) leads to a reduction in the total number of firms. Economic integration leads to an increased competition in the larger market. Each active firm produces a higher quantity than without trade.
- International trade lets low productive firms contract, and lowest-productive firms exit the market. Because of increased competitive pressure, firms that had high marginal costs

costs which are nonrecoverable and thus sunk costs, and do not enter into operating profit. If fixed costs should be considered, firms profitability decisions will depend on the average cost curve. It is of course possible that a firm sets a price level that creates operating profits according to the figures shown here, but that the average cost curve of this firm lies above the demand curve - which would imply losses.

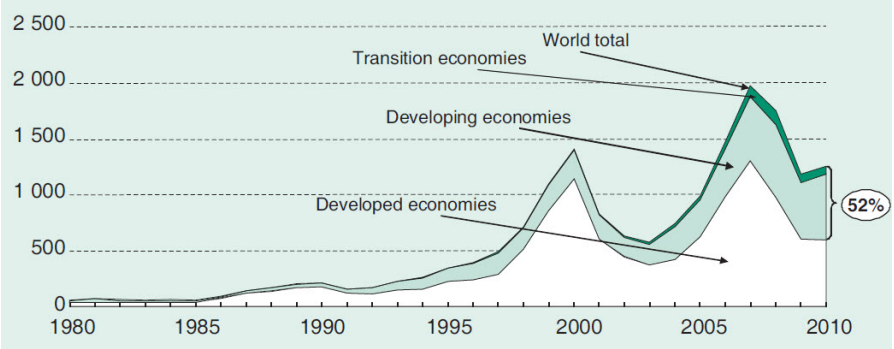

Figure 3.20: Inflows of foreign direct investment, 1980-2009 (billion of dollars) [37, p. 28]

(low productivity) and were barely profitable in the absence of trade are likely to be forced to exit the market in the presence of trade.

- Firms with low marginal costs (high productivity) can produce a higher quantity at lower costs. Therefore, high productive firms are potentially larger than firms showing a low productivity.

Outsourcing and foreign direct investment of multinational firms

The last section was able to show which firms profit or loose from an integrated economy. Based on an example of the car industry it was shown that an integrated market leads to a higher product variety and lower unit costs. In reality, markets are normally not fully integrated, but trade with each other or expand their business through *outsourcing* and *foreign direct investment (FDI)*.

A firm is usually considered as foreign-based multinational if at least 10 percent of the home firm is held by a foreign firm. On the other hand it is also considered as multinational if the home firm holds at least 10 percent of the stock of a foreign firm. If the home firm buys at least 10 percent of a foreign firm, or if it builds a production facility in a foreign country, this is considered as (outflows) foreign direct investment. The construction of a production facility is notated as *greenfield FDI*, while the monetary investment is called *brownfield FDI*. Figure 3.20 taken from the UNCTAD world investment report 2011 [37] shows the rising importance of foreign direct investment from an historical point of view, split up in developing economies, transition economies and developed economies. The 2010 trend shows that now more than half (52%) of global FDI inflows goes to transition and developing economies. United States, China, Hong Kong/China, Belgium, Brazil and Germany were the top 5 host economies (receipients) for global FDI inflows. Also, 2010 shows a shift in FDI inflows where half of the top 20 economies were from developing and transition economies (2009: seven economies). Also Indonesia entered the top-20 list for the first time in 2010. UNCTAD states that "FDI flows to developing economies rose by 12 per cent (to $574 billion) in 2010, thanks to their relatively fast economic recovery, the strength of domestic demand, and burgeoning South-South flows. The value of cross-border M&As into developing economies doubled due to attractive valuations of company assets, strong earnings growth and robust economic fundamentals (such as market growth). As

more international production moves to developing and transition economies, TNCs are increasingly investing in those countries to maintain cost-effectiveness and to remain competitive in the global production networks." [37, p. 3]. Confirming that, the inward FDI performance index, calculated as

$$\frac{\text{region's share in global FDI inflows}}{\text{share in global GDP}}$$

shows that developing countries receive relatively more (performance index ≥ 1), while developed countries receive relatively less (performance index ≤ 1). (cf. [37])

It should now be determined which factors drive firms investment or outsourcing decisions. Two different types of FDI have to be distinguished

1. horizontal FDI: the production process of the home facility is replicated in a foreign country.

2. vertical FDI: the home production process is split up, some parts of the process will be shifted to a foreign country.

Comparative advantage mainly drives vertical FDI due to the fact that countries specialize in things they are relatively good at. Therefore, parts of the production will be performed in countries which have the comparative advantage in producing a specific good or providing a specific service. According to Krugman [21] this is one of the main drivers of FDI inflows in developing countries. Contrary, horizontal FDI is mainly observed within developed countries. Here the motivation is to reduce transportation costs and therefore build up facilities near to a potential customer base. It has been shown in the last section that increasing returns to scale are somehow contradictory with the idea of replicating the production process, since then each facility will only produce a smaller amount and is therefore less able to benefit from the effects of internal economies of scale. This effect is called *proximity-concentration trade-off*. The last section showed that export increases a firm's costs, which was formulated as $MC + t$, which means the firm has to pay a premium on it's marginal costs. If a production facility would have been built in a foreign country, the costs t would be avoided. The price a firm has to pay for avoiding trade costs are the fixed costs F that occur when building up a foreign facility. This shall be formalized by the following equation, where Q is produced (or desired) quantity:

$$\text{If} \quad \begin{array}{ll} Q > F/t & \text{prefer FDI} \\ Q < F/t & \text{prefer export} \end{array}$$

Therefore, the decision between export and FDI depends on the quantity the firm produces (or wants to produce). It follows that foreign direct investment should therefore be mainly performed by large companies. (cf. [21])

The end of this part will shortly discuss the motivation of companies to *own* a foreign facility, instead of license and contract with an independent firm. This is called the *internalization motive*. Krugman [21] notes three main reasons for this decision as follows:

1. Risk through sharing proprietary knowledge/technology with third party companies.

2. Higher efficiency if own well-established techniques are used (for horizontal FDI).

3. Costly renegotiations with contractors if conflicts arise during the contracting period (potential risk of temporary production shutdown).

To summarize, it can be said that it will likely be the more productive firms that import intermediate goods (produced in a foreign country due to vertical FDI) and export goods (to reach foreign customers). Here, Krugman states: "For the United States in 2000, 92 percent of firms (weighed by employment) that imported intermediate goods also exported. Those importers thus also shared the same characteristics as U.S exporters: They were substantially larger and more productive than the U.S. firms that did not engage in international trade." [21, p. 208]. (cf. [21])

Empirical studies regarding Globalization and Productivity

As the last part introduced economic concepts on international trade and showed how profitability plays a role in firm's decisions, this section will now proof these theoretic concepts by linking them to existing literature and empirical studies. Therefore, this section will be split up into two different concepts that are relevant for globalization:

1. Selection effects: Firm's productivity and learning of specific procedures to participate in international trade acts as a selection mechanism where only some firms decide to participate.

2. Learning effects: Firms that invest in developed countries may gain from superior knowledge, or from cost reduction due to production in developing countries.

Selection effects

Exporting The theory explained that firms which export would show high productivity which makes it still profitable to pay the premium for exporting - this is what is called the *selection effect in exporting*. To test this empirically, the productivity of firms that start to export can be compared with that of non-exporting firms. Hayakawa stated that most of the studies showed that "the more productive producers self-select into the export market" [19, p. 3]. Further studies showed that firms which perform both, importing and exporting, show a higher performance than firms that are only involved in one part. Until now the literature does not show clearly which part, importing or exporting, demands a higher productivity. It was also found that exporting to an advanced economy (developed countries) requests a higher productivity level than exporting to developing countries. This is clearly in line with the theory of international trade that was introduced in this thesis, as competitive pressure of a larger market would force the lowest-performing companies to exit the market. Of course it will be easier for an exporting firm to export in a country with a lower productivity level. The literature agrees that sunk costs occur when firms decide to participate in exporting or importing - this is also in line with theory, since initial investments (fixed costs) have to be made. Additionally, the literature finds that these initial investments differ between countries. (cf. [19])

Foreign direct investment Empirical studies showed that firms which are investing in foreign countries are relatively productive firm. This was tested by comparing a pool of firms which

started investing and a pool of firms that did not perform investing. It was also found that firms which are owned by a foreign company have a higher productivity than domestic firms. According to Hayakawa [19] three factors lower the negative effects of productivity cutoff (which in the theoretical model was expressed as premium on marginal costs) when investing in a foreign country:

1. lager GDP in foreign country
2. small geographical distance between home and foreign country
3. high tariff rate in foreign country (this would increase trade costs which makes it more beneficial to directly invest in a foreign firm)

The more these factors are true for a given country, the less the productivity of the home firm has to be to make an investment advisable. It was also shown that more productive firms invest in a larger number of foreign countries. A further aspect was empirically supported regarding intra- and inter-firm trade: Firms participating in intra-firm trade with foreign FDI firms have a higher productivity than firms which perform inter-firm trade with third party foreign firms. The following ranking shows trade patterns related to firm's performance and is based on an empirical analysis of Taiwanese firms - the ranking goes from least performing firms to highest-performing firms: "domestic production, FDI to China, FDI to the USA and both FDI to China and FDI to the USA" [19, p. 5]. Again this fits to the introduced theoretical model on international trade theory. Lower performing firms have the highest chance to survive in the domestic market, while trading with USA and China requires a high productivity to stay competitive in these large markets. The following ranking is based on an Japanese firm sample and shows the chosen type of entry, also ranked from low-productivity to high-productivity: domestic firms, exporters, cross-border merger and acquisition, multinational-enterprises, joint-venture multinational-enterprises and wholly owned enterprises. (cf. [19])

Survival As it was shown by the theoretic model and also stated by Hayakawa [19] the liberalization of trade (tariff reductions, etc.) increases the pressure on domestic firms and leads to the closure of the least-productive firms. Different empirical studies proofed these effects using a probit model[18] where firm's death was used as dependent variable. It was found by Andrew B. Bernard that "results lend support to recent heterogeneous-firm models of international trade that predict a reallocation of economic activity towards high-productivity firms as trade costs fall. We find that industries experiencing relatively large declines in trade costs exhibit relatively strong productivity growth. We also find that low productivity plants in industries with falling trade costs are more likely to die; that relatively high productivity non-exporters are more likely to start exporting in response to falling trade costs; and that existing exporters increase their shipments abroad as trade costs fall." [5]. Considering trade liberalization in a foreign country, home country exporters have a higher incentive to export (decrease of premium on marginal costs) and show a higher probability of survival (in home and foreign). Often, a proportional

[18] a regression model where the dependent variable is a zero-one variable

hazard model[19] is applied to proof for the probability of firm exit. Pérez et al. performed an empiric study using the Cox proportional hazard model (CPHM) for Spanish manufacturing firms. He found that "(...) our results have also indicated that survival probability is higher for exporting firms and firms performing R&D activities. These results suggest that those factors which are likely to improve firms' efficiency and competitiveness are important drivers of firms' survival." [32, p. 270]. (cf. [19])

Learning effects

Exporting Empirical studies which focused on the learning effects from exporting often used matching techniques to control for a bias that arises from the fact that only the most productive firms are selected-in into export. Therefore, the matching algorithm matches one firm which is engaged in exporting activities with another company that shows similar characteristics (e.g. firm size) but is not engaged in exporting. As Hayakawa states one of the pioneering works using such a matching technique was performed by Wagner [39] for a sample of German firms. Wagner described the possible causality of firm's export and productivity as follows: "There are at least two important theoretical reasons why exporting might improve firm performance: serving a larger market might allow a firm to take advantage of any economies of scale in production or to provide some reduction in domestic variations in demand; and firms active on foreign markets are exposed to more intense competition and must improve faster than firms who sell their products domestically only." [39, p. 288]. Matching methods now help to answer the question of causality, which could be: "Would the productivity of the large firm X also have been improved if this firm *would have* decided to not participate in export activities?" It is clear that this question of causality can only be answered appropriate (and provide a better measure for the isolated effect of exporting activities) if a firm which starts exporting is compared with a very similar firm that did decide to not start exporting. The matching performed by Wagner was successful, he stated that it showed no difference on the 5% level for the defined characteristics which were (a) number of persons employed, (b) average sales per person, (c) average wage per person. He was able to show that firms which started to export showed on average a growth rate of 11.54%, while it was -1.78% for their matched peers (non-exporters). Also, he was able to show that the average real wage per person did grow by 4.84% for exporters compared to 1.91% for non-exporters. But, measuring labor-productivity (by average sales / person) there was only a 1% difference between firms that started to export and their matched peers of non-exporters. (cf. [39], [19])

According to Hayakava, several other studies were also able to find positive learning effects based on trade, which were dependent on the destinations of exports. Authors found that exports to high-income regions showed a stronger positive impact on productivity for the exporting firm. This would be in line with the theoretical model on international trade if one concludes that high-income regions are themselves relatively productive, which leads to a higher pressure on the exporting firms (which then, according to a learning theory, are forced to quickly improve their productivity). (cf. [19])

[19] also named Cox hazard model. A survival model where a unit increase of a covariate leads to multiplicative (therefore proportional) increase/decrease of the hazard rate (the risk - here it is firm exit).

Foreign direct investment As in the given examples of positive learning effects of exports, these learning effects could also arise with FDI. Hayakawa [19] finds that the empiric literature on this question is inconclusive - some studies find positive causal effects, but other studies do not. One reason that was stated is the difference between horizontal foreign direct investment (HFDI) and vertical foreign direct investment (VFDI). As it was already explained, HFDI also shows negative effects by the reduction of economies of scale; while on the other hand it gains from technology and process knowledge. Therefore, the effects of HFDI would not be clear in advance, it depends which effects - positive or negative ones - have a stronger impact on productivity growth. Contrary, the effect of VFDI is supposed to be positive since costs can be reduced due to the production of intermediate goods in countries that show a comparative advantage for these goods/services. One solution when analyzing these effects in empirical studies is to assume FDI into developing countries as VDFI, and that into developed countries as HFDI. A study by Hijzen [20] analyzed the effects of outsourcing for Japanese manufacturing industries between 1994 and 2000. He found that "intrafirm offshoring, which is, sourcing of intermediate inputs to foreign affiliates within a particular multinational firm, has generally a positive effect on productivity of the offshoring firm, while arm's-length offshoring, that is, sourcing to unaffiliated foreign firms, does not have such an effect. In addition, the impact of arm's-length offshoring is negative for nonmultinationals and nonexporters but nonnegative for multinationals and exporters. These results suggest that the costs of searching foreign firms suitable for offshoring are nonnegligible." [20, p. 880]. (cf. [19], [20])

Cross-border M&A The idea of cross-border M&A regarding to learning effects is that the foreign firm who wants to acquire assets of a domestic firm has a higher productivity which can raise the productivity of the domestic firm. On the other hand, the domestic firm has the geographical advantage and knows how to act in the local political and market environment. Both advantages are combined and the foreign firm can raise its competitiveness in the domestic country/market. Empirical studies try to measure productivity gains by comparing the productivity of domestic firms before/after the M&A took place. Several studies have been reviewed by Hayakawa [19] and he found that most of the studies showed an positive impact on productivity. Furthermore, it was found that cross-border M&A had a greater impact on productivity growth than local M&A had. It was also found that M&A coming from developed countries showed a higher impact on profits than M&A coming from developing countries. Also here, this conforms with the theory of international trade and monopolistic competition if one argues that the foreign firm needs to have a higher productivity to be competitive in the foreign developed country. Then, after M&A with a home firm, the benefit from the higher productivity of the foreign firm should be larger compared to merging with foreign firms that are coming from developing countries. Also, it has been found that home firms which did show a lower productivity before M&A had higher productivity gains after M&A, compared to firms which already showed a relatively high productivity. (cf. [19])

Spillover Benefits from FDI and M&A have just been mentioned and were explained regarding firms which are directly involved into these actions. These effects can also be viewed in the light of firms that are not directly involved into the mentioned actions, but gain from an indirect

effect. The literature separates two of these effects, called *intra-industry spillover* and *inter-industry spillover*. According to Hayakawa [19], a distinction is also made on four different paths of spillover effects:

1. imitation
2. skill acquisition and proliferation
3. competition
4. exports

(1) means the effect of local firms which are able to benefit from imitating superior products/technology or (process) knowledge. (2) means a direct transfer of these products/knowledge, for example through labor shifts from foreign to domestic firms. (3) means the effect of an increased competition which forces domestic firms to improve their productivity (i.e. by using technology efficiently), which has already been explained by the theory of international trade. (4) means a transfer of knowledge regarding export strategies and process knowledge related to (the start of) exporting activities.

As Hayakawa [19] states from his review of the existing literature on this topic, robust and significant positive impacts of spillover effects on domestic firms have not been reported by the literature. Reasons for that are somehow obvious and are also related to the theory of monopolistic competition in international trade. If a large mass of MNE enters a local market, the market share of each single company decreases which goes in hand with a reduction of the benefits from economies of scale. Producing a lower quantity leads to an decrease in productivity under the presence of economies of scale. If this negative effect is stronger than the just mentioned expected positive impacts of spillover, no increase in productivity would be observable. It was also stated by Hayakawa that of course not all firms will gain from positive spillover effects, but it is possible that a special group of firms depending on their characteristics will face productivity gains, while firms with other characteristics may not benefit. Empirical studies should therefore consider the heterogeneity of firms to discover which characteristics a firm has to show to benefit from the mentioned spillover effects. For example, it was shown by an empirical study on Indonesian firms that those MNEs which conduct human resource development in the domestic market lead to positive productivity effects for domestic firms, while those who do not conduct this kind of development show no positive effects on domestic firms. Another study showed that "Japanese FDI is more likely to create spillover for domestic Indian firms than US FDI. One possible reason for this result is that Japanese technology is more widely used, and thus it is easier to imitate than US technology." [19, p. 10]. It was also found that domestic firms which perform R&D can benefit more from spillover effects than firms that are not involved in R&D. A last suggestion that was made by Hayakawa to explain the differences in the observed effects is regarding the input-output relationship of MNEs with domestic suppliers. Here, empiric studies have found that closer relationships have a larger positive impact on the productivity of domestic firms. (cf. [19])

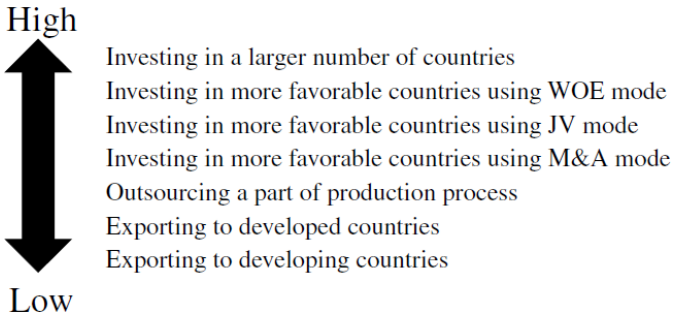

Figure 3.21: Differences in firms' behaviors according to their productivity: trade/investment liberalization in foreign countries [19, p. 12]

Firm's trade/investments decisions based on productivity - Summary

This section reviewed several studies of selection and learning effects due to import, export, FDI and M&A that are potential influencers on firm size and growth. Hayakawa [19] summarized the findings of the empiric literature graphically, depending on their productivity level. Figure 3.21 shows domestic firms' decisions based on an trade/investment liberalization in a foreign market. Depending on the domestic firms' productivity, they will choose different strategies which are appropriate to their current productivity level. As explained by the international trade theory, firms that show a low productivity could only stand weak competition and would therefore start exporting to developing countries. Firms that are competitive enough would engage in developed countries since these more productive firms have the possibility to lower their prices to a level that is competitive in the foreign market environment. Outsourcing and other strategies that are stated in Figure 3.21 and which are related to higher productivity require higher fixed costs. Therefore, these types of strategies are chosen by relatively productive firms which likely produce a larger amount of units (under the influence of economies of scale) or are more productive due to superior products/technology which let them produce at low marginal costs and thus earn a higher operating profit (which enables them to pay the required fixed costs for these strategies). (cf. [19])

Furthermore, Figure 3.22 shows the effects, found by the introduced empiric studies, of trade liberalization in the home country on firms that are active in the home country. The shown path suggests an increase of varieties in the home country, which is in line with the theory on international trade which has been discussed in this thesis. This increase of varieties comes with a trade-off for less-productive domestic firms. Since the competitive pressure did lead to lower prices, the operating profit of less-productive firms will be negatively affected, and the least-productive firms will have to exit the market since they do not make profits anymore. On the other hand, home firms that merge with foreign firms will benefit from the higher productivity level of the foreign firm and thus can improve their own productivity. And, as explained, home firms will (depending on the specific characteristics of the home firm) possibly benefit from technology and knowledge spillover from the foreign MNEs. Hawakaya summarizes that "(...) the magnitude of such effects differs according to the existence of MNEs' human resource development, MNEs' nationality, FDI types (export- or market oriented), the level of absorption

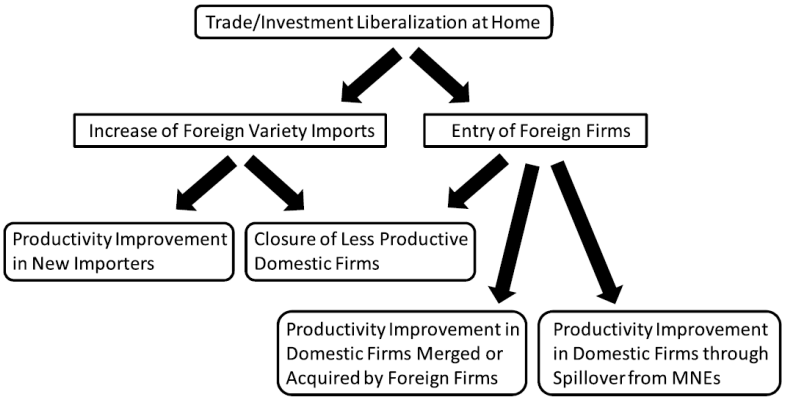

Figure 3.22: Effects of trade/investment liberalization at home [19, p. 13]

capability of domestic firms, and the existence of input-output relationships between MNEs and domestic firms." [19, p. 13]. (cf. [19])

This section has shown that the effects of globalization are twofold - a competitive market environment and thus the need for a higher productivity makes some firms better and some worse off. Empirically evidence was presented which underlined the important influence of firms' productivity on their export, FDI and M&A decisions, as well as the influence on firm survival and profits. The empirical literature is mainly in line with the theory of international trade which explained the necessity of productivity in the face of increased competition.

While Chapter 2 introduced the theoretic concepts and history of firm level data analysis, Chapter 3 has investigated and reviewed the empiric literature on the concepts of financial constraints, international trade and productivity. A large amount of possible influencers on firm size/growth have been introduced. To draw final conclusions on this section and provide an overview, Table 3.6 summarizes the introduced findings. The table will use the concept of dependent variable / independent variable, which could also be understood as the concept of cause and effect. Therefore it is important to point out that of course interdependencies of the variables exist, and variables are therefore not completely dependent or independent. Many of the introduced studies measured effects by using regression models, and it is important to note that the introduced studies often are not designed to finally answer the question of causality. Last, it should be noted that also historical findings are included, and some studies might not lead to the same results within the current market environment. Therefore, all listings are linked to the page of introduction in this thesis, as well as to the related scientific paper.

Table 3.6: Summary of identified influencers on firm structure

Independent variable	**Dependent variable**	**Relationship**	**Page reference**	**Paper**
firm size	exit	small firm size - higher probability of exit	8	[24] [36]
firm size	growth rate	small firm size - higher growth rate	8	[24]
firm size	growth rate variability	small firm size - higher variability	8	[24]
firm age	growth rate	young firm - higher growth rate	9, 19, 32	[36] [16] [2]
firm age	survival	young firm - lower probability of survival	9	[36]
plant type	growth rate	multi plant - higher net growth rate with size/age; single plant - lower net growth rate with size/age	9	[36]
productivity	exit	low productivity on entry - higher probability of exit	9	[36]
product life-cycle	number of firms	beginning of (innovative) product live cycle - large number of firms	10	[7]
process innovation	entry, exit	change to improved technology - increase of firm entry and exit rates	10, 13	[7] [36]
product innovation	market share	new product innovation - higher market share for entrants in first periods	10	[7]
entry, exit	entry, exit	positive correlation of gross entry and exit rates	13	[36]
demand	entry, exit	change of demand across varieties or locations - increase of entry and exit rates	13	[36]
industry size	exit, size distribution	industry decline - increase of firm exit rates and rise in concentration ratio	13	[36]
industry size	growth rate	industry decline - large firms only shrink faster if unit costs are constant	13	[36]
industry size	exit	industry decline - higher probability of exit for diversified and financially strong firms	13	[36]
industry sector	growth rate	sector specific influences on firm growth rates	19	[16]
firm age	firm size	young firm - smaller firm size (more skewed size distribution)	23, 29	[6] [2]
entrepreneur's education	firm size	higher education - larger firm size	26	[6]
entrepreneur's age	growth rate	young entrepreneur - small firm size at firm start-up	26	[6]
entrepreneur's age	financial constraint	young entrepreneur - higher probability of financial constraints on firm start-up	27	[6]

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Table 3.6 – continued from previous page

Independent variable	Dependent variable	Relationship	Page reference	Paper
entrepreneur's age	firm size	young entrepreneur - smaller firm size at start-up	27	[6]
financial constraint	entry	low financial constraints - higher stimulus for firm entry	28	[6]
firm age	financial constraint	young firm - stronger financial constraints	29	[2]
financial constraint	firm size	strong financial constraints - smaller firm size (related to the fact that strong constrained firms are young firms)	29	[2]
financial constraint	growth rate	existence of financial constraints - lower growth rate	32	[2]
firm size, financial constraint	growth rate	small size plus financially constrained - lower growth rate	32	[2]
Return on Assets	growth rate	high ROA - higher growth rate	32	[2]
economy type, financial constraint	firm size	financial constraints in developing country - lower firm size compared to financial constraints in developed country	33	[2]
external economies of scale	industry size	existence of external economies of scale - preference for industry clusters (no firm size preference)	36	[21]
external economies of scale	productivity	existence of external economies of scale - higher productivity for firms included in industry clusters	36	[21]
external economies of scale	entry	existing industry clusters showing external economies of scale - entry barrier for new firms outside of clusters	38	[21]
internal economies of scale	firm size	existence of internal economies of scale - preference for larger firms	40	[21]
market integration or trade liberalization	number of firms	market integration under monopolistic competition - lower number of firms	42	[21]
market integration or trade liberalization	firm size	market integration under monopolistic competition - increase in size of surviving firms	42	[21]
market integration or trade liberalization	exit	market integration under monopolistic competition - exit of lowest-productive firms	42, 49	[21] [19]
market integration or trade liberalization	operating profit	market integration under monopolistic competition - decrease of market share and profits for low-productive firms	42	[21]
productivity	operating profit	high productivity - high operating profit	42	[21]
firm size	FDI	large firm size - prefer FDI to exporting	46	[21]
import, export	productivity	firms that perform both, import and export - higher productivity than firms only involved in one activity	48	[19]

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Table 3.6 – continued from previous page

Independent variable	Dependent variable	Relationship	Page reference	Paper
export, economy type	productivity	exporting to advanced economy - higher productivity level requested	48	[19]
export, economy type	productivity	exporting to high-income economies - higher positive impact on productivity	50	[19]
firm ownership location	productivity	foreign owned firm - higher productivity in home than domestic firms	48	[19]
GDP in export country	FDI location	large GDP in export location - favorable country for FDI	48	[19]
geographical distance	FDI location	low geographical distance - favorable country for FDI	48	[19]
tariff situation	FDI location	high tariff rate in export location - favorable country for FDI	48	[19]
trade pattern	productivity	firms participating in intra-firm trade - higher productivity compared to inter-firm trade	48	[19]
productivity	FDI location	high productivity - investment in a larger number of countries	48	[19]
productivity, trade liberalization	export	high productivity and falling trade costs - more likely to start exporting	49	[19]
R&D activities	survival	firms performing R&D activities - higher probability of survival	49	[19]
export	growth rate	start to export - increase of growth rate	49	[19]
export	wage	start to export - real wage growth	50	[19]
VFDI	productivity	firms performing vertical FDI - positive impact on productivity	51	[19]
outsourcing, company type	productivity	outsourcing to unaffiliated foreign firms by nonmultinationals and nonexporters - negative effects on productivity	51	[19]
M&A	productivity	M&A with foreign company - increase of productivity in home country	51	[19]
M&A, economy type	profit	M&A coming from developed countries - higher impact on profits for home firm	51	[19]
M&A, firm type	productivity	M&A with home firm having low productivity - higher productivity gain for home firm	51	[19]

CHAPTER 4

Analysis and interpretation of publicly available date sources on firm structure

The last chapters have examined in detail the history of firm level data analysis, as well as recent empirical findings which are related to globalization, productivity and the financial crisis. For an even more complete overview of the topic, this section will introduce publicly available data sources which contain information on firm size and structure. It is the aim of this section to provide an overview of firm level data which can be used to (i) extend current research results, (ii) perform new empirical studies and (iii) explore additional causalities compared to the already existing findings which have been summarized in Table 3.6 of Chapter 3.

4.1 OECD Structural and Demographic Business Statistics

Data source overview

The OECD Database *Structural and Demographic Business Statistics* [29] can be accessed by research institutions and contains several variables for most of the OECD countries, split up by firm size classes and industry sectors. To harmonize the data set, OECD has defined standardized size classes to overcome the problem of different definitions in each country. Firm size classes (1 to 5) are defined by the number of employees: 1-9; 10-19; 20-49; 50-249; 250+. Furthermore, the industry sectors are defined by the OECD convention *ISIC*. It consists of a 4 digit code and is designed in a hierarchical way. At the top level, industry sectors are split up in categories, where 'A' is defined as 'Agriculture, hunting and forestry', 'B' as 'Fishing', 'C' as 'Mining and quarrying' and so on. At the next level, each of these categories are divided into one or more divisions which are identified by a 2-digit code. For example, the category 'Agriculture, hunting and forestry' is divided into the divisions '0**1**: Agriculture, hunting and related service activities' and '0**2**: Forestry, logging and related service activities'. Each division then is divided in one or more groups which are identified by a 3-digit code. For example, the division '01: Agriculture, hunting and related service activities' is divided into the groups '01**1**: Growing

of crops; market gardening; horticulture', '01**2**: Farming of animals' etc. Finally, on the last level of the hierarchy, which is ISIC Level 4, the groups are divided into one or more classes. For example, the group '012: Farming of animals' is divided into '012**1**: Farming of cattle, sheep, goats, horses, asses, mules and hinnies; dairy farming' and '012**2**: Other animal farming; production of animal products n.e.c.'. (cf. [27], [28])

As this thesis should provide an overview of data that are available for firm size and structure analysis, the following list represents the currently available variables of the Structural and Demographic Business Statistics database:

Turnover; Production; Value added; Value added at factor costs; Gross operating surplus; Total purchase of goods and services; Change in stock of goods and services; Purchase of energy products; Gross investment; Investment in land; Investment in existing buildings and structures; Investment in machinery and equipment; Sales of tangible investment goods; Net investment in tangible goods; Total employment (number engaged); Number of employees; Number of females employed; Employment, number of full time equivalent employees; Hours worked by employees; Remuneration; Remuneration of employees; Wages & salaries; Wages & salaries of employees; Other employer's social contributions, all persons engaged; Employment, number of unpaid persons employed; Other employer's social contributions, employees; Number of establishments; Number of enterprises; Total intra-mural R&D expenditure; Total number of R&D personell. (cf. [29])

Furthermore, additional analytical indicators, depending on size-class and sector, are available, for example 'size class contribution to total production ' and 'industrial sector share in total number of employees'. (cf. [29])

Analysis of firm size by different countries and sectors

As the details and variables of the OECD Structural and Demographic Business Statistics data set have been explained, some of them will now be used to perform exemplary analysis and will be linked to the introduced theoretical concepts described in this thesis. To proof for the skewness of the firm size distributions, which has been observed by the empirical studies introduced in this work and which was one of the main topics of investigation in this thesis, the variable 'size class contribution to total number of enterprises' was chosen for an analysis. Figure 4.1 shows the firm size distribution for Germany of the year 2007, which was the most recent available period at time of access. The figure points out two characteristics which are in line with the reviewed literature. First, a highly right skewed distribution can be observed, which means that small firms have the highest share in each industry. Second, while this statement holds true for each of the selected sector, the size distribution between the sectors shows notably differences. Considering electricity, which is often used as the standard example of a natural monopoly, the size distribution is less skewed than the distribution in sale and retail trade. Linking these results to the introduced concepts of economies of scale (cf. Chapter 3) one possible explanation at the electricity sector would be the high fixed costs at start-up (and therefore high average costs for a small amount of units) and the resulting advantage of large firms that produce a high quantity. To make an exemplary country comparison, Figure 4.2 shows the same industries for Italian firms. One can observe that Italy has, across all Industries, a higher share in small firms. The largest difference compared to Germany can be shown in the 'W\trade and retail trade ...' sector.

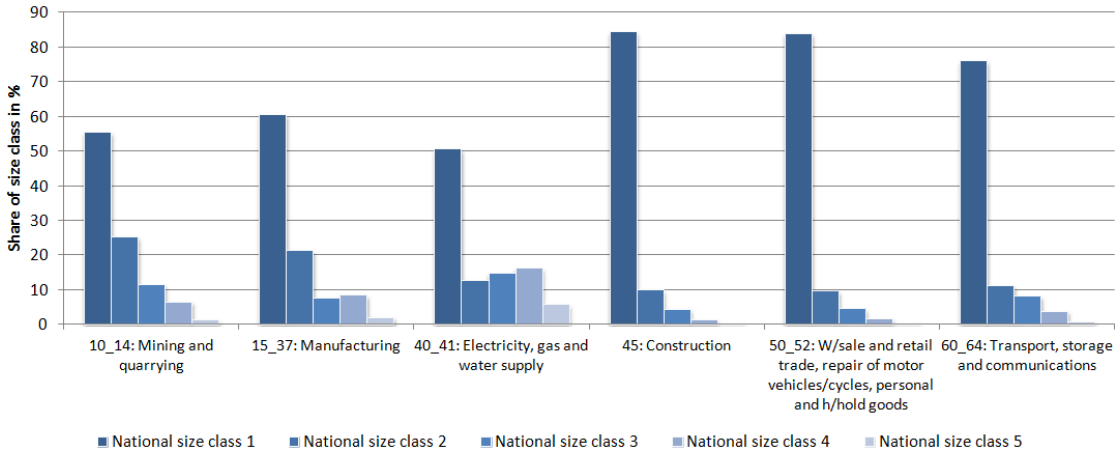

Figure 4.1: Firm size distribution by sectors, Germany 2007. Own graphical representation, based on data set [29]

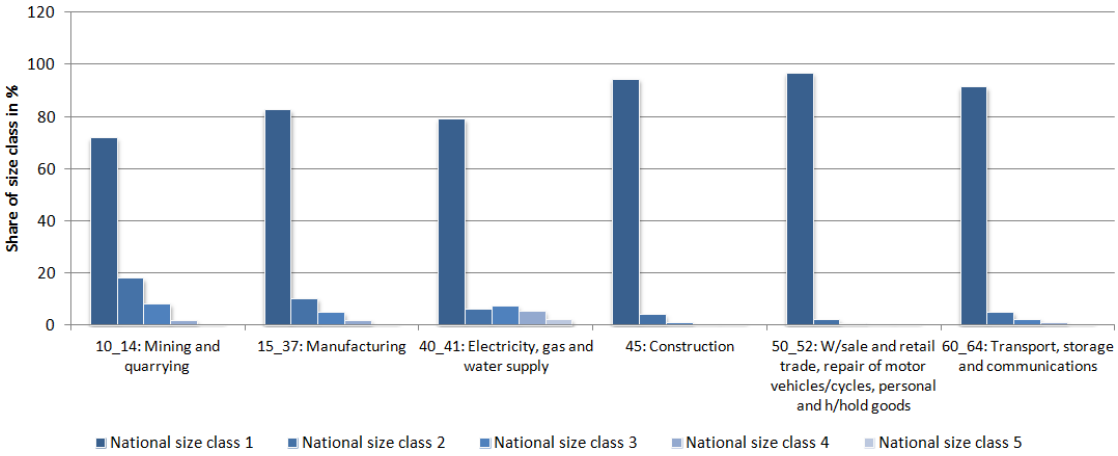

Figure 4.2: Firm size distribution by sectors, Italy 2007. Own graphical representation, based on data set [29]

In this sector, 97% of the Italian enterprises belong to the national size class 1 (1-9 employees), compared to 84% in Germany. This result is in line with the study of Falk, which was performed by using the AMADEUS firm level data base for the time period 2000-2004. For this data set, the study calculated a median average employment of 135 employees per firm for Germany, but only 99 for Italian firms [16, p. 8]. Furthermore, his results showed a high number of employees per firm in the 'Mining & Energy' sector, compared with a relatively low number of employees in the 'Distributive trade' sector. The results of Figure 4.1 and Figure 4.2 support Falk's results: The figures show that also for OECD data, more firms in the mining sectors are large firms (relatively high number of employees), compared with the trade sector with a relatively higher share of small firms.

Analysis of productivity by size class, countries and sectors

Chapter 3 explained in detail the concepts of productivity and its relationship with firm size, firm growth as well as firm entry and exit. Especially in the presence of international trade and an increased competitive pressure between firms, knowledge about productivity levels on the country, size and sector level will be useful to anticipate further developments in the firm structures. In general, productivity can be defined as output per input. One approach, often used in macroeconomic accounting, is the calculation of productivity using $\frac{\text{GDP(real)}}{\text{volume of work}}$. Volume of work can be defined as the number of employees, or the total work hours of all employees. While the number of employees is usually easy to survey and therefore available in many data sets, it often does not consider the bias of part-time employees, etc. As the just mentioned formula allows to calculate the work productivity for a country, it doesn't allow for a more detailed investigation at the firm size and sector level. Additionally, work productivity calculated by this method does only take into account one factor of work - labour. It is therefore not capable of making predictions of the reasons behind a change in productivity. For example, technical/organizational innovations, an increase of the factor capital and changes in the quality of the produced products will all influence the productivity measure based on GDP, while the real labour productivity might be constant. (cf. [4])

Taking into account these limitations and features of productivity measures, available variables of the OECD data source have been analyzed to check which ones are appropriate for the calculation of productivity measures.

For the input part, these variables have been evaluated:

- Turnover
- Production
- Gross operating surplus
- Value added
- Value added at factor costs

Turnover does not say something about the profit of a firm and will therefore not be an appropriate variable. Also Production, which additionally considers changes in stock, shows the same

limitation. Gross operating surplus is related to the profit, but since the compensation of employees and taxes reduce the surplus, it is biased by country and firm differences in wage levels as well as tax rates. Value added seems more appropriate, since it only considers the difference of a firm's production and its consumption of intermediate goods. Value added therefore measures the value which a firm additionally creates by its production process, similar to the GDP approach. Nevertheless, taxes and production subsidies could bias the variable value added. Therefore, *value added at factor costs* seems to be the appropriate measure for the input part: it excludes the effects of taxes and subsidies and will therefore be a measure for the *real* value that is created by a firm. (cf. [29])

For the denominator (output) side, the following variables have been evaluated:

- Number of employees
- Employment, Number of full time equivalent employees
- Hours worked by employees

As explained, the number of employees face the problem that it does not consider the bias of part time workers, fluctuation during the year, etc. Additionally, different countries have different work hours per week, statutory holidays and vacation entitlements which also create a calculation bias. The variable based on full time equivalent employees can eliminate the problem with part-time workers, but can't eliminate the second bias of different working conditions. Therefore, the variable *hours worked by employees* seems to be the appropriate measure since it only considers worked hours (incl. overtime) and excludes hours that were paid but not worked like vacation, etc. Unfortunately, the OECD data show an error for this variable. For example, the 'hours worked by employees' for Austria, 2007, size class 1 in the manufacturing sector is given as 67 923, while the 'number of employees' is given as 44 996. This pattern is similar across sectors and countries, therefore it was decided to use the variable 'number of employees' as input variable. (cf. [29])

After the variables 'value added at factor costs' and 'number of employees' have been identified as the appropriate input / output variables, the availability of data at country, firm size (class 1-5) and sector (ISIC) level was verified.

Table 4.1 shows in which countries (marked wit 'x') data for the variable 'value added at factor costs' were available at the firm size level (complete data for size classification 1-5). The sectors were numbered as follows:

1. Construction
2. Electricity, gas and water supply
3. Hotels and restaurants
4. Manufacturing
5. Mining and quarrying
6. Real estate, renting and business activities

7. Transport, storage and communications

8. W/sale and retail trade, repair of motor vehicles/cycles, personal and h/hold goods

Table 4.1: Available OECD data for variable 'value added at factor costs', 2007; Own table representation, based on data set [29]

Country/Sector	1	2	3	4	5	6	7	8
Austria	x	x	x	x		x	x	x
Belgium	x	x	x	x		x	x	x
Czech Republic	x	x	x	x	x	x	x	x
Denmark	x	x	x	x		x	x	x
Estonia	x	x	x	x		x	x	x
Finland	x	x	x	x		x	x	x
France	x	x	x	x	x	x	x	x
Germany	x		x	x	x	x	x	x
Greece	x	x	x	x		x	x	x
Hungary	x	x	x	x		x	x	x
Ireland			x	x	x	x	x	x
Italy	x	x	x	x	x	x	x	x
Latvia	x	x	x	x		x	x	x
Lithuana	x	x	x	x	x	x	x	x
Luxembourg				x		x	x	x
Netherlands	x		x	x		x	x	x
Norway	x	x	x	x			x	x
Poland	x	x	x	x	x	x	x	x
Portugal	x		x	x		x	x	x
Slovak Republic	x	x		x	x	x	x	x
Slovenia	x		x	x		x	x	x
Spain	x	x	x	x	x	x	x	x
Sweden	x	x	x	x	x	x	x	x
United Kingdom	x	x	x	x	x	x	x	x
# available data	**22**	**18**	**22**	**24**	**11**	**23**	**24**	**24**

Table 4.2 shows in which countries (marked wit 'x') data for the variable 'number of employees' was available at the firm size level (complete data for size classification 1-5).

Due to the incompleteness of the data in both, the input and output variables, the further analysis has been limited to the sectors (1) Construction and (4) Manufacturing, and to the countries where data for these three sectors were available, respectively (cf. Table 4.1 and Table 4.2).

The OECD data for the variable 'value added at factor costs' were available in local currencies only, therefore the currencies GBP, CZK, EEK, HUF, LTL, NOK, SEK were converted into EUR by using the exchange rates which were effective at December 31th, 2007. [25]

Table 4.2: Available OECD data for variable 'number of employees', 2007; Own table representation, based on data set [29]

Country/Sector	1	2	3	4	5	6	7	8
Austria	x	x		x				
Belgium	x	x		x				
Czech Republic	x	x		x	x			
Denmark	x	x		x				
Estonia	x	x		x				
Finland	x	x		x				
France	x	x		x	x			
Germany	x	x		x	x			
Greece	x	x		x				
Hungary	x	x		x				
Ireland				x	x			
Italy	x	x		x	x			
Latvia	x	x		x	x			
Lithuana	x	x		x	x			
Luxembourg				x				
Netherlands	x	x		x				
Norway	x	x		x	x			
Poland	x	x		x	x			
Portugal	x			x				
Slovak Republic	x	x		x	x			
Slovenia	x			x				
Spain	x	x		x	x			
Sweden	x	x		x	x			
United Kingdom	x	x			x			
# available data	**22**	**20**	**0**	**23**	**13**	**0**	**0**	**0**

Afterwards, the productivity level was calculated based on the rationale explained in this section, using the formula $\frac{\text{value added at factor costs}}{\text{number of employees}}$. The result for the construction sector is presented in Figure 4.3. As shown, the highest productivity level in size class 1-3 was calculated for Norway, where one employee creates a value added at factor costs of 79 000 Euro on average in 2007. Since the productivity level of Estonia lies on a scale that implies an error in the data source, no statements on the productivity level can be made based on the underlying OECD data. Concluding on the OECD productivity data for the construction sector, an important relationship between firm size and productivity becomes obvious: For most of the countries, the productivity level in the size class 4-5 is higher than the productivity level of size class 1-3. Comparing these results with the theory of economies of scale in Chapter 3, the results suggest that the construction sector seems to face economies of scale that are strong enough to influence firm productivity. Across all countries, the productivity of construction firms in size class 4-5

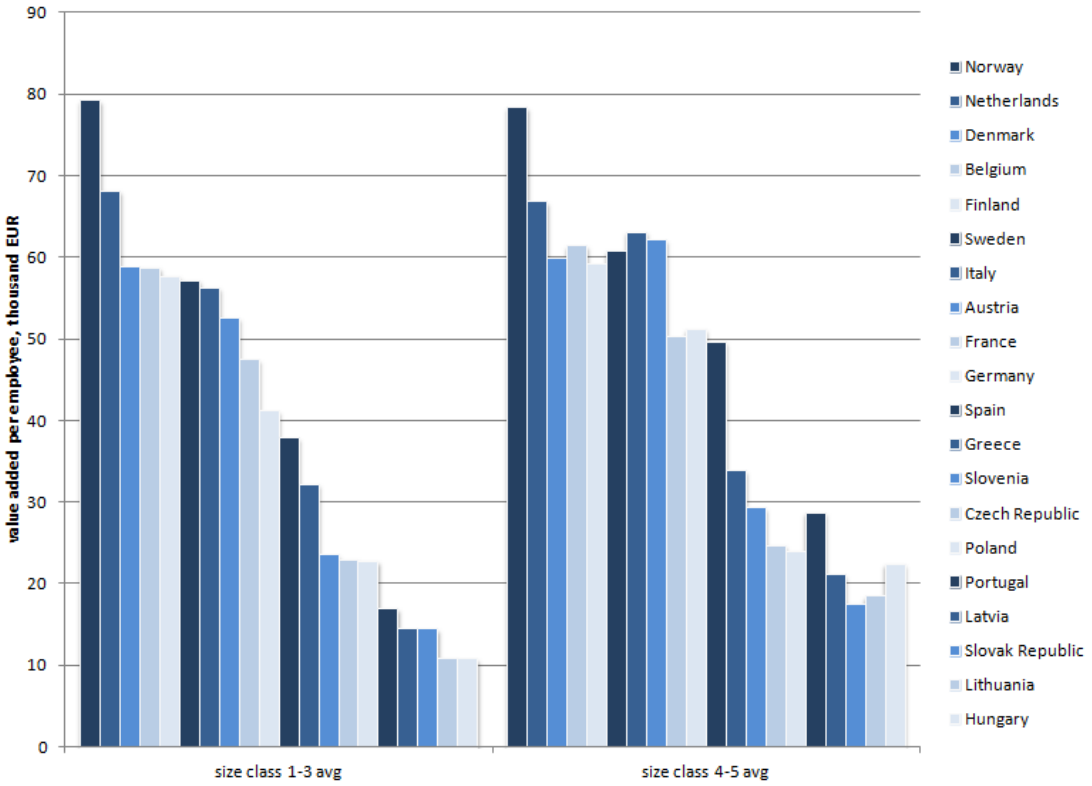

Figure 4.3: Country productivity in construction by firm size class, 2007. Own graphical representation, based on data set [29]

shows a level that is 12.46% above the level of firms in size class 1-3. (cf. [29])

To gain more evidence and draw reliable conclusions on the productivity measure, an analysis of the manufacturing sector is provided in Figure 4.4. First, it can be seen that the country ranking shows a similar pattern with only minor differences in the rankings. Additionally, Ireland and Luxembourg were included due to data availability and also show a relatively high productivity. Ireland shows a significantly higher productivity in size group 5 (large firms). Assuming that the provided data is correct, a possible explanation could be tax benefits for large (and highly productive) firms. Second, the productivity level of most of the countries is higher in size class 5 (250+ employees) than it is in size class 1 to 4. As Chapter 3 suggests (and as it was the case in the construction sector), the manufacturing strongly benefits from economies of scale. The theory is therefore supported by these results, showing a positive correlation of firm size and productivity. Excluding the outlier data of Ireland, large firms in size group 4-5 are on average 28% more productive than smaller firms in the size class 1-3. (cf. [29])

To proof for the validity of the presented results in Figure 4.3 and Figure 4.4, the productivity measures were compared with a publication of the Austrian chamber of commerce, using data published by the European commission via Eurostat [31]. The first ranked countries in 2007, calculated as $\frac{\text{GDP}}{\text{total employees}}$ were: Luxembourg, Norway, United States of America, Ireland,

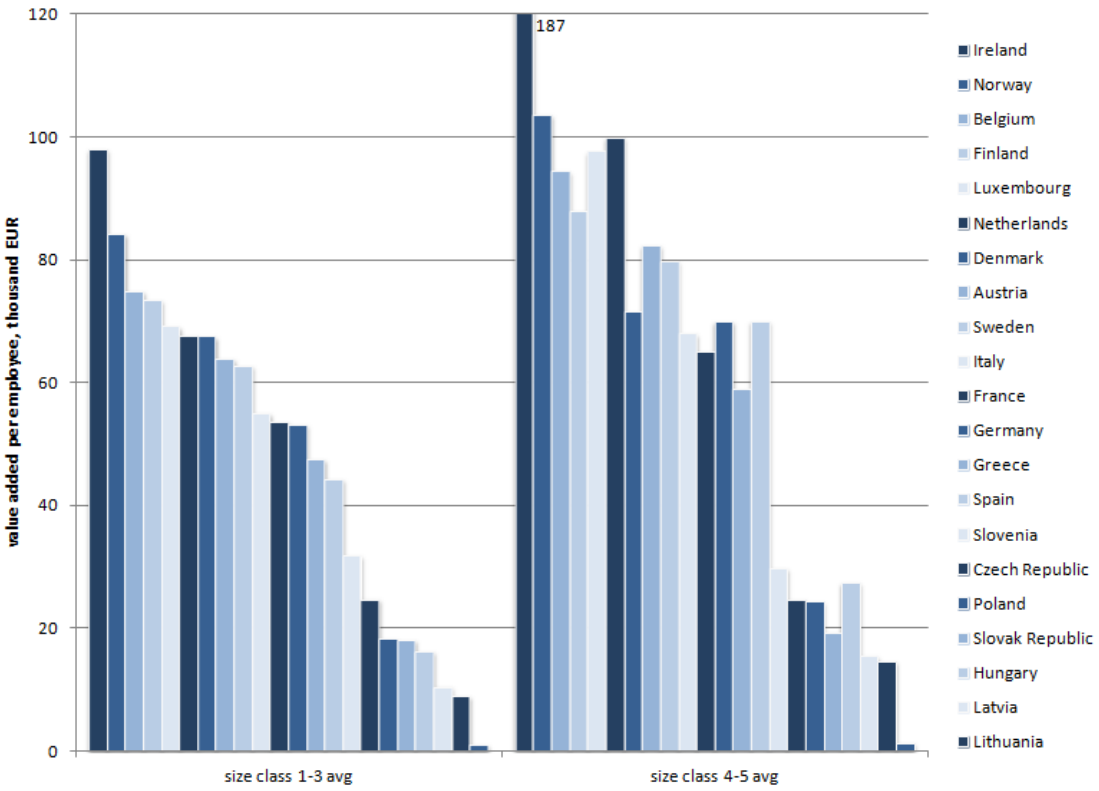

Figure 4.4: Country productivity in construction by firm size class, 2007. Own graphical representation, based on data set [29]

Belgium, Austria, France, Sweden, Netherlands, Finland, Italy, Great Britain, Switzerland and Germany. The worst ranked countries were Bulgaria, Romania, Latvia, Macedonia, Lithuania, Poland, Turkey, Estonia, Hungary and Portugal. Comparing these results with the presented OECD data, the rankings are quite consistent. Nevertheless, minor differences within the top / worst ranked groups exist, possible explanations can be (i) differences in the methodology of data gaining/processing, (ii) differences in the availability of data (in the OECD example, not all data for the sectors were available), (iii) differences in the used input / output variables (value added at factor costs per employee versus GDP per employee). (cf. [29], [31])

Summary

As a first step, this section analyzed firm size distributions for different sectors by the exemplary countries Germany and Italy. Second, suitable variables of the OECD data source have been identified and used to create productivity measures by country, sector and firm size. The results of these analysis showed that

- For Germany and Italy, the size distribution for various sectors is highly right skewed. Small firms build the largest share in each investigated sector. Large firms account only

for a small share in the overall number of firms.

- The firm size distribution shows large differences between sectors. While in the energy sector large firms build a relatively high share, they account for a much lower share in the sale and retail trade sector.

- The exemplary size distributions of Germany and Italy are in line with the theoretical foundation presented in Chapter 2, and the empirical findings in the literature presented in Chapter 3. Size distributions are often highly skewed and show cross-country and cross-sector differences.

- OECD data for the variables 'number of employees' and 'value added at factor costs', at size group level, are only available for a limited number of countries and sectors. The 2007 data for the variable 'hours worked by employees' seem to be inaccurate.

- Productivity levels across Europe are highly heterogeneous. For example, Norway shows a 7.3 times higher productivity rate than Hungary in the construction sector, size class 1-3.

- For the sectors construction and manufacturing, the productivity level for large firms (size class 4-5) is higher than for small firms (size class 1-3) for most of the countries. The presented theory in Chapter 3 provides a possible explanation by introducing the concept of economies of scale.

4.2 Eurostat Business Demography Indicators

Business demography indicators presented by size class - Data source overview

The Eurostat Database *Business demography indicators presented by size class* contains several variables related to firm birth rates, survival, churn rates (sum of birth and death), etc. The data are available at sector level, country level and size class level. As the last section introduced the ISIC sector classification of the United Nations which is used by the OECD, the data source of Eurostat is structured by the NACE[1] classification. While ISIC is used on a world-wide level, NACE is used on the European level and directly derived from ISIC. At the top level of the classifications, the ISIC and NACE positions are fully consistent while at deeper levels the NACE classification is more detailed [15]. The size classes of the investigated data base are defined as 1-4; 5-9; 10+ employees. As this thesis should provide an overview of data that are available for firm size and structure analysis, the following list represents the currently available variables of the Business Demography Indicators by size class database:[2] (cf. [15])

Population of active enterprises in t; Number of births of enterprises in t; Number of deaths of enterprises in t; Number of enterprises newly born in t-1*; Number of persons employed in the

[1] Nomenclature génerale des Activités économiques dans les Communautés Européennes - general classification of economic sectors in the European communities.

[2] variables that include the term *t-1** or *n+1** are available on the Eurostat database for the periods (t-1), (t-2), (t-3), (t-4), (t-5) and (n+1), (n+2), (n+3), (n+4), (n+5) respectively; variables that include the term *1* year old* are available for 1, 2, 3, 4, 5 year old firms; but are listed only once to stay space-saving in this work

population of active enterprises in t; Number of employees in the population of active enterprises in t; Number of persons employed in the population of births in t; Number of employees in the population of births in t; Number of persons employed in the population of deaths in t; Number of employees in the population of deaths in t; Number of persons employed in the population of enterprises newly born in t-1* having survived to t; Number of persons employed in the year of birth in the population of enterprises newly born in t-1* having survived to t; Net business population growth; Business churn: birth rate + death rate; Birth rate; Proportion of enterprise births in the reference period (t) by size class; Density of birth rate; Death rate; Proportion of enterprise deaths in the reference period (t) by size class; Survival rate; 1* year old enterprises' share of the business population; Employment share of enterprise births; Average size of newly born enterprises; New enterprise paid employment rate; Employment share of enterprise deaths; Average employment in enterprise deaths; 1* year old enterprises employment growth rate; Employment share of 1* year old enterprises; Average size of 1* year old enterprises; Number of enterprises newly born in the year (n) having survived to n+1*; Cohort survival rate; Number of persons employed in the survival year among enterprises newly born in (n) having survived to n+1*; Number of persons employed in the year of birth in the population of enterprises newly born in (n) having survived to n+1*; 1* year old enterprises employment growth rate. (cf. [13])

Analysis of firm survival rates in different countries

With the given Eurostat dataset it is possible to compare firm survival rates across countries and show their different levels. Therefore, the variable 'survival rate' was used, which is defined as the "number of enterprises in the reference period (t) newly born in t-1 having survived to t divided by the number of enterprise births in t-1" for the survival rate of year 1, and as t-n for the year n respectively [13]. Figure 4.5 shows the survival years of selected countries that were available for analysis in the Eurostat database. Sweden shows the highest survival rate of 96% in year one, while the lowest rate of 67% was reported for Portugal. From year one onwards, the survival rate decreases with each additional year, meaning that in each period some firms choose to or are forced to exit. The largest difference between the survival rate of year one compared to year five (represented by the slopes of the curves) was observed for Estonia (not included in Figure 4.5), where the 1-year survival rate was 89% compared with 47% for the 5-year survival rate which represents a difference of 43 percentage points. The smallest difference was observed for Lithuania (10 percentage points) and Austria (26 percentage points). Interpretations of the different levels and slopes of firm survival can be made considering various influencers. First, legal barriers and tax rates differ between countries and can influence a firms decision to exit the market. Second, different transfers and conditional grants are available for some countries and are also influencing firms survival and exit decisions. Third, the competitive environment as covered in Chapter 3 influences the exit rate, considering the introduced theory that new firms are not fully aware about their initial productivity level. Finally, financial constraints will have a strong influence for young firms and are influencing their exit decisions. (cf. [13])

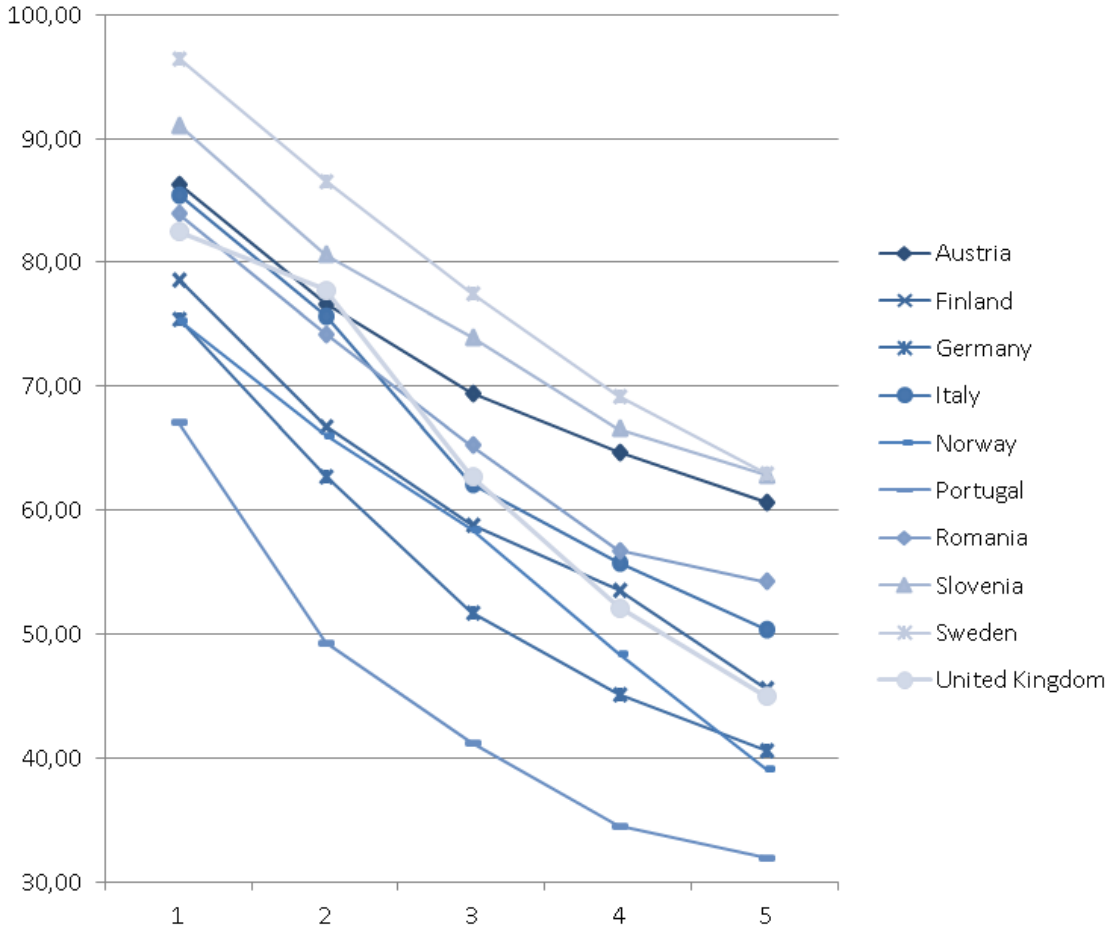

Figure 4.5: Firm survival rates for one to five year old firms, 2009. Own graphical representation, based on data set [13]

Analysis of the relationship between firm survival, growth and size for different countries

To analyze the relationship between survival, growth and size for young firms, Figure 4.6 represents a visualization for all countries where 2009 data were available. It shows the growth rate for five-year old firms as $\frac{\text{number of employees in t}}{\text{number of employees in t-5}}$ on the x-axis, the five-year survival rate on the y-axis and the relative total number of employees in 2009 (of firms that were founded in t-5) as the bubble size. One can see that the number of employed persons (x-axis) in Romanian firms did grow about 145% between the founding year in 2004 and 2009. Romanian firms also face a relatively high survival rate (y-axis), showing that 54% of the firms founded in 2004 survived until 2009. Finally, the total number of employees of firms that are five years old (founded in 2004) is relatively large (bubble size), being 203 479 employees. Figure 4.6 therefore allows to evaluate where potential improvements of survival and/or growth rates would have a powerful leverage. For example, policies that could potentially increase the firm survival rate of Bulgaria will have

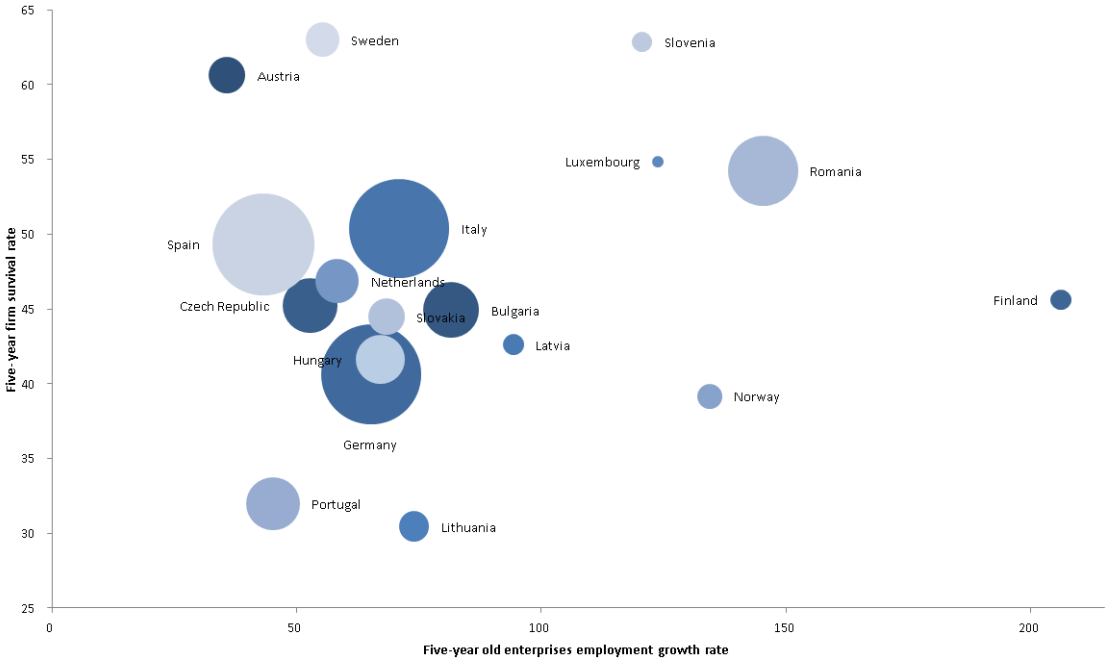

Figure 4.6: Firm survival rates for one to five year old firms, 2009. Own graphical representation, based on data set [13]

a larger overall impact than an increase in Slovakia which has a similar growth/survival rate. Of course, the graphical representation has its limitations and cannot answer causality effects that are not uncovered by the observed variables. For example, a low survival rate could be a result of a very effective mechanism that only allows relatively productive (and profitable) firms to recieve financial benefits and loans, which would overall be beneficial for the economy. On the other hand, a high survival rate would be easier to archieve for countries that show a relatively low productivity level where new firms would face only moderate competition. Furthermore, firms that initially start with a higher number of employees are likely to show a lower growth rate than firms that are small at start up. Nevertheless, the graphic allows to make two important statements on firm structure: First, large differences between the survival rates of the observed countries exist. Relatively large economies like Germany, Italy and Spain show a moderate survival rate between 40% to 50%, while there seems to be an issue with very low survival rates in Portugal and Lituania. Second, reasons for low survival rates in countries like Portugal and Lithuania should be investigated in more detail to identify reasons for early firm exits. Especially in Portugal, which has a moderate total employee level in five year old firms it would be important to identify possible reasons and improvements to advance the foundation and growth of young firms.

Factors likely limiting business growth - Data source overview

The last exemplary analysis of Eurostat data that will be performed in this thesis will raise the question of growth limiting factors in different countries. Therefore, an Eurostat database, containing survey data that were completed by 25 000 firms across 20 member states in 2010, was investigated. The survey question was given as "Between now and 31 December 2013: Which of the following are likely to be the most important factors limiting the growth of the business? Please X up to five most relevant response categories" [12]. The questionnaire was sent out to firms (excl. financial business community) with 10 to 249 employees in 2005 and at least 10 active employees in 2008. Furthermore, enterprises were classified as one of three groups: "gazelles", "other high growth" or "other business". Gazelles were defined as "businesses born in 2003, 2004 or 2005 where the employment in 2008 was at least 72.8% greater than the employment in 2005. (This is a compund rate annualy averaged of 20% per annum over three years)" [12]. Other high growth enterprises were defined as firms with the same growth rate condition as gazelles (72.8% between 2005 and 2008), but born before 2003. Other businesses were firms that did not meet the criteria for the gazelles and other high growth classification. (cf. [12])

Analysis of factors that could potentially limit business growth between 2011 and 2013

A first analysis of the introduced data set is shown in Figure 4.7. It includes all possible answers as an average across all participating countries and is grouped by the classifications "gazelles", "other high-growth enterprises" and "other enterprises" as explained. The figure shows that, on country average, more than 20% of the firms in the group "other high-growth enterprises" and "other enterprises" stated that the "general economic outlook" is expected to be one of their most growth limiting factors between 2010 and 2013. Note that for the "young high-growth enterprises", the percentage is slightly lower at 19%. In general, it can be clearly seen in Figure 4.7 that the most growth limiting factors were: General economic outlook; Price competition/small margins; Limited demand in the local/domestic markets and High cost of labour. Less than 10 percent (average of all countries and firm groups) of the firms stated the most important limitations by the factors New entrants in the market; Limited availability of suitable new personnel; Lack of fiscal incentives; Regulatory framework; Not enough financing; Necessary investment into equipment; Limited demand in foreign markets and Loss fo existing personnel. Less than 2 percent stated Technological competition; Business transfer problems; other infrastructure weakness; Products getting outdated; Difficult access to information technology as one of their top five limiting factors. In general it can be observed that the reasons for expected growth limtations were quite consistent across the three groups, while the "gazelles" groups shows a tendency to a more optimistic valuation of the general economic outlook (which seems reasonable considering their current phase of high-growth). (cf. [14], [12])

For a more detailed analysis, the four countries that reported the highest (relative, since the factors of each country sum up to 100%) constraint rates in the top-nine factors (which account for nearly 90% of the answers) have been analyzed and illustrated in Figure 4.8. The figure shows that significant differences in the distribution of the limiting factors between countries

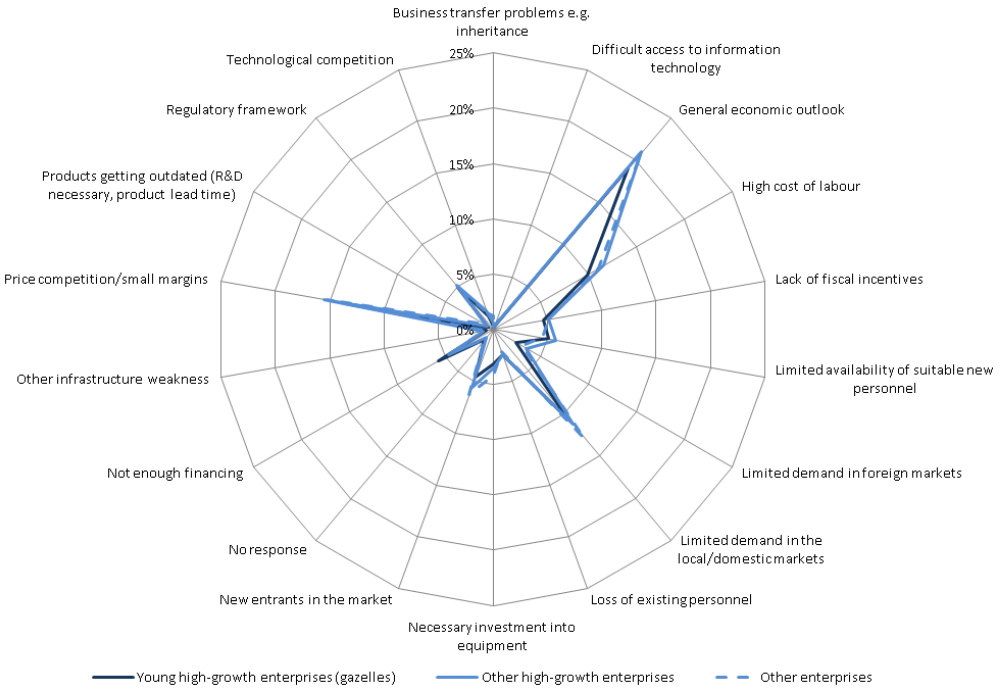

Figure 4.7: Percentage of firms that stated the factor as top-five limiting factor for business growth between 2010 and 2013, total of all participating countries. Own graphical representation, based on data set [14]

exist. For example, high cost of labour was stated as one of the top five limiting factors in Italy by 16% of the firms, where only 9% of Greek firms chose this factor. An other example can be given by the factor new entrants in the market, which was identified as a major limiting factor by 12% of Irish firms, and only 2% / 1% by Italian / Greek firms. Comparing Figure 4.7 and Figure 4.8, which only includes selected countries, it can be seen that the general economic outlook is by far the most requently mentioned factor. Considering all countries and firm groups, an average of 16% of the firms in each country stated that the general economic outlook is expected to be one of the top-five limiting factors until 2013. While this result seems reasonable considering the economic difficulties that were present at the time of questioning, a possible bias could arise due to the general type of the factor and judgements that are influenced by the public opinion rathen then rational judgements. First, since the general economic outlook is a very vague factor, it could be more likely to be chosen in the absense of knowledge of more concrete growth limiting factors. Second, the public opinion and pessimistic assessment of the near economic future could negatively influence the individual firms judgements on an emotional rather than realistic or rational basis.

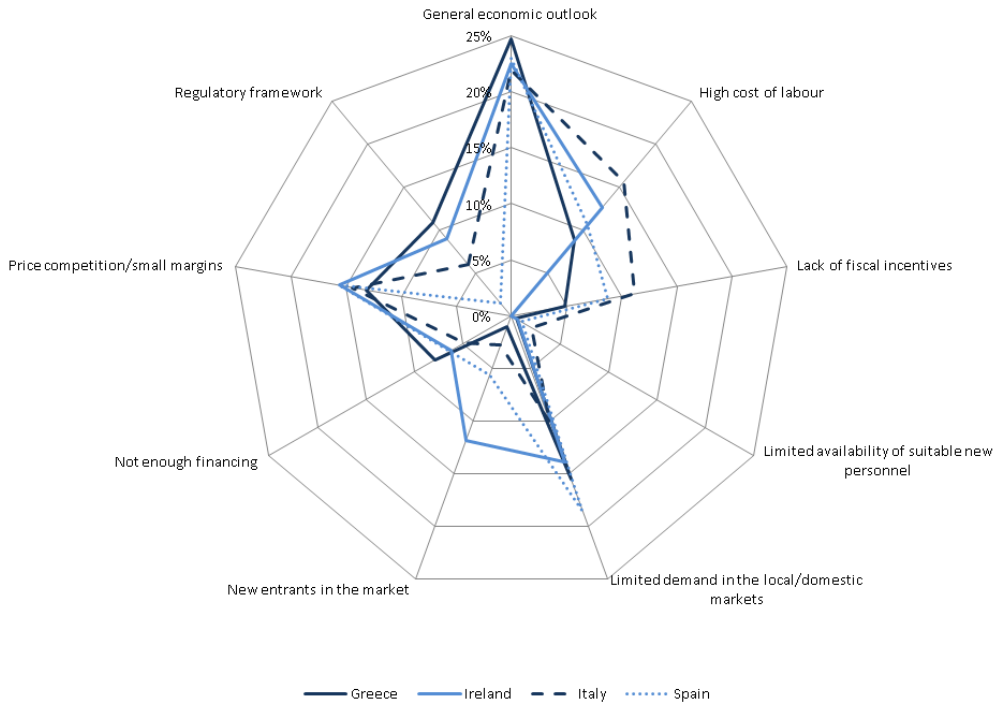

Figure 4.8: Percentage of firms that stated the factor as top-five limiting factor for business growth between 2010 and 2013, selection of top ranked factors and related countries. Own graphical representation, based on data set [14]

Summary

This section has reviewed two different Eurostat data sources, each containing valuable information on firm structure. The analysis and graphical representations have shown that

- One-, two-, three-, four- and five-year survival rates significantly differ between countries. While Sweden shows an one-year survival rate of 96%, Portugal only shows a rate of 67%.
- The slope of survival rates are different for the analyzed countries. Some countries show high one-year survival rates and strong decreases in the number of firms in the following years, while other countries start with a moderate survival rate and sustain moderate decreases in the observed five-year period.
- The theory presented in this thesis provides different explanations for the observed patterns of firm survival/exit rates. Legal barriers, tax rate differences, financial constraints and competition are some of the influencers that were discussed.
- The five-year firm growth rates differ significantly between countries. While Austria shows the lowest employee growth-rate of 36% in total between the founding year 2004 and the year 2006, Finland shows a growth rate of 206%.

- The five-year firm survival rates differ significantly between countries. The lowest survival rates were found for Lithuania and Portugal (30% / 32%), while Sweden and Slovenia show the highest survival rates being 63%.
- Country differences in the total number of employees of 5-year old firms lead to different leverages. Policy changes that can positively influence firm growth and/or survival rates will therefore have different impact levels on the overall European economy.
- More than 20% of the polled firms across 20 member states stated that the 'general economic outlook' will be one of their top-five growth limiting factors between 2010 and 2013.
- Young high-growth enterprises (gazelles) show a slightly less pessimistic evaluation of the general economic outlook than other high-growth enterprises or other enterprises.
- Across all countries and firms, the by far most answered top-limiting factors were stated as: General economic outlook; Price competition/small margins; Limited demand in the local/domestic markets and High cost of labour.

CHAPTER 5

Summary and Conclusion

The last chapter will summarize and conclude on the results of the introduced theoretical concepts and the empirical findings that have been presented in this thesis. Starting with the theoretical concepts, the thesis has discussed the important work of Robert Gibrat on the law of proportional effect. The occurrence of log-normal distributions in various areas was explained and it has been shown that if each firm faces the same probability of growth, expressed as percentage of the firm's size, a right skewed, log normal distribution would arise as a result. The work of Simon and his modifications to Gibrat's assumptions were then discussed, as well as the contributions of Mansfield, Klepper's work on innovation, the learning model of Jovanovic and investigations on firm exit. Each of them added different dimensions to firm structure (like size, growth, entry and exit) or introduced additional influencers on firm structure.

As Chapter 2 summarized the theoretical and basic work on firm structure, Chapter 3 covered the empirical proofs of these concepts. It focused on three main topics that were identified as being highly relevant for the explanation of firm size and growth. First, Gibrat's Law was tested for European multinational firms and it was shown that it does not hold empirically. Second, financial constraints were investigated as a potential source for observed limitations of firm growth and size. Therefore, studies performed on Portuguese and Italian firms showed that the skewness of firm size distributions decreases with firm age, that younger entrepreneurs show a higher probability of being financially constrained and that financial constraints lead to a negative impact on firm growth. Third, the empirical part introduced the concepts of comparative advantage, monopolistic/imperfect competition, internal and external economies of scale and the related implications on productivity and import/export decisions. It was shown that an integrated (globalized) economy could lead to a reduction in the total number of firms, an increase of the competitive pressure and to potential benefits due to economies of scale. The effects of trade and empirical studies related to selection and learning effects due to globalization (import/export, FDI and M&A) showed the importance of distinguishing between different types of investments and the productivity of the related countries. It was, for example, shown that large firms would potentially prefer FDI to exporting, that M&A that come from developed countries have a higher positive impact on profits for the home firms and that a high productivity is related

to firm's investments in a larger number of countries. The results of Chapter 3 were summarized in an extensive table (cf. Table 3.6) which captures all relationships regarding firm size and growth that were covered in this thesis.

Chapter 4 introduced different OECD and Eurostat data sources and highlighted the most important variables for the investigation of firm size and growth influencers. New analysis on the data were performed in this thesis and supported the findings that firm size distribution is highly right skewed, shows country and sectoral differences as well as notable productivity differences across European countries. Concluding, two additional analysis which were created showed the country differences of firm survival rates and its slopes over a five-year period. The survival rates were related to growth rates and total number of employees and thereby showed possibilities for improvements and policy advices. Finally, a survey of potential growth-limiting factors, including 25 000 firms of 20 member states, was evaluated and showed that across all countries and firm types, the 'general economic outlook' was identified as one of the top growth limiting factors between 2010 and 2013.

Concluding on the reasons for firm size and growth, many of them have been mentioned in this thesis. While some potential influencers were discussed in detail and supported by many empirical studies, like productivity and globalization, other topics like M&A and firms R&D investments were treated more briefly. Overall, it was the main aim of this work to identify potentially relevant influencers on firm size and growth, and these efforts resulted in the extensive summary table which linked independent variables (influencers/causes) with dependent variables (results/effects) (cf. Table 3.6). The mentioned table can first serve as a basis for an understanding and overview of already identified relationships. Even more important, it provides an overview of possible research questions to answer questions of causality and the strength of particular influencers. It can therefore be a starting point for future research on firm size and growth, which was already initiated by novel analysis of OECD and Eurostat data that have been performed in Chapter 4 of this thesis. It is the authors perception that many of the introduced studies provide powerful explanations on firm size and growth influencers; nevertheless, it was often not possibly to answer the question of causality with certainty. It seems to be hard to isolate specific influencers and clearly calculate their intensity of influence. While this would be a preferable outcome to make policy advices, the increased complexity of todays economic environment made it harder to achieve study results that stay true (i) for a long time period, (ii) for a large number of countries and (iii) a large number of sectors. Contrariwise, due to these conditions, studies often became more specialized and make statements only for specific circumstances (regions, industries, productivity levels, etc.). Therefore, todays policy advices have to consider the specific circumstances of our interconnected economy and try to take into account interdependencies which exist between countries and sectors. Often, only formalized mathematical models would allow to calculate accurate scenarios that reflect the complexity of various influencing and influenced economic entities. It will be the task of future researchers to isolate, quantify and formalize these influencers to still make reliable predictions on firm structure development in a globalized world.

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