# Entrepreneurs from Low-Skilled Immigrant Groups in Knowledge-intensive Industries – Company Characteristics, Survival and Innovative Performance

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**Non-technical summary**

Technology entrepreneurship is an important facilitator for the introduction of new products and for the diffusion of innovations throughout the economy. It is therefore an important contributor to long-term growth. For a country to reach its long-term growth potential, it is crucial that members of all population groups have the ability to participate in technology entrepreneurship. In that context, the present paper will take a comparative look at technology entrepreneurs with and without immigrant background. A specific focus is on start-up characteristics, company survival and innovative performance.

Immigrant groups whose levels of education have been historically lower than those of natives are significant components of the overall populations of many developed countries. This paper investigates how immigrants from the "recruitment countries" of south and southeast Europe contribute to technology entrepreneurship in Germany. Immigrants from the first and higher generations are considered. Immigrants from recruitment countries are the largest immigrant group in Germany, representing 7% of the population. They came to Germany to work in dependent employment in the industrial sector and had typically a low level of education at the point of arrival in Germany.

The present study uses company data from Creditreform, Germany's largest credit rating agency. The company information was matched with information on patent applications from the European Patent Office. The company owners were identified as immigrants from recruitment countries or natives on the basis of ethnic name-coding performed by the market research company Acxiom.

The results show that immigrant entrepreneurs are less than half as likely to found a company in a knowledge-intensive industry as native entrepreneurs. Compared to companies in exclusively native ownership, companies owned exclusively by immigrants have a smaller start-up size and their founders are younger when they start their company. Furthermore, these immigrant companies have a shorter survival span. Once detailed controls for the resources that are available to the company have been included, there is no difference in filing patent applications between these two company types. Partnering between immigrants and natives seems to pay off. Firms in mixed immigrant-native ownership are larger than or as large as firms owned exclusively by natives, and their survival rates in the manufacturing sector are comparable to those of companies owned exclusively by natives.

The lower participation of immigrant entrepreneurs in knowledge-intensive industries can be explained by lower education levels. In order for Germany to reach its full potential in the area of technological innovation, it is important that more immigrant entrepreneurs become active in knowledge-intensive industries. The most important implication for public policy is therefore the necessity to improve the education of second- and third-generation immigrants in Germany. The smaller size of firms exclusively in immigrant ownership calls for an investigation into whether immigrants face specific problems with regard to access to capital.

**Das Wichtigste in Kürze**

Technologieintensive Unternehmensgründungen spielen eine wichtige Rolle für die Einführung von neuen Produkten und für die Verbreitung von Innovationen in der gesamten Wirtschaft. Sie liefern damit einen wichtigen Beitrag für das langfristige Wachstum. Damit ein Land sein langfristiges Wachstumspotenzial erreichen kann, ist es entscheidend, dass die Mitglieder aller Bevölkerungsgruppen an technologieintensiven Unternehmensgründungen beteiligt sind. In diesem Zusammenhang gibt das vorliegende Papier einen vergleichenden Überblick zu technologieintensiven Unternehmensgründungen von Unternehmern mit und ohne Migrationshintergrund. Ein besonderer Schwerpunkt liegt auf Gründungseigenschaften, dem Überleben und der innovativen Leistung der Unternehmen.

In vielen entwickelten Ländern gibt es größere Immigrantengruppen, deren Bildungsniveau unter dem der einheimischen Bevölkerung liegt. Diese Studie untersucht, inwiefern Immigranten aus den „Anwerbeländern" Süd- und Südosteuropas zu technologieintensiven Unternehmensgründungen in Deutschland beitragen. Immigranten aus Anwerbeländern stellen mit 7% an der Gesamtbevölkerung die größte Zuwanderergruppe. Sie kamen nach Deutschland, um in einer abhängigen Beschäftigung in der Industrie zu arbeiten und hatten in der Regel ein relativ niedriges Bildungsniveau zum Zeitpunkt der Zuwanderung.

Diese Studie verwendet Unternehmensdaten von Creditreform, Deutschlands größter Ratingagentur. Diese Daten wurden mit Informationen über Patentanmeldungen von dem Europäischen Patentamt zusammengeführt. Aufgrund einer von dem Maktforschungsunternehmen Acxiom durchgeführten Namenskodierung nach ethnischer Herkunft können einheimische Unternehmer und Unternehmer mit Migrationshintergrund aus Anwerbeländern unterschieden werden.

Im Vergleich zu einheimischen Unternehmern haben Unternehmer mit Migrationshintergrund eine weniger als halb so hohe Wahrscheinlichkeit ein Unternehmen in einer wissensintensiven Branche zu gründen. Unternehmen, die ausschließlich von Unternehmern mit Migrationshintergrund geführt werden, sind bei Gründung kleiner als Unternehmen mit ausschließlich einheimischen Unternehmern. In der ersten Gruppe sind die Gründer zum Zeitpunkt der Gründung jünger und die Unternehmen weisen eine kürzere Überlebensdauer auf. Wird für die im Unternehmen zur Verfügung stehenden Ressourcen kontrolliert, gibt es in Bezug auf Patentanmeldungen keine Unterschiede zwischen beiden Gruppen. Die Zusammenarbeit von Unternehmern mit und ohne Migrationshintergrund scheint sich auszuzahlen. Unternehmen im gemeinsamen Besitz von Eigentümern mit und ohne Migrationshintergrund sind im Durchschnitt mindestens so groß wie Unternehmen ausschließlich im Besitz von einheimischen Eigentümern. Im verarbeitenden Gewerbe weisen beide Unternehmensgruppen vergleichbare Überlebenswahrscheinlichkeiten auf.

Die geringere Beteiligung von Unternehmern mit Migrationshintergrund in wissensintensiven Branchen kann mit geringeren Bildungsniveaus erklärt werden. Damit Deutschland sein volles Innovationspotenzial erreichen kann, ist es wichtig, dass mehr Unternehmer mit Migrationshintergrund in wissensintensiven Branchen gründen. Die wichtigste Implikation für die Politik besteht daher in der Notwendigkeit das Bildungsniveau der Immigranten in der zweiten und dritten Generation zu erhöhen. Die kleinere Gründungsgröße von Unternehmen, die ausschließlich im Besitz von Immigranten sind, wirft die Frage auf, ob Unternehmer mit Migrationshintergrund besondere Probleme beim Zugang zu Kapital haben.

# Entrepreneurs from Low-Skilled Immigrant Groups in Knowledge-intensive Industries – Company Characteristics, Survival and Innovative Performance

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## Abstract

This paper analyzes how companies of immigrant entrepreneurs in knowledge-intensive industries differ from companies of native entrepreneurs with respect to start-up characteristics, firm survival and innovative performance. I focus on immigrants from the "recruitment countries" of south and southeast Europe, who arrived in Germany mainly in the 1970s to fill labor shortages. They are the largest immigrant group in Germany and can be reliably identified via ethnic name coding. Immigrant entrepreneurs are less than half as likely to found a company in a knowledge-intensive industry as native entrepreneurs. Firms owned exclusively by immigrants tend to be smaller and have higher exit rates. After controlling for resources, I found no differences in patenting activity compared to firms owned exclusively by natives. Firms in mixed immigrant/native ownership have no size disadvantage. In that group, exit rates are higher in services but not in manufacturing, and, again, there are no differences in patenting when resources are taken into account. The lower participation of immigrant entrepreneurs in knowledge-intensive industries can be explained by lower education levels, while smaller firm sizes suggest more limited access to capital.

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# 1    Introduction

Technology entrepreneurship is an important facilitator for the introduction of new products and for the diffusion of innovations throughout the economy. It is therefore an important contributor to long-term growth. For a country to reach its long-term growth potential, it is crucial that members of all population groups have the ability to participate in technology entrepreneurship. In that context, the present paper will take a comparative look at technology entrepreneurs with and without immigrant background. A specific focus is on start-up characteristics, company survival and innovative performance.

Several studies analyze the contributions of immigrants to technology entrepreneurship in the US (see, for example, Saxenian, 1999). This literature typically focuses on immigrant groups with a high level of education, such as the Chinese and Indians. However, since immigrant groups whose levels of education have been historically lower than those of natives are significant components of the overall populations of many developed countries, it is important to study their contributions to innovation as well. For example, 12.5% of the US population over the age of 25 is of Hispanic origin. In this subpopulation the share with bachelor's degree is with 13% substantially lower than in the overall population (28%); for high school degrees the shares are 61% and 85%, respectively (U.S. Census Bureau, 2009, p. 3).

Germany is an appropriate country to study the participation of low-skilled immigrant groups in technology entrepreneurship. In order to fill labor shortages, Germany had a large influx of immigrants from the so-called recruitment countries of south and southeast Europe in the 1960s and 70s. These immigrants are a quite homogenous group. They came to Germany to work in dependent employment in the industrial sector and had typically a low level of education at the point of arrival in Germany. Immigrants from recruitment countries are the largest immigrant group in Germany, representing 7% of the population.

The present study uses information on German companies from the Centre for European Economic Research (ZEW), which is based on data from Creditreform, Germany's largest credit rating agency. The company information was matched with information on patent applications from the European Patent Office. The company owners were identified as immigrants from recruitment countries or natives on the basis of ethnic name-coding performed by the market research company Acxiom.

The results show that immigrant entrepreneurs are less than half as likely to found a company in a knowledge-intensive industry as native entrepreneurs. Compared to companies in exclusively native ownership, companies owned exclusively by immigrants have a smaller start-up size and their founders are younger when they start their company. Furthermore, these immigrant companies have a shorter survival span. Once detailed controls for the resources that are available to the company have been included, there is no difference in filing patent applications between these two company types. Partnering between immigrants and natives seems to pay off. Firms in mixed ownership are larger than or as large as firms owned exclusively by natives, and their survival rates in the manufacturing sector are comparable to those of companies owned exclusively by natives.

In order to develop an efficient economic policy, it is crucial to understand whether there are inefficiencies in the participation of immigrant groups in technology entrepreneurship that could be remedied. The lower participation of immigrant entrepreneurs in knowledge-intensive industries can be explained by lower education levels. Thus, the most important policy implication of this study is the necessity to improve the education of second- and third-generation immigrants in Germany. A good education is a prerequisite for participation in technology entrepreneurship. Smaller firm sizes of immigrants point to more limited access to capital. This calls for an investigation into whether immigrants face specific problems with regard to access to capital.

The paper is structured as follows: Section 2 describes the related literature and highlights the paper's contribution. Section 3 provides background information on immigrants in Germany. The data that this study draws on is described in Section 4. Section 5 presents the paper's findings on the characteristics and performance of firms owned by immigrants and natives. These results are discussed in Section 6, and the conclusions are presented in Section 7.

## 2 Related Literature

This paper is related to the literature exploring the contribution of immigrant entrepreneurs to the innovative performance of the host country. This topic has been analyzed mainly with relation to the US. One quarter of Silicon Valley companies that were started between 1980 and 1998 are headed by a CEO of either Chinese or Indian ethnic origin (Saxenian, 1999). It is likely that those CEOs have also founded the respective companies. With regard to the US as a whole, Wadhwa et al. (2007) found that at least one immigrant was a key founder in one quarter of engineering and technology companies started between 1995 and 2005. Hunt (2009) differentiates the immigrants' contribution to innovation on the basis of their visa status at entry into the US. She finds that immigrants with at least a bachelor's degree are more likely to found a company than natives with at least a bachelor's degree. Since many immigrants are highly qualified with a master's or doctoral degree, Hunt concludes that this "suggests a niche for immigrants in founding firms using specialized academic knowledge" (Hunt, 2009, p. 16). Hsu et al. (2007) also find higher new company formation rates for MIT alumni who are not U.S. citizens compared to U.S. citizens.

The contribution of immigrants to the innovative performance of the host country has also been investigated. Stephan and Levin (2001) find that a disproportional percentage of researchers who have made exceptional contributions to science and engineering projects conducted in the US are foreign-born or foreign-educated. In Silicon Valley, 32% of the scientists and engineers in the high-technology workforce are foreign-born (Saxenian, 1999).

Investigating the contribution of inventors of either Chinese or Indian ethnic origin to the overall patenting activity in the US, Kerr (2007) finds that these immigrant groups are more active than the average US population. In the case of Germany, Niebuhr (2010) finds that at the regional level there is a positive relationship between cultural diversity in the highly skilled workforce and R&D activity, measured as patents per capita.

More generally, this paper is also related to that section of the entrepreneurship literature which analyzes differences between native and immigrant entrepreneurs (see, for example, Waldinger et al., 1990). Such differences include, for example, the determinants of self-employment (Borooah and Hart, 1999), the share of self-employed individuals in different ethnic groups (Fairlie, 1999), company survival rates (Georgarakos and Tatsiramos, 2009), and the role of involvement in the ethnic community for business characteristics (Chaganti and Greene, 2002).

In contrast to the US, Germany has no tradition of an influx of highly skilled immigrants on a large scale. I am not aware of any study on the contribution of immigrants to the innovative performance of Germany, however there are studies on immigrant entrepreneurs. Leicht et al. (2005b) investigate the self-employment activity of immigrants from recruitment countries in Germany. For immigrants, the possibility of earning more than they would as employees is a more important motive for deciding to start a company than it is for natives. Self-employment could partly be an escape from the discrimination faced in paid employment. Constant et al. (2007) compare native Germans with immigrants. Both groups achieve very similar earnings in self employment, but interestingly, more years of education in Germany leads to a decrease in earnings for immigrants. This could indicate that highly qualified immigrants find that they have good options in paid employment. Constant and Zimmermann (2006) found that immigrants who feel discriminated against are more likely to opt for self-employment than natives, but earn less than self-employed natives. At a regional level, Audretsch et al. (2010)

find a positive relationship between the cultural diversity of employees and the start-up rate of technology-oriented firms.

This paper contributes to the literature by studying the participation in the innovative activity of the host country of an immigrant group that has on average a lower level of education than the native population. The paper adds to the literature by directly investigating the innovative output at the company level. It also departs from other studies in that it uses a cross-company dataset that covers an entire country and is not restricted to a specific region.

## 3   Background on Immigrant Populations in Germany

### 3.1   *History of Immigration to Germany*

In 1951 there were only 506,000 foreigners in Germany, i.e. 1% of the population (Bundesamt für Migration und Flüchtlinge, 2009, p. 339). In the following decades there were two distinct main immigration waves. Immigrants from "recruitment countries" constitute the first wave. Due to the labor shortages that became felt in the mid 1950s, bilateral recruitment agreements were signed with several countries including Italy (1955), Spain (1960), Greece (1960), Turkey (1961), Portugal (1964) and Yugoslavia (1968) (Bundesministerium des Innern, 2011). "Guest workers" (in German: "Gastarbeiter"), typically with a low level of formal qualifications, were attracted to Germany to work in the mass production of the manufacturing sector. In 1973 Germany had around 2.6 million "guest workers" (Bundesministerium des Innern, 2011). Originally, it was planned that the immigrants would return to their home countries after stays of one to two years. Therefore little effort was made to integrate them in the German society. This changed later, when it became clear that many would stay in Germany permanently. The second large migration wave started towards the end of the 1980s, when around 3 million ethnic Germans ("Aussiedler") from the Former

Soviet Union and from east European countries arrived between 1988 and 2004 (Leicht et al., 2005a, p. 16).[1]

## 3.2  Characteristics of Immigrant Populations

The household survey "Mikrozensus 2009" provides current information about the population of immigrant background in Germany. The survey is based on a 1% household sample and the provision of information is mandatory for the selected households. The group of persons of immigrant background comprises (a) all foreigners, whether born in Germany or not, (b) all persons who immigrated to the current area of the Federal Republic of Germany after 1949, and (c) all persons born in Germany as Germans, with at least one parent who immigrated to Germany or who was born in Germany but held a foreign nationality at birth. Here foreigners refers to persons without German nationality and Germans are persons with German nationality. Loosely speaking, the group of persons of immigrant background includes foreigners and immigrants of first or higher generation.

According to this definition, a large share of the population in Germany has an immigrant background. Out of the overall population of 81.9 million, 19%, or 15.7 million, have an immigrant background. The largest subgroup comprises immigrants from recruitment countries, who make up 34% of the population of immigrant background (5.3 million). The most important single country of origin is Turkey, from which 16% of the population of immigrant background originates. The other recruitment countries are former Yugoslavia (9%), Italy (5%), Greece (2%), Spain (1%), and Portugal (1%). The second largest immigrant subgroup comes from the Former Soviet Union and east European countries. This group makes up 30% of all immigrants in Germany (4.7 million). Here, the Former Soviet Union is

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[1] For further details on the history of German migration see, e.g., Chapter 2 in Zimmermann et al. (2007).

the single most important country of origin, accounting for 16% of all immigrants in Germany.[2]

There are several important differences between the population of immigrants from recruitment countries and the native population. Table 1, which is also based on information drawn from the Mikrozensus 2009, highlights the principal differences. First, immigrants from recruitment countries are on average younger. Whereas 48% of the native German population are under 45 years old, this share is 68% in this immigrant subgroup. The differences are even greater in the age group of up to 19 years, from which potential entrepreneurs are most likely to stem. Only 16% of natives belong to this age group, compared to 24% in the subgroup of immigrants from recruitment countries.

--- Table 1 about here ---

The education levels of the native population and of immigrants from recruitment countries also differ significantly. Overall, the native population is better educated, as 20% have a high-school degree (i.e. a degree which allows them to study at a university), compared to only 11% of this particular immigrant subgroup. Similarly, 9% of the native population, but only 4% of the immigrant population, have a university degree. Differentiating immigrants from recruitment countries according to country of origin reveals a high degree of homogeneity with respect to education. The only exception is the Greek population whose share of high-school degree holders is similar to that of the native population, while the share of university degree holders is only 1.4 percentage points below that of natives.

The unemployment rate among immigrants as a whole and per country of origin is much higher than among natives. In fact, the unemployment rate in the overall immigrant population is more than double than in the native population. When it comes to the likelihood

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[2] Information taken from Statistisches Bundesamt, (2010) and from additional calculations from the Statistisches Bundesamt [Federal Statistical Office of Germany] based on data from the Mikrozensus 2009.

of founding a company, the immigrant group from recruitment countries is not homogeneous. Whereas Italians and Greeks are more likely than the native population to found a company, this propensity is lower among immigrants from Turkey and former Yugoslavia. The legal framework for founding a company in Germany is the same for all immigrant groups. Since 1991, when the law concerning foreigners was revised, every person who has the right to temporary or permanent residence in Germany has the right to found a company (Leicht et al., 2006, p. 23). Consequently, concerning the recruitment countries, there is no difference between Turkey, which is not a member of the European Union, and the remaining countries, which belong to the European Union.

Unlike immigrants from recruitment countries, immigrants from the Former Soviet Union and east Europe have a level of education comparable to that of the native population. Nevertheless, the unemployment rate of this subgroup is higher than that of natives (Statistisches Bundesamt, 2010).

## 4 Data

### 4.1 Data Source

The present analysis is based on company data from ZEW. The original company data has been provided by Creditreform, Germany's largest credit rating agency. The analysis is restricted to companies in knowledge-intensive industries, where most innovative activity takes place. Table A1 in the Appendix provides a list of the industries covered here. The company data includes basic information such as number of employees, year of founding and legal form, as well as the names of the owners. The ZEW data includes almost all companies founded in Germany in 1998 or later. This start-up year serves as a cut-off point for the analysis on company survival. In the analysis of patenting I have also included companies started in 1990 or later, to increase the number of immigrant companies with patents. For

start-up years 1990 to 1997 the data covers only a smaller share of start-ups in Germany. Unfortunately it is not entirely clear according to which criteria companies with start-up years between 1990 and 1997 were included in the dataset, but there is an overrepresentation of companies from East Germany. The dataset comprises annual observations up to and including 2007.

In order to capture only "de novo" firms, the sample was restricted to companies with a start-up size of up to 50 employees and at least one natural person as an owner. An additional restriction was that at least one natural person should be an owner throughout each company's history. These restrictions aimed to ensure that new firms that were merely the result of reorganizations of existing firms were excluded from the analysis, and to make the classification into companies in immigrant versus non-immigrant ownership possible. The company data was matched with information on patent applications from the European Patent Office. Each match was manually checked.

### 4.2  Name Coding

In the ZEW database, the migration background of owners is identified according to their first and last names. The owners' ethnic background was coded by the German subsidiary of the global market research company Acxiom (www.acxiom.com) on the basis of a name list normally used to identify the ethnic background of potential customers. Initially entrepreneurs are allocated to an ethnic class according to their last name. Subsequently the results are refined and entrepreneurs may be reclassified if the combination of first and last name suggests a different ethnic origin. The data provider reports that the accuracy of identifying ethnic background lies between 90 and 95%. Nevertheless, it was not possible to code all combinations of first and last names, because of e.g. typos or because certain names had not been included in the Acxiom database. It was, however, possible to classify the ethnic identity

of 94% of company owners. Immigrants are probably slightly overrepresented in the group of unidentified owners.

The name coding system differentiates between the following areas of origin: Turkey, former Yugoslavia, Italy, Greece, and Spain/Portugal/Latin America. These origins make up the recruitment countries. It is not possible to differentiate among owners from Spain, Portugal or Latin America on the basis of name and surname, since the names in all three regions are similar. For the purpose of this study this poses no problem, since few persons from Latin America actually live in Germany. Table A2 in the Appendix gives examples of names typical of each ethnic group according to country of origin.

Although it would be interesting to analyze the second largest immigrant group in Germany, which comprises immigrants from the Former Soviet Union and east Europe, it was not possible to do so using the ZEW database: members of that subgroup are often ethnic Germans, with typical German first or last names, so identification of ethnic origin on that basis is less reliable. To analyze this particular subgroup it would be necessary to conduct a survey that requested explicit information on immigration background.

Name coding has advantages as well as limitations. A big advantage is that name coding can be applied to large-scale datasets, whereas in tailor-made surveys that collect information specifically on migration background sample sizes are often limited. In the case of Germany, the Mikrozensus, which surveyed 1% of the population, does include questions on migration background, however it has only very limited information on businesses. There is another large-scale household survey in Germany, the Socio-Economic Panel (SOEP), however, this includes only information on nationality and, like the Mikrozensus, offers only limited information on businesses.

A further advantage of name coding is that it identifies ethnic origin and is thus not restricted to nationality. This is especially useful in the case of people who acquire German citizenship but may still be perceived as immigrants. The main disadvantage of name coding is the probabilistic nature of the results. This means that there is no certainty that a specific owner has been correctly classified. Nevertheless, name coding has been used in previous studies; for example, Kerr (2008) identified US inventors according to their Chinese or Indian origin. In the present study, given the large number of observations, I am confident that the data provides a correct representation of the different groups.

### 4.3  Descriptive Statistics

Table 2 presents the descriptive statistics for the datasets of start-ups founded in 1998 and thereafter, and in 1990 and thereafter. In the sample of start-ups since 1998 the dataset includes 573,180 observations with information on 133,384 firms. For start-ups since 1990 there are 1,360,367 observations for 222,171 firms. Since values are quite similar for both datasets, the description is limited to start-ups since 1998. All observations of the dataset with start-ups since 1998 are also included in the dataset with start-ups since 1990.

Observations for companies in exclusively immigrant ownership make up 2.9% of all company–year observations. In these companies every owner is an immigrant from a recruitment country.[3] Companies in mixed immigrant and native ownership represent 1.6% of all observations. The category 'immigrant participation in ownership' comprises observations with exclusively immigrant ownership as well as with mixed immigrant and native ownership and comprises 4.5% of all observations. In absolute numbers, 4,418 companies in the sample were owned only by immigrants at start-up, 2,127 companies were in joint immigrant and non-immigrant ownership, and 133,384 companies were owned by natives. Determining the

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[3] For simplification purposes, in the rest of the paper I'll refer to immigrant entrepreneurs from recruitment countries as "immigrant entrepreneurs," unless otherwise stated. Also as a simplification, the term "immigrant" may refer to an immigrant of the first or of a higher generation.

category of ownership is time variant, but the variable displays a high degree of persistence because ownership changes are not that common.

Figure 1 shows an upward trend for the share of companies with immigrant participation in ownership at the time of start-up. In the ten-year period from 1998 to 2007 the share of companies in this ownership category increased from 3.6% to 5.6%.[4] This upward trend is an encouraging sign of better integration of immigrants into the economic activity of Germany, the host country.

The majority of companies are of small size, with 3.2 employees on average.[5] The company–year observations that concern companies with at least one patent application come to 0.9% while the observations concerning companies with financing from at least one venture capitalist (VC) come to 0.3%. In 4.4% of the observations at least one owner holds an academic title ("Dr." or "Professor"). It is possible that this variable is an underrepresentation of the qualifications of immigrant entrepreneurs. If a doctorate has been obtained abroad it may not be recognized in Germany and the German habit of attaching academic titles to a name is not universal, so it is possible that the original data collector, Creditreform, will not be aware of recognized titles. In 35% of the observations firms have at least two owners and in 7.2% of the observations there is a corporate investor, meaning that at least one other firm holds an ownership stake. In the sample of start-ups since 1990 firms are on average larger, because they have had more time to grow.

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[4] Data from the Mikrozensus 2009 allows a very crude plausibility check for the name coding method. In knowledge-intensive industries there are 10,000 self-employed immigrants from recruitment countries (5% of a total of 216,000 self-employed immigrants from recruitment countries), compared to 478,000 self-employed native Germans (14% of a total of 3,537,000 self-employed native Germans). Therefore, entrepreneurs of immigrant background represent 2.1% of all entrepreneurs in knowledge-intensive industries. The share of firms with immigrant participation in ownership in the ZEW data that was identified on the basis of name coding is 4.5%. The latter value is likely to be higher, because the share of immigrant participation is increasing over time and the ZEW data contains not the overall population of companies, but only start-ups.

[5] The number of employees includes owners who are actively involved in the management of the company. In companies with unlimited liability this is the case for all owners. The owners of a private limited liability company (GmbH) may be actively involved or not involved at all in the company management. In such companies, only owners actively involved in the company management are counted as employees.

--- Table 2 about here ---

## 5 Start-up Characteristics and Performance of Immigrant Companies

### 5.1 Sector Distribution

To gain an overview of the broad sectoral distribution of companies founded by native Germans and by immigrants from recruitment countries (see Table 3), this study draws on Mikrozensus data from 2005. The main dataset cannot be used for this analysis, because it only includes companies from knowledge-intensive industries. Whereas 14% of native entrepreneurs are active in such industries, the share of immigrant entrepreneurs is only 5%. The latter group's lower participation rate is observed both in knowledge-intensive manufacturing and in knowledge-intensive services. Entrepreneurs of migration background are overrepresented in non-knowledge-intensive industries, such as restaurants and trade. These sectors do not require a tertiary education and are characterized by relatively low initial investments.

--- Table 3 about here ---

### 5.2 Availability of Resources

Table 4 compares the availability of resources for different ownership categories. Columns 1 to 3 show that firms in mixed immigrant–native ownership have the highest amount of resources, followed by firms in exclusively native ownership, while firms in exclusively immigrant ownership have the smallest amount of resources. These differences are partly due to the relationship between ownership category and number of individuals as owners. Firms in mixed ownership are larger because, by definition, they have at least two owners, whereas most firms (65%) have only one owner. The only case where resources are not statistically different is for the number of employees at start-up in the manufacturing sector for the comparison between firms in native ownership and firms in mixed ownership.

Columns 4 and 5 compare resources for companies that belong to either a single native or a single immigrant owner. The amount of the following resources is significantly lower for firms in immigrant ownership: number of employees at start-up (all sectors together, manufacturing), number of employees (all sectors together, manufacturing, services), average owner age at start-up, academic title, patent application, and corporate investor. There is no difference with respect to the number of employees at the time of starting up in services. In the services sector, capital requirements are lower and firms tend to be generally smaller than in manufacturing. The smaller start-up size of companies that have a single immigrant owner in manufacturing may therefore reflect less access to financial resources, be it personal savings or bank loans. There is also no difference in VC financing, possibly because the majority (78%) of VC-financed firms have more than one owner.

Columns 6 to 8 compare firms owned by at least two individuals in order not to give the mixed ownership category a size advantage. Firms with only immigrant ownership have significantly lower resource endowments in almost the same categories as with restriction to one owner.[6] In contrast, a higher amount of resources is available to companies in mixed ownership than to companies in exclusively native ownership. Thus, heterogeneous owners may be advantageous for the companies in question.

The average age of the owner(s) at start-up is lower for firms in immigrant ownership and in mixed ownership. It is not influenced by the number of owners a firm has. Age can be taken as a crude proxy for the sum of education and work experience. As the difference in average age between companies in native ownership and companies in immigrant ownership ranges from three to five years, immigrant entrepreneurs are likely to have substantially less experience in other dependent or independent work when they found their companies. Having

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[6] For companies in exclusively immigrant ownership there are only 50 observations available for the number of employees at start-up in the manufacturing sector This could explain the insignificant difference in comparison to companies in exclusively native ownership in a situation where the difference in absolute magnitude is almost one employee. For all other entries the number of observations is at least 185.

said that, the age difference may reflect different start-up strategies or the overall younger age structure of the population of immigrant background. The following two subsections investigate the potential negative consequences of lower resource endowments and less work experience on company survival and patenting activity.

--- Table 4 about here ---

## 5.3   Company Survival

This subsection examines whether there are differences between immigrant and native companies with respect to survival. The dataset includes exact closing dates for forced closures (bankruptcies). In the case of voluntary closures, approximate dates are used wherever an exact closing date is not available. If the information that Creditreform holds on a particular company is not updated within a period of five years, it is assumed that the company was closed one year after the last update. With regard to company takeovers, it is not clear a priori whether they should be regarded as cases of closure or survival. For the purposes of this paper, takeovers are treated as survival, since the company continues to exist although under different ownership. It should be noted that the results are almost identical when takeovers are regarded as closures, because takeovers constitute only 2.2% of all closures. Of the 22,546 exits in the sample, 964 relate to firms in exclusively immigrant ownership at the time of exit, and 432 relate to firms in mixed immigrant–native ownership at the time of exit.[7]

Table 5 presents the results of Cox regressions. The first results represent a parsimonious specification with only one dummy for limited liability and location in East Germany as controls. Companies with immigrant participation in ownership have with 1.46 a higher hazard rate of exit than native firms (column 1). The same is true when this category is broken

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[7] I would like to thank my former colleague from ZEW, Sandra Gottschalk, for making the exit variable available to me.

down into companies in exclusively immigrant ownership and companies in mixed immigrant–native ownership with hazard ratios of 1.56 and 1.27 respectively (column 2). The hazard ratios are marginally lower when detailed controls for availability of resources are included (columns 3 and 4). In view of this, the higher exit rates of start-ups with any type of immigrant participation cannot be explained as a result of lower resource availability.

Firms survive over a longer period if they are larger, their owners are older and if at least one owner holds an academic title. 'Owner age' is used in a quadratic form to allow for a higher exit probability when owners near retirement age. The hazard of exit is higher for companies with VC financing, which is plausible, since venture capital is a financing source for start-ups with high risk and high expected return. The hazard of exit is also higher for companies owned by at least two persons or at least one other company. In addition to controlling for available resources, using the dummy for at least two owners makes it possible to differentiate the influence of immigrant ownership from that of size alone.

--- Table 5 about here ---

Table 6 explores differences between the knowledge-intensive industries in the manufacturing and services sectors, including full controls for resources. The results for services are very similar to the overall result, most likely because the observations relating to services dominate the dataset. Interestingly, the exit rate in manufacturing is higher for firms in exclusively immigrant ownership but not for firms in mixed immigrant–native ownership. In this sector, partnering with natives seems to pay off: Beckman et al. (2007) for example, have shown that teams which combine heterogeneous perspectives can achieve superior performance. In this case, heterogeneous teams achieve the same performance as teams made up only by natives.[8]

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[8] The proportionality assumption for all Cox models was tested on the basis of Schoenfeld residuals. The local test was almost always passed for the dummies that indicate the ownership category. The global test was only passed for manufacturing, which could be due to the very high number of observations in the other specifications.

--- Table 6 about here ---

The higher exit rate of immigrant firms may be an indication of different start-up strategies. Immigrants start firms at a younger age, i.e. with less experience. One reason is that they may be more willing to found a company at a young age, because this gives them more time to establish themselves in paid employment should the venture fail. However, as in the present study it was not possible to control for all company resources, there might be other explanations for the higher exit rates of immigrant firms; for example, lower capital intensities or more limited access to financial resources.

The higher exit rate could also be partly explained by the higher unemployment rate among immigrants from recruitment countries. Unemployment or the threat of unemployment can be a powerful push-factor for starting a company. However, companies that start under pressure may be less stable. Leicht et al. (2005b) found that among immigrant entrepreneurs from Turkey escaping unemployment is a slightly more important motive for starting a company than it is for natives.

Immigrants do not close successful companies in order to return to their countries of origin. The credit ratings at the time of exit suggest that, on average, the ratings of immigrant companies are not better than those of companies in native ownership.

### 5.4  Innovative Performance

The innovative performance of companies is approximated by patent applications to the European Patent Office (EPO). Unfortunately, there is no information on R&D expenditure, which would also be an interesting measure of innovative performance. The category of ownership tends to be very time-persistent: in the present data, only 0.7% or 1,477 companies changed ownership category after starting up, therefore I chose not to use panel estimators.

Standard errors have been adjusted for within-firm correlation across time and for heteroscedasticity.

Table 7 shows the results of probit regressions for the probability of having filed at least one patent application with the EPO. The sample comprises 2,061 companies that have filed patent applications. Twenty-six of the companies in exclusively immigrant ownership and 64 of the companies in mixed immigrant–native ownership have filed for patents. When only basic control variables are used (column 1), there is no difference between start-ups with immigrant participation in ownership and start-ups in purely native ownership. Differentiating between the two immigrant ownership categories reveals a significant negative effect for start-ups in exclusively immigrant ownership and a significant positive effect for start-ups in mixed immigrant–native ownership (column 2). This, however, reflects the availability of resources: once company resources have been controlled for, the differences between the two ownership categories disappear (columns 3 and 4). All resource variables have a positive and at least at the 10% level significant influence on the probability of patenting. Here owner age is included in a logarithmic form because the experience of higher age should increase the patenting probability without a reversal of sign. It is plausible that the negative effect observed in companies in exclusively immigrant ownership vanishes once resources are controlled for, because the resource endowments for companies of this type are lower in all cases.

To gain a better understanding of the participation of natives and immigrants in innovative activity in Germany, it is useful to compare the relative importance of sector selection and the probability of patent application. Concerning sector selection, Table 2 shows that immigrant entrepreneurs are less than half as likely as natives to found a company in a knowledge-intensive industry. Differences in the probability of patent applications can be inferred from the marginal effect observed for firms owned exclusively by immigrants (column 2 of Table

7). The marginal effect of -0.002 implies a 0.2 percentage points smaller probability of applying for a patent for this type of firm. Compared to the raw probability in the company–year observations of the dataset of 1%, this represents a 20% reduction. The calculation shows that the comparatively greater hurdle for immigrants seems to lie in sector selection. Once a company has been founded in a knowledge-intensive industry, the differences between companies owned exclusively by immigrants and those owned exclusively by natives are more limited.

--- Table 7 about here ---

Table 8 investigates the correlation between ownership category and size of the patent application stock. Negative binomial regressions are used for the analysis. In the specifications without controls for company resources (columns 1 and 2), firms of exclusively immigrant ownership show a significantly smaller application stock. Once controls for resources are employed (columns 3 and 4), this difference disappears. It can therefore be concluded that, once resource endowment has been taken into account, innovative performance, as measured in the form of number of patent applications, is not lower for firms in purely immigrant ownership than for firms in other ownership categories. This result is to be expected because patent applications, as an output measure of innovation, depend mainly on the input factors used. In addition, we do not find a positive influence of the ethnic diversity of mixed immigrant-native ownership on innovation. This is in line with Østergaard et al. (2011) who did not find a significant relationship between the ethnic diversity of employees and the probability of introducing an innovation for Danish firms. Also, Hart and Acs (2011) who investigate high-growth companies in the US high-tech sector did not find differences in technological performance for immigrant- and native-founded companies.

--- Table 8 about here ---

## 6 Discussion

The lower education level of immigrants from recruitment countries accounts to a significant extent for the finding that immigrant entrepreneurs are half as likely to found a company in knowledge-intensive industries. In a recent report, the OECD (2010a, p. 7) highlights the importance of education for innovation: "High-level skills are critical for innovation and, as such, are key to economic growth and social development." Ensuring that the population with immigrant background has access to better education is probably the most important means of increasing the participation of immigrant entrepreneurs in knowledge-intensive industries.

According to a calculation by the National Statistical Office, based on data from the 2009 Mikrozensus, 38% of immigrants from recruitment countries are second generation or higher. Although these people have been educated in Germany, their educational achievements are below the achievements of the native population. With the exception of female Greek students, second-generation immigrants from recruitment countries leave full-time education earlier than the natives (Algan et al., 2009).[9] An evaluation of student performance that was conducted by the OECD in Germany and was not restricted to immigrants from recruitment countries (PISA study) found that students of both first- and second-generation immigrant background are more than one year of schooling behind native students in reading performance, measured at the age of 15 (OECD, 2010b, p. 30). In the future, it will be necessary to invest resources into means of increasing the educational attainment of immigrants.

Furman et al. (2002, p. 899) define the concept of "national innovative capacity" as "the ability of a country to produce and commercialize a flow of innovative technology over the long run." An important determinant of the national innovative capacity is the available R&D

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[9] This study provides information on students from Turkey, former Yugoslavia, Italy and Greece, but there is no separate information available for students from Spain and Portugal.

manpower. If Germany wants to benefit from its full potential innovative capacity, it should not neglect the population of immigrant background as contributors to innovation. This is especially important considering that the workforce in Germany is expected to shrink in the future and the age distribution of immigrants from recruitment countries is more favorable than that of the native population in that respect.

Lack of access to capital can constitute a severe problem for immigrant entrepreneurs. The results of this study show that the probability of patenting would increase if firms in immigrant ownership had the same resources as firms in native ownership. Thus, if firms in immigrant ownership were better endowed with resources, ultimately this would help increase the innovative capacity of Germany as a whole. The ability of immigrant entrepreneurs to raise capital in order to finance their companies is probably more limited than that of natives for two reasons: the first generation typically found low-paid jobs when they arrived in Germany, therefore immigrant parents are likely to have relatively limited means to support their children. Also, immigrants from recruitment countries have on average more children than natives (Statistisches Bundesamt, 2010), which means that within a family the potential financial support per child is proportionally smaller. Since size is an important determinant for firm survival and patenting, it would be of great interest to establish whether immigrants face specific problems with regard to access to capital. In the US, for example, Blanchflower et al. (2003) found that companies owned by black entrepreneurs are more likely to be refused credit than can be explained by their economic situation alone.

## 7 Conclusion

The results of this paper show that immigrant entrepreneurs from recruitment countries are less than half as likely to start a firm in knowledge-intensive industries as native entrepreneurs. Companies in exclusively immigrant ownership have on average a smaller start-up size and also rely on lower amounts of resources such as experience, as measured by

the age of their owner(s), support by venture capitalists, or academic qualifications of the owners. However, there are no differences between immigrants and natives in the probability of filing a patent application and in the size of the patent application stock, when available resources are controlled for.

Two main implications for public policy can be derived from the present results. First, in order for Germany to reach its full innovative potential, it is important that the education of second- or higher-generation immigrant populations is improved. This applies to the education offered both at school and at university level. A good education is a prerequisite for an entrepreneur's participation in knowledge-intensive industries. Second, it would be useful to test whether access to capital poses specific problems to immigrants that cannot be explained solely on the basis of individual economic circumstances. If this is the case, policy-makers will need to respond with appropriate measures.

A limitation of this study is that, besides patent applications, for the time being there are no quantifiable alternative or additional ways of measuring innovative activity. For example, it would be useful to take R&D expenditures into account. A worthwhile subject of future research would be the specific challenges that immigrant entrepreneurs face. This could be investigated with the help of tailor-made surveys focusing on access to capital, familiarity with German and European institutions, degree of fluency in the German language, years of education in Germany, field of study in bachelor and master degrees, and any experiences of discrimination. It would also be of interest to investigate which push and pull factors lead to the decision to found a firm.

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## Tables and Figures

**Table 1: Population Characteristics (2009)**

|  | **Native Germans** | **Immigrants from recruitment countries** |
|---|---|---|
| Age group |  |  |
| • 0 – 9 years | 7.0% | 8.1% |
| • 10 – 19 years | 9.2% | 16.0% |
| • 20 – 44 years | 31.4% | 43.4% |
| • 45 – 64 years | 28.7% | 24.5% |
| • 65 + years | 30.6% | 16.1% |
| School education |  |  |
| • No school degree | 1.9% | 24.6% |
| • High school degree ("Abitur") | 19.5% | 11.1% |
| Professional qualification |  |  |
| • No qualification | 19.4% | 58.6% |
| • University degree | 8.8% | 3.8% |
| Labor market participation |  |  |
| • Unemployment rate | 6.5% | 14.7% |
| Entrepreneurial activity |  |  |
| • Propensity to found a company | 10.4% | 7.9% |

Note: recruitment countries include Turkey, former Yugoslavia, Italy and Greece. Information on Spain and Portugal is not available. "School education" and "professional qualification" are calculated for the population with completed education phase. "Propensity to found a company" is number of self-employed divided by labor force of the specific population group.

Source: Statistisches Bundesamt (2010) reporting results from Mikrozensus 2009.

**Table 2: Descriptive Statistics on Firms**

| Variable | Firms with year of start-up since 1998 | | Firms with year of start-up since 1990 | |
|---|---|---|---|---|
| | Mean | St. Dev. | Mean | St. Dev. |
| Only immigrant ownership (0/1) | 0.029 | 0.168 | 0.022 | 0.147 |
| Mixed immigrant–native ownership (0/1) | 0.016 | 0.125 | 0.013 | 0.112 |
| Immigrant participation in ownership (0/1) | 0.045 | 0.207 | 0.035 | 0.183 |
| Number of employees | 3.16 | 7.19 | 4.15 | 8.89 |
| Owner age (in years) | 40.37 | 9.56 | 40.83 | 9.36 |
| Company age (in years) | 4.58 | 2.23 | 6.67 | 3.68 |
| Patent application (0/1) | 0.0086 | 0.092 | 0.0096 | 0.098 |
| Application stock [#] | 2.39 | 3.13 | 2.22 | 3.18 |
| VC financed (0/1) | 0.0033 | 0.057 | 0.0022 | 0.047 |
| Academic title (0/1) | 0.044 | 0.205 | 0.047 | 0.212 |
| $\geq 2$ owners (0/1) | 0.353 | 0.478 | 0.363 | 0.481 |
| Corporate investors (0/1) | 0.072 | 0.258 | 0.058 | 0.234 |
| Limited liability (0/1) | 0.450 | 0.498 | 0.444 | 0.497 |
| East Germany (0/1) | 0.180 | 0.384 | 0.272 | 0.445 |
| Number of observations | 573,180 | | 1,360,367 | |
| Number of firms | 133,384 | | 222,171 | |

[#] Calculated for observations with at least one patent.

Note: Based on ZEW data.

**Table 3: Industry Distribution According to Ethnic Background of Entrepreneur (2009)**

| Ethnic background of entrepreneur | Native German | Immigrant from recruitment countries |
|---|---|---|
| Knowledge-intensive industries | 14% | 5% |
| • Knowledge-intensive manufacturing | 2% | 1%[#] |
| • Knowledge-intensive services | 12% | 4% |
| Remaining industries | 86% | 95% |

[#] Calculation by author. Value not directly reported by the Statistical Office, because a limited number of observations cause a relatively high sampling error.

Note: The unit of observation is an individual entrepreneur, not a company. Recruitment countries include Turkey, former Yugoslavia, Italy, Greece, Spain and Portugal.

Source: Special analysis by the German National Statistical Office based on Mikrozensus 2009.

**Table 4: Mean Values of Available Resources**

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Number of owners | | unrestricted | | | one | | ≥ two | |
| Ownership category | native | only immig. | mix | native | only immig. | native | only immig. | mix |
| Number of employees at start-up, all sectors | 2.21 | 1.71*** [0.00] | 3.19*** [0.00] | 1.70 | 1.61* [0.10] | 3.23 | 2.54*** [0.00] | 3.19 [0.74] |
| Number of employees at start-up, manufacturing | 3.55 | 2.50*** [0.01] | 3.65 [0.85] | 3.07 | 2.34* [0.10] | 4.28 | 3.32 [0.36] | 3.65 [0.26] |
| Number of employees at start-up, services | 2.09 | 1.65*** [0.00] | 3.15*** [0.00] | 1.59 | 1.56 [0.49] | 3.12 | 2.45*** [0.01] | 3.15 [0.79] |
| Number of employees, all sectors | 3.16 | 2.12*** [0.00] | 5.23*** [0.00] | 2.29 | 1.97*** [0.00] | 4.78 | 3.30*** [0.00] | 5.22*** [0.00] |
| Number of employees, manufacturing | 5.44 | 3.17*** [0.00] | 6.16* [0.08] | 4.49 | 2.99*** [0.00] | 6.83 | 4.17*** [0.00] | 6.16 [0.16] |
| Number of employees, services | 2.95 | 2.04*** [0.00] | 5.13*** [0.00] | 2.10 | 1.90*** [0.00] | 4.55 | 3.20*** [0.00] | 5.14*** [0.00] |
| VC financed (in %) | 0.32 | 0.12*** [0.00] | 1.17*** [0.00] | 0.11 | 0.07 [0.17] | 0.71 | 0.48 [0.24] | 1.17*** [0.00] |
| Academic title (in %) | 4.47 | 1.69*** [0.00] | 6.26*** [0.00] | 3.35 | 1.48*** [0.00] | 6.54 | 3.30*** [0.00] | 6.26 [0.29] |
| Corporate investor (in %) | 7.23 | 11.8*** [0.00] | 2.96*** [0.00] | 5.20 | 2.79*** [0.00] | 11.0 | 11.8*** [0.00] | 4.31** [0.02] |
| Patent application (in %) | 0.87 | 0.38*** [0.00] | 1.40*** [0.00] | 0.52 | 0.28*** [0.00] | 1.51 | 1.17 [0.23] | 1.40 [0.39] |
| Owner age (in years) | 40.7 | 35.6*** [0.00] | 38.0*** [0.00] | 40.5 | 35.5*** [0.00] | 41.2 | 36.8*** [0.00] | 38.0*** [0.00] |

* significant at 10%, ** significant at 5%, *** significant at 1%

Note: Based on ZEW data on start-ups since 1998. The p-values for comparisons of means are in brackets. Column 1 is compared to columns 2 and 3, column 4 is compared to column 5, and column 6 is compared to columns 7 and 8.

**Table 5: Cox Regressions for Company Exit**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent variable | Hazard of exit | Hazard of exit | Hazard of exit | Hazard of exit |
| Immigrant participation in ownership (0/1) | 1.46*** (0.04) | | 1.40*** (0.04) | |
| Only immigrant ownership (0/1) | | 1.56*** (0.05) | | 1.47*** (0.05) |
| Mixed immigrant–native ownership (0/1) | | 1.27*** (0.06) | | 1.26*** (0.06) |
| Ln(employees) | | | 0.86*** (0.01) | 0.86*** (0.01) |
| Owner age | | | 0.91*** (0.004) | 0.91*** (0.004) |
| Owner age squared | | | 1.001*** (0.000) | 1.001*** (0.000) |
| VC financed (0/1) | | | 2.34*** (0.19) | 2.34*** (0.19) |
| Academic title (0/1) | | | 0.78*** (0.03) | 0.78*** (0.03) |
| ≥ 2 owners (0/1) | | | 1.09*** (0.02) | 1.10*** (0.02) |
| Corporate investor (0/1) | | | 1.14*** (0.03) | 1.14*** (0.03) |
| Limited Liability (0/1) | 0.88*** (0.1) | 0.89*** (0.01) | 0.95*** (0.02) | 0.95*** (0.02) |
| East Germany (0/1) | 1.15*** (0.02) | 1.16*** (0.02) | 1.17*** (0.02) | 1.17*** (0.02) |
| Observations | 573,180 | 573,180 | 573,180 | 573,180 |
| Firms | 133,384 | 133,384 | 133,384 | 133,384 |
| Log likelihood | -250,816 | -250,810 | -250,345 | -250,341 |
| *Knowledge-intensive industries included* | *All* | *All* | *All* | *All* |

\* significant at 10%, ** significant at 5%, *** significant at 1%

Note: Based on ZEW data with start-ups since 1998. The failure event is exit of the firm. Hazard ratios are shown. All regressions contain industry dummies at the 2-digit SIC level, as well as dummies for the start-up periods 1998–2000, 2001–2003 and 2004–2007. Standard errors are shown in brackets.

**Table 6: Cox Regressions for Company Exit**

|  | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent variable | Hazard of exit | Hazard of exit | Hazard of exit | Hazard of exit |
| Immigrant participation in ownership (0/1) | 1.40*** (0.16) |  | 1.40*** (0.04) |  |
| Only immigrant ownership (0/1) |  | 1.68*** (0.22) |  | 1.46*** (0.05) |
| Mixed immigrant–native ownership (0/1) |  | 0.99 (0.20) |  | 1.28*** (0.07) |
| Ln(employees) | 0.85*** (0.02) | 0.85*** (0.02) | 0.86*** (0.01) | 0.86*** (0.01) |
| Owner age | 0.95*** (0.02) | 0.95*** (0.02) | 0.91*** (0.004) | 0.91*** (0.004) |
| Owner age squared | 1.001*** (0.000) | 1.001*** (0.000) | 1.001*** (0.000) | 1.001*** (0.000) |
| VC financed (0/1) | 2.16*** (0.44) | 2.20*** (0.45) | 2.37*** (0.20) | 2.37*** (0.21) |
| Academic title (0/1) | 0.92 (0.11) | 0.93 (0.11) | 0.77*** (0.03) | 0.77*** (0.03) |
| ≥ 2 owners (0/1) | 1.17*** (0.07) | 1.19*** (0.07) | 1.08*** (0.02) | 1.09*** (0.02) |
| Corporate investor (0/1) | 1.02 (0.08) | 1.02 (0.08) | 1.15*** (0.04) | 1.15*** (0.04) |
| Limited liability (0/1) | 1.09 (0.07) | 1.09 (0.07) | 0.94*** (0.02) | 0.94*** (0.02) |
| East Germany (0/1) | 1.35*** (0.08) | 1.35*** (0.08) | 1.15*** (0.02) | 1.15*** (0.02) |
| Observations | 49,475 | 49,475 | 523,705 | 523,705 |
| Firms | 11,585 | 11,585 | 123,703 | 123,703 |
| Log likelihood | -14,055 | -14,053 | -230,412 | -230,410 |
| *Knowledge-intensive industries included* | *Manuf.* | *Manuf.* | *Services* | *Services* |

* significant at 10%, ** significant at 5%, *** significant at 1%

Note: Based on ZEW data on start-ups since 1998. The failure event is exit of the firm. Hazard ratios shown. All regressions contain industry dummies at the 2-digit SIC level as well as dummies for the start-up periods 1998–2000, 2001–2003 and 2004–2007. Standard errors are shown in brackets.

**Table 7: Probit Regressions for Decision to File a Patent Application**

| Dependent variable | (1) Patent application (0/1) | (2) Patent application (0/1) | (3) Patent application (0/1) | (4) Patent application (0/1) |
|---|---|---|---|---|
| Immigrant participation in ownership (0/1) | -0.0002 (0.0008) | | 0.00002 (0.0007) | |
| Only immigrant ownership (0/1) | | -0.002** (0.0008) | | -0.0007 (0.0009) |
| Mixed immigrant–native ownership (0/1) | | 0.002* (0.0012) | | 0.0006 (0.0009) |
| Ln(employees) | | | 0.002*** (0.0001) | 0.0023*** (0.0001) |
| Ln(owner age) | | | 0.005*** (0.0007) | 0.005*** (0.0007) |
| VC financed (0/1) | | | 0.05*** (0.007) | 0.054*** (0.007) |
| Academic title (0/1) | | | 0.008*** (0.0008) | 0.008*** (0.0008) |
| ≥ 2 owners (0/1) | | | 0.0005** (0.0003) | 0.0005* (0.0003) |
| Corporate investor (0/1) | | | 0.006*** (0.0007) | 0.006*** (0.0007) |
| Ln(company age) | | | 0.001*** (0.0002) | 0.001*** (0.0002) |
| Limited liability (0/1) | 0.01*** (0.0003) | 0.008*** (0.0003) | 0.002*** (0.0003) | 0.002*** (0.0003) |
| East Germany (0/1) | -0.0006 (0.0003) | -0.0006* (0.0003) | -0.002*** (0.0002) | -0.002*** (0.0003) |
| Observations | 1,360,367 | 1,360,367 | 1,360,367 | 1,360,367 |
| Firms | 222,171 | 222,171 | 222,171 | 222,171 |
| Log likelihood | -64,000 | -63,973 | -59,489 | -59,486 |
| *Knowledge-intensive industries included* | *All* | *All* | *All* | *All* |

\* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%

Note: Based on ZEW data on start-ups since 1990. The dependent variable is a dummy for at least one patent application. Marginal effects are shown. The regressions contain industry dummies at the 2-digit SIC level and year dummies. Standard errors in brackets allow for heteroscedasticity and for autocorrelation within firms.
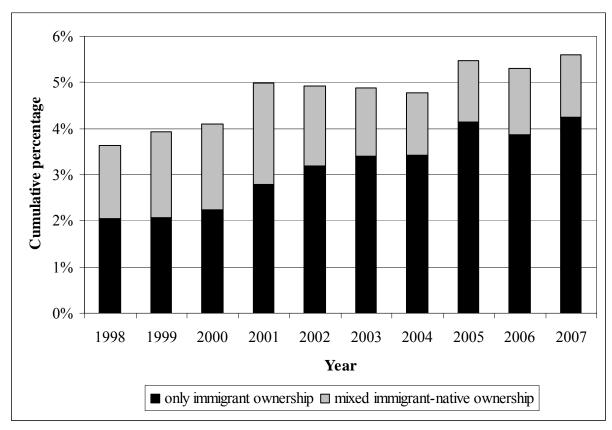
**Table 8: Negative Binomial Regressions for Size of Patent Application Stock**

| Dependent variable | (1) Patent application stock | (2) Patent application stock | (3) Patent application stock | (4) Patent application stock |
|---|---|---|---|---|
| Immigrant participation in ownership (0/1) | -0.165 (0.188) | | -0.098 (0.150) | |
| Only immigrant ownership (0/1) | | -0.633** (0.265) | | -0.342 (0.257) |
| Mixed immigrant–native ownership (0/1) | | 0.195 (0.254) | | 0.087 (0.188) |
| Ln(employees) | | | 0.49*** (0.035) | 0.485*** (0.035) |
| Ln(owner age) | | | 1.76*** (0.19) | 1.45*** (0.20) |
| VC financed (0/1) | | | 2.41*** (0.139) | 1.89*** (0.188) |
| Academic title (0/1) | | | 1.44*** (0.078) | 1.02*** (0.084) |
| $\geq$ 2 owners (0/1) | | | 0.09 (0.08) | 0.08 (0.08) |
| Corporate investor (0/1) | | | 1.01*** (0.11) | 0.93*** (0.13) |
| Ln(company age) | | | 0.172*** (0.061) | 0.264*** (0.062) |
| Limited liability (0/1) | 1.54*** (0.092) | 1.53*** (0.092) | 0.770*** (0.099) | 0.632*** (0.101) |
| East Germany (0/1) | -0.359*** (0.088) | -0.362* (0.088) | -0.493*** (0.089) | -0.694*** (0.088) |
| Observations | 1,360,367 | 1,360,367 | 1,360,367 | 1,360,367 |
| Firms | 222,171 | 222,171 | 222,171 | 222,171 |
| Log likelihood | -84,280 | -84,256 | -82,360 | -80,568 |
| *Knowledge-intensive industries included* | *All* | *All* | *All* | *All* |

\* significant at 10%, \*\* significant at 5%, \*\*\* significant at 1%

Note: Based on ZEW data on start-ups since 1990. The dependent variable is the size of the patent application stock. Coefficients are shown. The regressions contain industry dummies at the 2-digit SIC level and year dummies. Standard errors in brackets allow for heteroscedasticity and for autocorrelation within firms.

**Figure 1: Relative Importance of Ownership Categories Over Time**



Note: Based on ZEW data on start-ups since 1990. The category comprising companies in exclusively native ownership is not depicted here.

# Appendix

**Table A1: Knowledge-intensive Industries**

| | **Knowledge-intensive manufacturing** |
|---|---|
| | *Cutting-edge technology* |

| | |
|---|---|
| 2330 | Processing of nuclear fuel |
| 2420 | Manufacture of pesticides and other agrochemical products |
| 2441 | Manufacture of basic pharmaceutical products |
| 2461 | Manufacture of explosives |
| 2911 | Manufacture of engines and turbines (except aircraft, vehicle and cycle engines) |
| 2960 | Manufacture of weapons and ammunition |
| 3002 | Manufacture of computers and other processing equipment |
| 3162 | Manufacture of other electrical equipment |
| 3210 | Manufacture of electronic valves and tubes and other electronic components |
| 3220 | Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy |
| 3320 | Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment |
| 3330 | Manufacture of industrial process control equipment |
| 3530 | Manufacture of aircraft and spacecraft |

| | *Value-intensive technology* |
|---|---|

| | |
|---|---|
| 2233 | Reproduction of computer media |
| 2411 | Manufacture of industrial gases |
| 2412 | Manufacture of dyes and pigments |
| 2413 | Manufacture of other inorganic basic chemicals |
| 2414 | Manufacture of other organic basic chemicals |
| 2417 | Manufacture of synthetic rubber in primary forms |
| 2430 | Manufacture of paints, varnishes and similar coatings, printing inks and mastics |
| 2442 | Manufacture of pharmaceutical preparations |
| 2462 | Manufacture of glues and gelatines |
| 2463 | Manufacture of essential oils |
| 2464 | Manufacture of photographic chemical material |
| 2466 | Manufacture of other chemical products not included elsewhere |
| 2912 | Manufacture of pumps and compressors |
| 2913 | Manufacture of taps and valves |
| 2914 | Manufacture of bearings, gears, gearing and driving elements |
| 2931 | Manufacture of agricultural tractors |
| 2932 | Manufacture of other agricultural and forestry machinery |
| 2940 | Manufacture of machine tools |
| 2952 | Manufacture of machinery for mining, quarrying and construction |
| 2953 | Manufacture of machinery for food, beverage and tobacco processing |
| 2954 | Manufacture of machinery for textile, apparel and leather production |
| 2955 | Manufacture of machinery for paper and paperboard production |
| 2956 | Manufacture of other special purpose machinery not included elsewhere |
| 3001 | Manufacture of office machinery |
| 3110 | Manufacture of electric motors, generators and transformers |

| 3140 | Manufacture of accumulators, primary cells and primary batteries |
| 3150 | Manufacture of lighting equipment and electric lamps |
| 3230 | Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods |
| 3310 | Manufacture of medical and surgical equipment and orthopaedic appliances |
| 3340 | Manufacture of optical instruments and photographic equipment |
| 3410 | Manufacture of motor vehicles |
| 3430 | Manufacture of parts and accessories for motor vehicles and their engines |
| 3520 | Manufacture of railway and tramway locomotives and rolling stock |

**Knowledge-intensive services**

*Technology-intensive services*

| 642 | Telecommunications |
| 72 | Computer and related activities |
| 731 | Research and experimental development on natural sciences and engineering |
| 742 | Architectural and engineering activities and related technical consultancy |
| 743 | Technical testing and analysis |

*Non-technical consulting services*

| 732 | Research and experimental development on social sciences and humanities |
| 7411 | Legal activities |
| 7412 | Accounting, book-keeping and auditing activities; tax consultancy |
| 7413 | Market research and public-opinion polling |
| 7414 | Business and management consultancy activities |
| 744 | Advertising |

Note: Classification according to Grupp and Legler (2000) and Nerlinger and Berger (1995). The first column gives the industry code according to the German industry classification WZ (Klassifikation der Wirtschaftszweige) from 1993.

**Table A2: Examples of Ethnic Name Coding**

| Ethnic Origin | Typical Names |
| --- | --- |
| Germany | Peter Laube, Sandra Hohloch |
| Turkey | Semir Yüzgülen, Aslan Erol |
| Former Yugoslavia | Krunoslav Saric, Josip Siniko |
| Italy | Luciano Bertani, Giovanni Federico |
| Greece | Dyonysios Tsichritzis, Roumeliotis Panayiotis |
| Spain, Portugal | Natividad Martinez, Mervyn Fernandez |