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Master Thesis Urban, Port & Transport Economics

The role of the neighborhood on new firm success

An analysis of post-entry performance of startups in Rotterdam

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The aim of this study is to determine what role the neighborhood has on the post-entry performance of startups. The performance of startups was measured in their probability of survival and their ability to grow in number of employees. A panel dataset was created combining annual data, provided by Stichting LISA, on Rotterdam-based firms with relevant neighborhood characteristics found in databases from CBS and OBI. Based on the analysis, some evidence was found for a negative link between factors that are detrimental to local quality of life, such as crime rates and vacant real estate, and the survival of startups in Rotterdam. However, most of the neighborhood characteristics only had an insignificant or inconsistent effect on startup performance.

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1. Introduction

Despite economic cycles, cities have been relatively consistent in their ability to attract people and businesses. Urban regions in the Netherlands have higher current productivity levels and productivity growth rates compared to rural areas, making the Dutch cities important drivers of the national economy (Rijksoverheid, 2014). As a result, policy has shifted in focus from a national level to a regional- or neighborhood-level (Sleutjes, van Oort, & Schutjens, 2012). These developments should not come as a surprise, as there is a large body of economic literature on the potential advantages of high-density areas. Marshall (1920) introduced the concept of agglomeration economies by arguing that the mechanisms of a shared labor pool, shared inputs, and knowledge spillovers put clustered economies in an advantageous position. The research on clustering was revitalized by Porter (1990) with his seminal book 'The Competitive Advantage of Nations' and has since been applied at a lower level by researching the advantages of clusters in (inner-) cities (Porter, 1995).

Another advantage of cities is their ability to act as seedbeds for new firms (Audretsch & Fritsch, 1994). In addition to the agglomeration benefits, urban areas have competitive advantages in local market demand, strategic business locations, and human resources (Porter, 1995). Furthermore, Sleutjes et al. (2012) pointed out several recent developments that have created a favorable urban environment for new firm formation. First, the current service economy has led to large firms outsourcing work to contractors, which are often small startup firms or one-man businesses. Second, modern telecommunications allow for productivity in non-enterprise environments, thus increasing the business activity in residential neighborhoods. Third, due to societal trends workers desire independence and flexibility, which results in the rise of independent solo entrepreneurs with modest growth goals (Sleutjes et al., 2012). Additionally, many small firms start in residential areas as these firms do not require much real estate and these areas are typically closer to network contacts. (Sleutjes, 2012).

This development is important for policy makers as small and new firms play several crucial roles for a nation's economy. Startups, for instance, are important drivers of innovation as they enter untapped markets, currently unutilized by incumbent firms (Geroski, 1995; Santarelli & Vivarelli, 2007). Their smaller organizational structure also gives them a competitive advantage as they can be more flexible and responsive to market trends, despite their disadvantages in limited capital (Rothwell, 1989). Furthermore, startups play a crucial role in economic competition as they keep prices down when incumbent firms are unwilling to do so (Geroski, 1995), and replace obsolete incumbent firms in a process known as the 'creative destruction' (Schumpeter, 1943). Additionally, new firms are responsible for a large portion of newly created jobs (Birch, 1979; Birley, 1986;

Rothwell, 1989). In the Netherlands 40% of new jobs are created by companies that are younger than 5 years old (Kamp, 2017). As a result, the Dutch government plans to spend an extra 65 million euro annually on their startup policy during the next four years (Rijksoverheid, 2019).

The aim of this thesis is to analyze the post-entry performance of startups and to determine how regional characteristics may influence the success of these new firms. Currently, there is a vast body of literature on the virtues of startups and potential factors that affect the creation of startups and subsequent scaleups. However, the factors that influence the success of startups after their creation are equally important. As Geroski (1995) noted, entry is common, however market penetration and survival of firms is rarer. As, entry and exit have been found to correlate positively (Geroski, 1995), there may be considerable barriers of survival that are worth investigating further.

In this thesis the post-entry performance of startups will be analyzed for the Dutch city of Rotterdam over a period from 2013 to 2017. This region was chosen for several reasons. First, this region is of interest, as Rotterdam is an important driver for the Dutch economy, which in large part can be attributed to the performance of the Port of Rotterdam (Kuipers, 2018). Despite this, the COROP region in which Rotterdam is located (Groot-Rijnmond) lags in gross regional product and economic growth compared to similar urbanized COROP regions (Groot-Amsterdam, Utrecht) (Jonkers, 2017). Furthermore, Rotterdam faces problems with above average levels of unemployment, which are particularly high and increasing in the south of Rotterdam (van der Aa, de Graaf, Moors, Roode, & van Toorn, 2018). Interestingly, the 'self-employed without employees' (legally known as ZZP'ers) is one of the few working demographics that has experienced high job growth rates within Rotterdam, with job growth for freelancers in general being stable (van der Aa et al., 2018). This finding, again, denotes the importance of small and starting firms on job creation, as the amount of permanent jobs in Rotterdam has consistently declined since 2011 (van der Aa et al., 2018). As a result, policy that focuses on improving startup success could be of importance for Rotterdam's unemployment problem. The thesis will structure around the following central research question:

What role does the neighborhood play in new firm success?

Where firm success is determined by a firm's ability to survive and grow in number of employees. As not all firms have the same ambitions regarding growth, survival will be regarded as the main component for firm success. However, the growth in number of employees is still a valuable metric for policy regarding job creation. The neighborhood level was chosen as more firms, especially one-man businesses, are operated from home in residential areas, as was discussed above (Sleutjes, 2012; Sleutjes et al., 2012). Furthermore, this is the lowest regional level with enough data available

to make econometric analysis possible. Based on the literature, neighborhoods are assumed to influence firm performance based on their function as living spaces and markets (Sleutjes, 2012; Sleutjes et al., 2012). Where factors like crime, quality of infrastructure, and socioeconomic status of the neighborhood are believed to affect the livability of a neighborhood, and factors such as income-, migration background-, education level- of residents, and the population size of the neighborhood are believed to affect the market function of neighborhoods. Additionally, the neighborhood effects will be analyzed for separate industries, as some sectors may be affected more by the locale than others. Separate models will also be made for neighborhoods in Rotterdam-Zuid and neighborhoods in other parts of Rotterdam, as the socioeconomic disparities between these regions are significant enough to warrant region specific analysis. This research contributes to the existing body of literature by applying regional economics specifically to startup success.

Using empirical research, the hypotheses relating to the main question in this study will be tested using panel data. A panel dataset on all startups in Rotterdam was created for the years 2010-2017 containing data on firms and their characteristics from *Stichting Lisa (2017)*, and data on neighborhood characteristics from *CBS* (2016; 2019), and *CBS and OBI (2019)*. The dataset includes variables such as firm age, firm size, and local population characteristics such as education levels, income, social welfare, and other regional aspects, such as housing composition and reported crime. Firm growth will be analyzed using fixed-effects regression methods, while firm survival will be studied using random-effects probit models in a panel setting.

This thesis will be structured as follows: Section 2 will give an overview and discussion of existing literature on firm survival and growth. Based on the literary findings, several hypotheses will be formulated in the same section. Section 3 will describe the data used for the analysis. In section 4 the methodology for the statistical analysis will be outlined, with the results of the method following in section 5. Finally, the thesis will conclude with a discussion on the findings, limitations, and implications for policy of this research in section 6.

2. Literature Review

In economic literature, the post-entry success of firms is roughly determined by two factors: (1) The firm's ability to survive, and (2) the growth of a firm (Santarelli & Vivarelli, 2007; Sleutjes et al., 2012), with growth being defined as increases in sales, profit, or the number of employees (Sleutjes et al., 2012). Firms may have different ambitions regarding growth, as some entrepreneurs primarily started their firm to achieve independence, as was noted by Sleutjes et al. (2012). In this case, characterizing a lack of growth as a firm failing would be a misinterpretation. Thus, the primary focus of this research will be on survival. An extensive number of factors that could influence firm performance can be found in economic literature. This section will give an overview of the findings most commonly found in economic literature.

2.1 Internal factors that influence startup success

The first set of determinants of firm survival relate to firm-specific factors. Geroski (1995) noted in one of his stylized results on firm entry, that both the size and age of a firm are correlated with a firm's ability to survive and grow. First, both the firm's initial size when entering the market (Audretsch & Mahmood, 1995; Audretsch, Houweling, & Thurik, 2000; Brüderl & Schüssler, 1990) and the firm's current size (Bates, 1995; Brüderl & Schüssler, 1990; Dunne, Roberts, & Samuelson, 1989; Fotopoulos & Louri, 2000; Huggins, Prokop, & Thompson, 2017; Mata, Portugal, & Guimaraes, 1995) have been found to correlate positively with the survival of firms. Larger firms are assumed to have more resources, more experienced management, and closer contacts to creditors, which increases their chance of survival during financial downturns (Brüderl & Schüssler, 1990). Brüderl and Schüssler (1990) added to this *'liability of smallness'* that increases in firm size result in favorable tax conditions, and a greater ability to attract human capital and financial capital. Additionally, smaller startups often underinvest in gathering market research due to their limited resources (Geroski, 1995). As a result, market opportunities may be left unexploited, which decreases the chance of survival for new firms (Geroski, 1995). Firms with fewer employees are also limited in their production capacity. Smaller firm generally produce below the minimum efficient scale (MES) output of the industry in which they operate, resulting in higher average costs compared to larger established firms (Audretsch & Mahmood, 1995; Audretsch et al., 2000). This effect can cause a snowball effect, as growing firms are able to produce more efficiently and at lower costs, which enables further growth. Jovanovic (1982) noted that firm success depends on the relationship between pre-entry uncertainty and post-entry learning. Unexperienced firms may choose an inefficient entry-scale and will swiftly exit the market post-entry (Jovanovic, 1982). Based on this theory, current firm size may be a better indicator for firm survival over time, as current size also reflects past performance (Mata et al., 1995). However, Agarwal and Audretsch (1999) added that

while larger startups are more likely to survive, small firms can still be efficient when occupying a market niche in mature markets.

The second common internal determinant of firm success is age (Geroski, 1995). Generally, the chance of firm survival increases with age, which is often coined the '*liability of newness*' (Stinchcombe, 1965). Stinchcombe (1965, p148) noted several reasons why younger firms are more likely to fail. First, within new firms there is a learning curve of tasks and roles. Second, newly created roles can conflict with a firm's constraints on capital and creativity. Third, the people working within the new firm are not well acquainted with each other, which may stifle (informal) communications. Fourth, stable relationships with clients or customers are not yet established. Brüderl and Schüssler (1990), challenged the '*liability of newness'* with their own hypothesis of the '*liability of adolescence'*. According to this theory startups will experience an initial period of safety due to a large influx of resources at the creation of the firm, which enables survival regardless of entrepreneurial performance. This initial period of adolescence is followed by a peak in firm deaths when the starting capital of firms runs out (Brüderl & Schüssler, 1990). This hypothesis suggests that age and size both affect firm survival and often reinforce each other, as the capital size at the start of firm will determine the length of a firm's adolescence. Strong support for this hypothesis was found in Brüderl and Schüssler's (1990) study on firm survival in Munich and Upper-Bavaria. Strotmann (2007) similarly found that, for German startups, the risk of exit peaked at the one- or two-year mark, with chances of failure decreasing beyond this age. Dunne et al. (1989) found for U.S. manufacturing plants that, regardless of size category or ownership-type, the risk of firm exit decreased as firms aged. For the Netherlands, empirical evidence was found for Geroski's (1995) stylized facts on firm entry and survival by Audretsch et al. (2000), who noted that, despite unique institutional and policy differences caused by the '*Polder Model*', the general determinants of firm survival hold true for the Netherlands. According to these findings, one could reasonably expect age and size to positively influence the success of startups in Rotterdam. However, as only very small and young firms will be analyzed in this research, the full potential of these factors may not be revealed at this stage of firm development. To avoid any potential omitted variable bias, firm size and firm age will nevertheless be added as control variables to the analysis when possible.

Apart from firm size and firm age there are several other firm-specific determinants of survival that can be found in economic literature. While the support for these factors is less universal, these factors may still affect the survival of small firms operating in Rotterdam and are thus worth discussing. Mata and Portugal (2002) noted that human capital provides an important competitive advantage for entering firms, since physical assets such as tools, machinery, and IT-systems can be copied or traded with relative ease. As such, the factors that are tacit such as

knowledge will act as more robust differentiators of entrants (Mata & Portugal, 2002). Wennberg and Lindqvist (2010) confirmed these findings and found for Swedish firms that adding an employee with a college degree in science or engineering decreased the firm's risk of disbanding by 34%. These findings also extend to the firm's owner, since firms that are being led by a highly educated owner who works full-time for their own business are more likely to survive (Bates, 1995). Due to limited amount of data available for this thesis, the internal human capital of startups in Rotterdam cannot be analyzed. However, as Sleutjes et al. (2012) noted, as more firms are appearing in residential neighborhoods, the human capital of a neighborhood could potentially be used as a proxy for entrepreneurial human capital of firms operating in the region. Additionally, an empirical link between legal structure and firm performance has been found (Brüderl & Schüssler, 1990; Huggins et al., 2017; Mata & Portugal, 2002). However, as only small startups are considered in this research, it is not unreasonable to assume that most firms will choose similar legal forms with unlimited liability ('eenmanszaken' and V.O.F. as opposed to B.V. and N.V.) due to the lower costs of these legal forms.

2.2 External factors that influence startup success

In addition to firm-specific factors, there are several external determinants of firm success, with a smaller subset of determinants of firm success focusing on characteristics of neighborhoods. The most renowned regional indicator of economic performance are agglomeration economics, which was a concept first introduced by Marshall (1920), who noted that high density areas provide economic gains due to their shared labor pools, shared inputs, and ability to spillover knowledge. While agglomeration economics are generally accepted as a determinant of a region's economic performance, the literary findings on a potential link between clustering and firm survival are less robust (Sleutjes et al., 2012). Generally, there are two competing hypotheses on clustering and firm survival (Huggins et al, 2017). The first hypothesis argues in favor of agglomeration with empirical positive links found between population density and survival (Fotopoulos & Louri), and industrial clusters (measured in employees per industry) and survival (Wennberg & Lindqvist, 2010). The opposing hypothesis is based on findings that suggest a negative relation between economic density and survival, with Strottmann (2007) finding a 30% higher chance of startup failure in urban areas compared to rural areas, and others finding a positive link between entry and exit of firms (Brixy & Grotz, 2007; Mata et al., 1995) which is caused by increased levels of competition. Grotz (2007) noted that in agglomerated areas firms are closer together, which makes switching between suppliers easier for consumers and thus further intensifies the competition effects between firms in clusters. As this thesis focusses on startups in urban residential neighborhoods, industrial clusters

are assumed to not be the primary differentiator between the studied failing and succeeding firms. However, the number of firms operating within a neighborhood can be controlled for.

Apart from economic density, there may be other characteristics of neighborhoods that could determine the success of startups. Sleutjes (2012) noted that neighborhoods have three primary functions for firms: the function as a living environment, the function as a community, and the function as a market. This thesis will focus on the living environment and market functions, as a neighborhood's degree of community is a dimension that is hard to measure objectively and can only be done effectively using survey data. Thus, the neighborhood's function as a community is beyond the scope of this research. However, this does not mean that this function has no influence on the performance of startups. In her seminal book *The Death and Life of Great American Cities,* Jacobs (1961) critiqued contemporary urban policy claiming that urban renewal policies often resulted in displacement of disadvantaged residents and a loss of community and innovation due to the homogenization of modern urban spaces. This loss of social cohesion could potentially stifle the performance of firms targeting local residents in neighborhoods that face displacement as a result of gentrification.

Considering the neighborhoods function as a living environment, the local quality of life may be an important determinant of firm performance, especially for home-based firms or local-oriented firms in the retail sector. Entrepreneurs may base their choice of location on personal housing preferences as opposed to more objective economic metrics, and customers may choose to visit shopping areas that are perceived as attractive (Sleutjes, 2012). Factors that could influence the livability of a neighborhoods include crime and nuisance, perceived safety, and quality of infrastructure. Porter (1995), argued that entrepreneurs are often reluctant to start businesses in American inner-cities due to ill-maintained infrastructure and low levels of security resulting from high crime rates and inadequate enforcement of property rights. Raspe et al. (2010) found that startups located in neighborhoods with high levels of burglary and deterioration (of the neighborhood) have a significantly lower chance of survival, with deteriorations also negatively affecting a startups ability to grow. Additionally, the amount of unoccupied real estate in a neighborhood and its level of property theft negatively influences the survival of all firms, with unoccupied real estate also harming firm growth, and property theft negatively influencing growth of startups (Raspe et al., 2010). In contrast to these findings, both Raspe et al. (2010) and Sleutjes et al. (2012) found counterintuitive results with property crimes, and reported cases of violence and harassment having a positive effect on the survival of firms (Sleutjes et al., 2012), and theft having a positive effect on startup growth (Raspe et al., 2010). These findings may be attributed to reverse causality, as successful firms attract nuisance (Raspe et al., 2010). On the other hand, significant

negative links were found between perceived insecurity of residents and firms' survival, and location in disadvantaged neighborhoods and firms' survival (Sleutjes et al., 2012). Given these latter findings, one could hypothesize that the perception of safety is of greater importance to firm survival than the objective number of reported crimes. Furthermore, Mollenhorst and Schutjens (2017) argued that, while social- & physical- disorder could affect firm performance, firm performance only 'responds' to recent changes in disorder and only significantly affects firms that rely on daily visits form mostly local customers. While the findings on the livability of neighborhoods are mixed, one could reasonably assume that nuisance or disorder will not positively influence firm performance. Furthermore, it is reasonable to expect that businesses that depend on local customers, such as restaurants or shops, in particular will be affected by environments that are perceived as unsafe or unpleasant. Based on these assumptions and some of the findings in the literature, the following hypotheses were formulated:

Hypothesis 1A: Disorder and deterioration at the neighborhood level will negatively influence the survival and growth of startups in general.

Hypothesis 1B: Disorder and deterioration at the neighborhood level will negatively influence the survival and growth of startups in the retail and hospitality industry (horeca).

A similar analysis will be done for startups operating in business services to reveal any potential differences between distinct industries. The sector 'business services' was chosen as these startups are assumed to be less dependent on local customers compared to startups in retail or hospitality services. However, as disorder also affects the quality of life of firm-owners in this industry, the hypothesized effect will be the same, although the effect could be smaller:

Hypothesis 1C: Disorder and deterioration at the neighborhood level will negatively influence the survival and growth of startups in business services.

A second function of neighborhoods is their role as markets for businesses. This role is of great importance for local-oriented firms, such as restaurants or retail stores, as these firms rely on the (collective) purchasing power of neighborhood residents (Sleutjes, 2012). An early example of this was given by Porter (1995), who pointed out that the populous inner-cities in the US have a high local market demand, despite average wages of inner-city residents being relatively low. Furthermore, Fotopoulos and Louri (2000) found in their research on the survival of Greek startups that firms located in Greater Athens, the country's largest urban environment, had a higher chance of survival than firms located in less urbanized areas. This finding was particularly strong for smaller firms (Fotopoulos & Louri, 2000). In the Netherlands comparable results were found, with firms

operating in residential areas having higher chances of survival, and firms specialized in business services having higher chances of survival in inner-cities (Sleutjes et al., 2012). Furthermore, factors that influence local market demand, such as population size, population age, and resident's level of education of a neighborhood, all had a strongly significant positive relation with firm survival (Sleutjes et al., 2012). Average income on a neighborhood level had a significant negative effect on survival, however a significant inverse relationship exists when accounting for the income level of surrounding neighborhoods (Sleutjes et al., 2012). Similarly, Raspe et al. (2010) found that new firms located in neighborhoods with high levels of unemployment faced lower chances of survival. Huggins et al. (2017) found analogous results, with lower levels of unemployment increasing firm survival. Based on these 'neighborhoods as markets' findings the following hypotheses were formulated:

Hypothesis 2A: Neighborhood characteristics that indicate higher local purchasing power will positively influence the survival and growth of startups in general.

Hypothesis 2B: Neighborhood characteristics that indicate higher local purchasing power will positively influence the survival and growth of local-oriented startups (retail and hospitality industry).

Again, the business services industry may or may not benefit from the same neighborhood factors and will be analyzed to determine the sector heterogeneity and specificity of separate industries. Based on the trends discussed by Sleutjes et al. (2012), it is reasonable to expect that local demand is less important to business services as advancements in telecommunications de-emphasize the location of operation. However, if the education level of residents is considered as a proxy for human capital of firm owners or potential employees, this factor may still influence the performance of firms in business services. As a result, the neighborhood factors that indicate high local human capital are hypothesized to have a positive effect on firm performance for startups in business services:

Hypothesis 2C: Neighborhood characteristics that indicate higher local human capital will positively influence the survival and growth of firms in business services

3. Data

For this thesis, data from several sources have been compiled to create a dataset which consists of firm characteristics and matching neighborhood data for the years 2010 to 2017. The data on firms are sourced form the Dutch employment register, *Stichting LISA* (from now on referred to as just LISA), which has panel data on all operational firms in the Netherlands. With data measured on the first of January, all firms that were operational in Rotterdam during 2002 to 2017 are included in the LISA data. Neighborhood data were collected from several databases from *Statistics Netherlands* (CBS). Most of the neighborhood data were retrieved from the database *'Kerncijfers Wijken en Buurten'* (KWB) which has annual data on the demographics and features of Dutch neighborhoods (CBS, 2019). The CBS database *'Geregistreerde criminaliteit per gemeente, wijk en buurt'* was used for statistics on reported crime in neighborhoods from 2010 to 2015 (CBS, 2016), while the data on crime for the last two years were retrieved from the previously mentioned *'KWB'* database (CBS, 2019). Finally, the database from Rotterdam's research department (*Onderzoek en Business Intelligence, or OBI)* has been used to obtain data on the education level within neighborhoods. Unfortunately, *OBI* did not start collecting data on education till 2013, resulting in no observations on education for the years 2010 to 2012 (CBS & OBI, 2019). Similar limitations hold for data on the amount of businesses per sector within a neighborhood and the amount of vacant buildings within a neighborhood, which were not measured before 2011 and 2012 respectively (CBS, 2019). As a result, the time range consisting of all the data is from 2013 to 2017.

3.1 Unit of analysis

The aim of this thesis is to analyze the regional determinants of firm success. In order to successfully include the characteristics of the firm's locale, the regional characteristics are measured at the lowest level possible. In the Netherlands this is at the neighborhood-level (*buurt*). The included data from LISA is measured at the firm-level and includes the postal code and house numbering of each individual firm, while the CBS and OBI data is measured at the neighborhood-level. In order to make firm data compatible with the neighborhood data a conversion table from CBS linking the 6-digit postal codes, combined with house numbering (without suffix), with the matching neighborhood code (gwb-code) for the year 2017 (CBS, 2017) was used. As no similar tables were available for previous years, the table for 2017 was used for all years to link firms to their respective neighborhood. As a result, some firms have missing neighborhood data in the years before 2017. However, as only a small portion (1,09%) of firms were affected, this method is still preferred over less precise methods used in previous research, such as linking firms to neighborhoods based on the most frequently occurring postal codes in neighborhoods.

3.2 Data selection

The data that was retrieved from LISA, CBS, and OBI includes data on all firms and all neighborhoods in Rotterdam, including data that is beyond the scope of this research. As a result, the dataset was first cleared from irrelevant data. First, when analyzing just the LISA dataset from 2002 to 2017, it became evident that for some firms the gap between observations was larger than one year. Multiple explanations for these observations can be hypothesized such as firms moving back into the city after a previous move out of the region, firms restarting after dissolution, or simply due to measurement error. While the methodology can manage an unbalanced dataset (for the survival analysis an unbalanced dataset is indeed required), these gaps in time for individual firms may be erroneously interpreted as the start or end of a firm. To avoid this, firms with more than one consecutive run of observations were dropped from the data. Second, as the hypotheses are focused on startups, firms that cannot be classified as new firms should be discarded from the panel. As the relevant CBS data were not measured before 2010, the focus of this thesis will be on firms that started in this year or later. Thus, firms that have their first data entry before the year 2010 were dropped from the data. As was mentioned before, it is still possible that existing firms that moved in the region between 2010 and 2017 remain in the dataset. Evidence for this is found by looking at the number of employees of firms still in the dataset, with the highest observation having more than 3,000 employees. To address this problem, firms with more than 10 employees during their first observation were also deleted from the dataset. The remaining firms are assumed to be starting businesses.

Now that a selection has been made based on firm characteristics, the data will be narrowed down further to include only residential neighborhoods within Rotterdam. This selection is based on the notion of 'neighborhoods as living environments' from the study of Sleutjes et al. (2012), where the degree of livability in a neighborhood is hypothesized to influence firm performance. Firms operating in neighborhoods with primarily non-residential functions (e.g. industrial sites, nature reserves) should thus be removed from the dataset, as this livability theorem does not apply here. Lastly, the neighborhoods located in the districts *Hoek van Holland* and *Rozenburg* were dropped from the data, as these locations are atypical compared to other neighborhoods in Rotterdam. Hoek van Holland, while technically part of Rotterdam, is located several kilometers away from the rest of the city, making it a geographical outlier. Rozenburg, is a former independent municipality that became part of Rotterdam in 2010. Due to historic differences in governance this region may also be considered an outlier. Firms that were observed at least once in one of the above-mentioned regions were dropped from the dataset entirely to prevent the creation of new time gaps within firm

observations. After all these alterations, 44,940 Rotterdam-based startups remain in the data, creating an unbalanced panel dataset covering the years 2010 to 2017.

3.3 Data transformation

Before starting the analysis, a few variables were added or modified. Due to inconsistent data reporting, the *KWB* data was presented as a mix of absolute number of observations and as percentages of total residents in a neighborhood. As data on the total number of residents per neighborhood was available for all years, the inconsistent variables were transformed to percentages.

Second, to control for the firm's age, the variable 'age' was added, which measures the age of firms starting at zero at the firm's first observed data entry. Additionally, the dummy variable survival (*survive_3y*) was created based on the maximum age per firm in the dataset, which will be used as the dependent variable in the survival analysis. The dummy has a value of 1 in all time periods if a firm survives 3 or more years (i.e. the maximum age of firm is 3 or higher) during 2010 to 2017. For firms which entered later than 2014 the dummy variable will be missing, as there is an insufficient amount of data left to evaluate survival. Finally, the dummy 'zuid' and corresponding categorical variable 'lisa_zuid' were added. The dummy will take the value 1 if a neighborhood is in the district (*wijk*) Feijenoord, Charlois, or IJsselmonde. The categorical variable denotes whether a firm is operational in Rotterdam-Zuid and takes the value 0 if a firm never operates in Zuid, 1 if it is always operational in Zuid, and 2 if the firms is only part of the time located in Zuid. This way separate analyses can be done for firm performance within and outside of Rotterdam-Zuid and moving firms (category 2) can be excluded. Note that the definition of Rotterdam-Zuid is based on the one used by the municipality of Rotterdam in its policy program *'Nationaal Programma Rotterdam Zuid'* (NPRZ) (van der Aa et al., 2018), and does not include southern districts such as Hoogvliet and Pernis. Furthermore, the neighborhood 'Kop van Zuid' is an outlier as it was regarded as part of the district Rotterdam Centrum till 2012 when it became part of the district Feijenoord (CBS, 2019). For this research, this neighborhood will not be considered as part of Rotterdam-Zuid, as the region's socioeconomic status is akin to the wealthier neighborhoods in Rotterdam Centrum as a result of gentrification.

4. Methodology

Due to the availability of longitudinal data, the methods discussed in this section are all done in a panel setting. Generally, the dependent variables and firm-internal independent variables (firm size and firm age) are on the firm level, with the firm-external independent variables being on the neighborhood level in which the firm operates. The performance of firms will be based on their ability to survive and their ability to grow in number of employees.

4.1 Startup Survival Method

To test the survival aspect of startup performance for all variants of hypothesis 1 and 2, a random effects probit analysis will be introduced for different sectors and regions with *firms surviving at least three years* as the dependent variable. Generally, fixed effects models are considered to be more convincing for economic analysis than random effects models (Wooldridge, 2013, p. 399), however, due to a lack of within variation in the dependent variables (firms either do or do not survive) a random effects model will be more suitable for this research design.

As independent variables the hypothesized external determinants of firm success will be added. For the neighborhood as a market function the following independent variables were used: *the population size*, *the share of residents with a non-western migration background, the average income per income provider*, *the share of residents with secondary education attainment*, and *the share of residents with higher education attainment*. For the neighborhood as a living environment, the independent variables *the share of houses that were constructed after the year 2000, the share of vacant houses, the reported cases of burglary, and the reported cases of vandalism or public-order crimes* were added The only internal control variable in these models will be the *size of a firm* expressed in the number of employees, as the firm's age was already used to generate the dependent variable survival. Lastly, *the number of firms* were added to the models with all startups included, and *the number of firms in retail or hospitality services* and *the number of firms in business services* were added to the respective sector-specific models as a neighborhood-control variable. The model will be applied separately for both Rotterdam-Zuid and the other neighborhoods in Rotterdam for firms in general, firms in retail and hospitality services, and firms in business services, resulting in a total number of 6 regressions, based on the following structure:

$$[1]\ P(\ survival_i\ = 1|\boldsymbol{X}) = \Phi(\alpha_i\ + \beta_1 * banen_{it} + \beta_m * markets_{it} + \beta_l * livability_{it} + \beta_2 * control_{it} + u_{it}\ )$$

With,
$P(survival_i = 1/\boldsymbol{X})$: The probability that firm i survives at least 3 years, based on all the explanatory variables '$\boldsymbol{X}$'
α_i: The unobserved time-invariant characteristics of firm i.

$banen_{it}$: The size of firm i at time t, expressed in the number of jobs, used as control.
$markets_{it}$:The 'market' measures of the neighborhood in which firm i is located at time t.
$livability_{it}$: The 'livability' measures of the neighborhood in which firm i is located at time t.
$control_{it}$: The number of firms operating in the neighborhood in which firm i is located at time t.
u_{it}: The idiosyncratic error.

The correlation matrix of the independent variables can be found in *Appendix B*. As no problematic levels of correlation are found, it is assumed that multicollinearity will not be in issue for this analysis. Note that the correlation between the separate variables indicating the number of firms in a neighborhood is irrelevant, as no model will jointly add these variables.

4.2 Startup Growth Method

The growth aspect for all variants of hypothesis 1 and 2 are tested using fixed effects regression models. This method is generally preferred over random effects as only the growth variation within firms is considered, eliminating the need to control for variables that stay constant over time, such as a neighborhood's distance to the nearest freeway or the upbringing of the firm owner. A Hausman test for each model confirmed that using fixed effects is indeed more appropriate than using random effects for this analysis.

As the dependent variable the *number of jobs within the firm* was used as a measure of firm size, and the same independent variables from the probit model were added for the neighborhoods role as a market and living space. Again, the number of all firms and firms per sector were added as a control variable to the respective models. As a firm-internal control variable *the age of the firm* was used. As it is unlikely that startups will enjoy indefinite linear growth, the squared form of *firm's age* was added to account for diminishing growth over time. The resulting model is as follows and will again be done 6 times with different configurations of neighborhood locations and firm sectors:

$$[2]\ banen_{it} = \alpha_i + \beta_f * internal_{it} + \beta_m * markets_{it} + \beta_l * livability_{it} + \beta_1 * control_{it} + u_{it}$$

With,
$banen_{it}$: The total number of jobs at firm i at time t (used as a measure of firm size).
α_i: The unobserved time-invariant characteristics of firm i.
$internal_{it}$:The firm-specific controls of firm i at time t.
$markets_{it}$:The 'market' measures of the neighborhood in which firm i is located at time t.
$livability_{it}$: The 'livability' measures of the neighborhood in which firm i is located at time t.
$control_{it}$: The number of firms operating in the neighborhood in which firm i is located at time t.
u_{it}: The idiosyncratic error.

5. Results

5.1 Determinants of Startup Survival

The main results of the survival analysis are in the table below.

Table 1: Results Survival Analysis

	All Firms		Retail & Horeca		Business Services	
VARIABLES	Rotterdam	Zuid	Rotterdam	Zuid	Rotterdam	Zuid
Firm-Internal (control):						
number of jobs	0.174***	0.141***	0.194***	0.659***	0.382***	0.006
	(0.007)	*(0.011)*	*(0.011)*	*(0.155)*	*(0.140)*	*(0.055)*
Neighborhood (markets):						
population size	-0.000***	-0.000***	-0.000	-0.000**	-0.000***	0.000
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
share non-Western	0.873***	-1.106***	1.025***	-0.878	1.385**	2.607
	(0.089)	*(0.183)*	*(0.220)*	*(1.186)*	*(0.642)*	*(1.890)*
average income	0.036***	-0.058***	0.036***	-0.112*	0.059***	0.031
	(0.002)	*(0.012)*	*(0.005)*	*(0.068)*	*(0.017)*	*(0.125)*
share educated (sec.)	1.634***	-0.881	3.359***	4.864	0.899	3.324
	(0.262)	*(0.688)*	*(0.667)*	*(3.504)*	*(1.555)*	*(6.280)*
share educated (high)	-0.211	-3.659***	0.011	3.055	-0.145	9.816
	(0.151)	*(0.699)*	*(0.325)*	*(3.639)*	*(1.131)*	*(8.323)*
Neighborhood (living):						
share vacant houses	-0.024***	-0.146***	-0.016**	-0.217***	-0.026	-0.267***
	(0.003)	*(0.008)*	*(0.008)*	*(0.044)*	*(0.021)*	*(0.064)*
share new houses	-0.530***	3.337***	-0.267**	5.278**	-0.980***	-0.598
	(0.050)	*(0.335)*	*(0.125)*	*(2.260)*	*(0.348)*	*(4.938)*
reported crime (theft)	-0.051***	-0.035***	-0.053***	-0.079**	-0.058***	-0.039
	(0.004)	*(0.006)*	*(0.008)*	*(0.036)*	*(0.018)*	*(0.065)*
reported crime (vand.)	-0.012***	0.000	-0.016***	-0.026*	-0.011*	-0.029
	(0.001)	*(0.003)*	*(0.002)*	*(0.015)*	*(0.006)*	*(0.029)*
Neighborhood (control):						
total number of firms	0.000***	0.002***				
	(0.000)	*(0.000)*				
number of firms: R & H			0.001***	0.008***		
			(0.000)	*(0.003)*		
number of firms: B S					0.001	0.001
					(0.000)	*(0.007)*
Constant	*0.258**	*4.494****	*-1.221****	*3.438*	*0.598*	*-0.400*
	(0.153)	*(0.447)*	*(0.385)*	*(2.499)*	*(1.115)*	*(4.160)*
Observations	54,550	16,633	8,936	3,104	17,165	3,655
Number of Startups	15,033	4,926	2,717	990	4,754	1,106

Standard errors in parentheses

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

Regarding the firm-internal determinant of firm survival, evidence for the previous findings from the literature can be found in most models. Except for startups in business services operating in Rotterdam-Zuid, the survival of firms becomes significantly more likely as the firm size increases in number of employees. Interestingly, the control variable of the number of firms, has a significant positive effect on the probability of startups surviving for firms in general and firms in retail or

hospitality services, but no significant findings can be found for startups in business services. This may indicate that modern telecommunications make geographical clustering less important for startups in this sector.

For the relation between the market function of neighborhoods and the survival of startups the results are mixed. For instance, the significant links between the neighborhood's population size and likelihood of startup survival are all negative. These findings are counter-intuitive as one would expect that a larger population size also results in higher aggregated local demand, thus increasing the chance of firm survival. A significant positive link can be found between the share of residents with a non-Western migrant background and the likelihood of a firm surviving for startups operating outside of Rotterdam-Zuid. This finding similarly contradicts previous findings from the literature where the share of this population group was found to negatively correlated with firm survival (see Sleutjes et al., 2012). It could be that there is a significant number of startups that specifically target this demographic and thus benefit from a higher share of non-Western residents in their neighborhood. The exception seems to be in Rotterdam-Zuid were a significant reverse result can be found in the model analyzing all firms. This discrepancy in coefficient signs between Rotterdam-Zuid and other neighborhoods is also present for the results on income. Here, the expected increase in likelihood of survival as a result of higher average neighborhood income can be found in all models omitting Zuid. On the other hand, the only significant findings on income and startup survival for Rotterdam-Zuid are negative. These findings imply that an increase in local income may not always result in higher local consumption. Finally, there are some significant findings related to the education level of locals. When using the education data as another indicator of purchasing power, the results are generally as expected, with only higher education giving atypical results in the aggregated-startup model for Rotterdam-Zuid. Education can also be analyzed as a proxy for human capital. In this case the negative link between startup survival and higher education in Rotterdam-Zuid could be the result of a firm selection effect, with southern firms possibly depending more on blue-collar workers. Overall, the evidence for a possible market effect of the neighborhoods is too inconsistent to accept the survival part of hypothesis 2A and 2B. Moreover, as no significant findings were found regarding the link between local education level and the survival of startups in business services, the survival element of hypothesis 2C must be rejected.

With respect to the neighborhood's function as a living environment the results are much more consistent. Both measures of crime, and the measure of vacant real estate have a significant negative effect on the probability of a startup surviving in most of the models, with the other models having no significant findings. The construction year is an interesting variable, as the sign of the coefficient differs between the neighborhoods in Rotterdam-Zuid and the remaining neighborhoods

in Rotterdam. Generally, it seems that having a higher share of modern residential properties increases the chance of startup survival only in Rotterdam-Zuid. A possible explanation for this could be that older buildings in Rotterdam-Zuid may not be as well maintained as in the rest of Rotterdam, making the quality difference between old and new buildings more pronounced. However, this theory does not explain the negative link found in all models on the neighborhoods outside of Rotterdam-Zuid. These conflicting results may indicate that the construction year is not the best determinant of the quality or desirability of houses. With the other livability factors, it seems that the survival element of hypothesis 1A and 1B are mostly confirmed. Concerning the startups in business services, the results are less consistent, especially in Rotterdam-Zuid where the share of unoccupied houses is the only significant determinant of startup survival. This may indicate that firms that are less dependent on local customers may not be as affected as much by the quality of the neighborhood. However, the livability factors were still hypothesized to influence the quality of life of firm owners and thus deterioration was expected to negatively affect the performance of startups in business services. As a result, the survival aspect of hypothesis 1C cannot be fully accepted.

As an additional robustness check, similar models were deployed with an alternative dependent variable (*survive_5y*) which predicts the survival of startup for at least 5 years. The findings can be found in *Appendix C*. Overall, fewer significant findings can be found for these alternative models, which may be a consequence of the smaller sample size. However, most of the coefficients that are significant have the same coefficient sign as in the main models. The exceptions are found in the model for startups in general outside of Rotterdam-Zuid, with average income now having a significant negative effect on survival probability, and the share of highly educated residents having a positive effect on startup survival. Overall, these models echo the previous findings with the livability effects of neighborhoods being relatively consistent and the market effects of neighborhoods giving mixed results with respect to startup survival.

5.2 Determinants of Startup Growth

The results of the startup growth analysis are displayed in the table below.

Table 2: Results Growth Analysis

	All Firms		Retail & Horeca		Business Services	
VARIABLES	Rotterdam	Zuid	Rotterdam	Zuid	Rotterdam	Zuid
Firm-Internal (control):						
age	0.033***	0.053***	0.084***	0.071***	0.025**	0.037
	(0.007)	*(0.015)*	*(0.021)*	*(0.024)*	*(0.011)*	*(0.038)*
age-squared	-0.002*	-0.004**	-0.011***	-0.011***	0.000	0.003
	(0.001)	*(0.002)*	*(0.003)*	*(0.003)*	*(0.001)*	*(0.005)*
Neighborhood (markets):						
population size	-0.000***	-0.000	-0.000	0.000	0.000	0.000
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
share non-Western	0.474***	0.151	0.928	0.856	-0.215	0.180
	(0.147)	*(0.325)*	*(0.569)*	*(0.640)*	*(0.228)*	*(0.830)*
average income	0.001	0.011	0.019***	0.030*	-0.008**	0.003
	(0.002)	*(0.010)*	*(0.007)*	*(0.016)*	*(0.003)*	*(0.024)*
share educated (sec.)	0.953***	0.037	1.729***	0.612	0.946***	1.923
	(0.185)	*(0.570)*	*(0.599)*	*(0.935)*	*(0.292)*	*(1.498)*
share educated (high)	0.205	-0.800	0.251	0.611	0.184	-0.377
	(0.177)	*(0.603)*	*(0.564)*	*(0.996)*	*(0.266)*	*(1.415)*
Neighborhood (living):						
share vacant houses	-0.009***	-0.009	-0.009	0.006	-0.013***	0.001
	(0.003)	*(0.007)*	*(0.009)*	*(0.012)*	*(0.004)*	*(0.017)*
share new houses	0.134	0.264	-0.075	-1.081	0.227	0.968
	(0.116)	*(0.549)*	*(0.398)*	*(0.839)*	*(0.163)*	*(1.504)*
reported crime (theft)	0.002	-0.001	0.010	-0.001	-0.001	0.002
	(0.002)	*(0.003)*	*(0.007)*	*(0.006)*	*(0.004)*	*(0.009)*
reported crime (vand.)	-0.005***	0.000	-0.002	-0.007*	-0.004***	-0.010
	(0.001)	*(0.003)*	*(0.002)*	*(0.004)*	*(0.001)*	*(0.007)*
Neighborhood (control):						
total number of firms	0.000***	0.000				
	(0.000)	*(0.000)*				
number of firms: R & H			-0.000	-0.001		
			(0.000)	*(0.001)*		
number of firms: B S					0.000**	-0.003
					(0.000)	*(0.002)*
Constant	*1.182****	*1.342****	*0.852*	*0.347*	*1.473****	*0.939*
	(0.156)	*(0.454)*	*(0.525)*	*(0.780)*	*(0.235)*	*(1.159)*
Observations	78,924	24,767	13,460	4,708	25,014	5,401
Number of Startups	29,362	9,931	5,378	2,006	9,417	2,172
R-squared	0.007	0.005	0.007	0.011	0.010	0.007

Standard errors in parentheses

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

Again, for the firm-internal determinants of firm success the predicted results are mostly confirmed, with startups in general and startups in the retail and hospitality services significantly growing with age, regardless of neighborhood location. Furthermore, the squared term of age is significant and negative for these observations, indicating diminishing returns. For startups in

business services, only the linear term of age is significant in neighborhoods outside of Zuid. This may suggest that the diminishing returns in growth for this group are not yet present at the early stages of firm development. Overall, the firm-internal findings seem to give additional support for the previously established findings in the literature.

Regarding the market function of neighborhoods and its effect on startup growth, the findings again give little ground to unconditionally accept hypothesis 2A and 2B. The few significant findings for population size and migration background oppose the expectations established by economic literature. Income does have the expected positive effect on startup growth for firms in retail or hospitality services in all of Rotterdam. However, for startups in business services outside of Rotterdam-Zuid a significant negative link can be found for average income. Finally, secondary education attainment has a significant positive effect on startup growth, but this finding only holds for the models studying neighborhoods outside of Rotterdam-Zuid. As a result, there is too little evidence that local human capital positively influence growth in business service. Hypothesis 2C can thus similarly not be accepted

For the variables relating to a neighborhood's livability quality, only a few significant coefficients can be found. However, these findings are generally congruent with the findings in previous literature, with the share of vacant properties having a significant negative effect on startup growth outside of Rotterdam-Zuid for both firms in general and firms in business services, and cases of vandalism or nuisance having a negative effect on startup growth outside of Zuid for firms in general and firms in business services. The only significant finding for Rotterdam-Zuid relating to livability is the negative link between cases of vandalism or nuisance and the survival prospect of startups in retail or hospitality services. All these findings give some minor evidence for the growth element of hypothesis 1A, 1B, and 1C.

Again, as a robustness check some alternative configurations of the growth models were tested. By omitting some variables with a more limited time range, such as *education* (2013-2017) and *share of vacant houses* (2012-2017), alternative models were created with less explanatory variables that analyze a larger time frame. The findings can be found in *Appendix D*. In some models, the significance changes for coefficients of *firm age*, *share of vacant houses*, *average income, and reported crimes of vandalism*. Interestingly, the significance of the coefficients on the crime measures stay relatively consistent outside of Rotterdam-Zuid, which further supports the findings on livability and startup performance. However, with the other neighborhood characteristics being less robust in their coefficient significance, the overall neighborhood effects on startup growth seem weak.

6. Conclusion

6.1 Discussion & Policy Implications

In this thesis the relationship between the location and performance of new firms was studied. The performance of startups was measured in their ability to survive at least three years and their growth in number of employees. The location data was on the neighborhood level and generally reflected the quality of a neighborhood as a living environment and as a consumer market (Sleutjes, 2012). The aim of this thesis was to determine the role of neighborhoods on the performance of startups. Based on the literature, several hypotheses were formulated with variables indicating a higher or lower quality of the neighborhood expecting to have a respectively similar influence on startup performance.

Generally, this research found some evidence supporting a relationship between startup performance and the living environment function of neighborhoods. Except for the construction year of houses, the significant findings relating to the neighborhood's livability all had the hypothesized effect on startup performance. As the construction year is arguably a less definitive indicator of neighborhood quality (or lack thereof) as crime rates and vacant properties, the hypotheses 1A, 1B, and 1C are at least partially confirmed with deterioration and nuisance having a significant negative effect on survival of startups in Rotterdam, with startups in business services in Rotterdam-Zuid being the sole exception. For startup growth, fewer significant determinants were found, however, there is some evidence that the share of vacant properties and number of reported cases of vandalism or nuisance negatively impact the growth of new firms in some combinations of sectors and regions.

Regarding the market function of neighborhoods, the significant links between indicators of local purchasing power and startup performance were inconsistent, with some significant coefficients having the hypothesized sign while the others had either the opposite effect or no effect. As a result, hypothesis 2A and 2B are rejected, indicating that there is insufficient evidence in support of an overall positive relationship between the market function of neighborhoods and the performance of startups in Rotterdam. The neighborhood is possibly not ideal to analyze as a single market, as the catchment area of firms likely reaches beyond the borders of its neighborhood. Moreover, as only one education coefficient was significant across the models for startups in business services, hypothesis 2C must be rejected indicating that no link between local human capital and startup performance was found for firms in business services.

Concerning the firm-internal determinants of startup success, most of the findings are in support of the established literature, indicating that startups are generally more likely to survive as they increase with size and will grow as they age, but with diminishing returns.

Interestingly, fewer significant findings can be found for Rotterdam-Zuid compared to the other neighborhoods in Rotterdam. This is especially apparent for business services with vacant property being the only significant determinant of startup performance in Rotterdam-Zuid, but only regarding the survival aspect of startups. This could be the result of the relatively smaller sample size but may also indicate at larger systematic problems in Rotterdam-Zuid that make the effect of the determinants used in this study negligible. Another possibility is that the firms located in Rotterdam-Zuid based their location choice on other factors, not included in this thesis, that are strong enough to make the disadvantages in the livability- or market- functions that southern neighborhoods potentially have insignificant. For example, there could be time-variant factors in the community and social aspect of neighborhoods, as discussed by Jacobs (1961) and Sleutjes (2012), which may affect the performance of local-oriented startups in Rotterdam-Zuid to a greater degree than in other neighborhoods.

For local policy, these findings have several implications. First, it seems there is little proof of local startups directly benefiting from higher neighborhood purchasing power. While policy aimed at increasing local wealth may have a myriad of other benefits beyond the scope of this research, this increase in disposable income may not be spent on local firms. Second, policy aimed at making neighborhoods safer and more attractive to firm owners and consumers could directly benefit the performance of young firms in some ways. An important detail to note is the low explanatory power of the growth models. Similarly to the findings by Raspe et al. (2010) the neighborhood effects are responsible for only small part of the variation of firm performance. Thus, it seems wise to address the determinants with a bigger influence on startup performance first, before shifting policy focus on the neighborhood determinants of startup success. Another caveat is that having high regional survival rates of firms may not always be positive, as this can also be an indicator of low levels of regional competitiveness between firms (Brixly & Grotz, 2007).

6.2 Limitations & Suggestions for Future Research

This study has some methodological limitations that should be considered carefully when interpreting the results. The first set of limitations is related to the properties of the data used in this research. First, the dependent variable survival was created with the assumption that firms disappeared from the dataset as a result of firm closure. Firms disappearing from the data as a result of mergers or a move out of the region are thus not accounted for and are potentially marked as a

firm closure. For future research, an official register of bankruptcy, if available, may be a more accurate source of firm operation status. Furthermore, the reason for firm closure is unknown in this research. Birley (1986) noted that a high percentage of firm closures are voluntary and are thus not the result of poor economic performance or hostile environments. Future studies may use this finding to only examine firms that are forced to exit. Additionally, there are some factors that were omitted from this research due to inaccessible- or incompatible- data and may be used in similar follow-up studies if available. Examples include the average age of residents, which may influence local purchasing power, and the more subjective measure of perceived level of safety, which may affect the livability factor of neighborhoods in different ways compared to the absolute number of reported crimes. The share of residents in certain age categories were available in the CBS KWB dataset, but could not be included in this research as a result of multicollinearity between the different age categories and between the number of residents and certain age categories. Furthermore, another measure may be used to better reflect the quality of houses in neighborhoods in future studies. An obvious choice would be house prices, however for the sample used in this research the correlation between house prices and income was too high to avoid multicollinearity problems. Additionally, using the neighborhoods human capital as a proxy for firm human capital may not be the most accurate determinant of firm success. Using firm-internal data for human capital would be preferred for future research if this data is available.

The second set of limitations is related to the specific methods used in this thesis. First, due to a lack of within variation in the dependent variable firm survival, a random effects probit model was chosen. A requirement of random effects models is that the unobserved time-invariant characteristics of startups (α_i) should be independent from the explanatory variables. As it is unlikely that this is the case in practice and only a limited number of time-constant variables could be added to control for this, the results for these models may be biased. An alternative research design that could be used for future research are fixed effects probit or logit models using a dependent variable that changes over time, such as the year of firm exit. However, for these types of models a sample should be chosen that has enough variation in the explanatory variables over time to make within-analysis possible, which may not always be the case in practice. The second limitation is inherent to fixed effects models and relates to the unseen mechanisms causing the variation within explanatory variables. While the results of the fixed effects models can reveal relationships between neighborhood determinants and startup performance, the factors that cause changes in the neighborhood determinants over time are unknown. It is possible that there are omitted variables that causes changes in both the firm performance and neighborhood determinants of firm success. This can be addressed in prospective studies by adding additional time-varying control variables.

A final suggestion for future research would be the implementation of a Heckman selection model, which would first analyze the effects that influence startup survival and subsequently incorporate these findings in the growth analysis models. This method has the advantage of diminishing any selection bias, as surviving firms will likely have different characteristics that may also influence their ability to grow, thus creating a non-random sample. However, as growth was analyzed using a fixed effects model in this research, the analysis in this research is still valid as variation between surviving and exiting firms was not analyzed regarding startup growth.

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VARIABLES	DESCRIPTION	SOURCE	MEAN	SD
Dependent Variables				
banen	Growth Analysis: Total number of jobs at firm	LISA (2017)	1,63	2,24
survive_3y	Survival Analysis: Takes value "1" if firm survives at least 3 years	Generated using LISA (2017)		
Firm-Internal (Controls):				
age	Age of firms, starting at 0 at first observation (growth analysis only)	Generated using LISA (2017)	1,78	1,85
banen	Total number of jobs at firm (survival analysis only)	LISA (2017)	1,63	2,24
Neighborhoods (Markets):				
a_inw	Population size	CBS (2017)	11185,96	5748,67
p_nw_all	Share of residents with a non-Western migration Background	CBS (2017)	0,37	0,18
g_ink_po	Average income per income provider [x € 1,000]	CBS (2017)	30,51	8,93
p_opl_mi	Share of residents with secondary education (incl. MBO) attainment	CBS & OBI (2019)	0,29	0,05
p_opl_ho	Share of residents with higher (tertiary) education attainment	CBS & OBI (2019)	0,26	0,14
Neighborhoods (Living):				
p_leegsw	Share of vacant houses	CBS (2017)	7,17	3,59
p_bjo2k	Share of houses constructed after the year 2000	CBS (2017)	-86,10	17,92
g_wodief	Registered cases of theft from a property [per 1,000 residents]	CBS (2015; 2017)	6,82	3,31
g_vernoo	Registered cases of vandalism or public-order crimes [per 1,000 residents]	CBS (2015; 2017)	11,35	11,84
Neighborhood (Controls):				
a_bedr_tot	Total number of firms	CBS (2017)	959,10	685,53
a_bedr_gi	Number of firms in retail or hospitality services	CBS (2017)	211,27	171,96
a_bedr_mn	Number of firms in business services	CBS (2017)	308,22	292,70

Appendix A: Description of variables used in this research.

Appendix B: Correlation Matrix Independent Variables

(obs=105,595)

	age	banen	a_inw	p_nw_all	g_ink_po	p_opl_mi	p_opl_ho	p_leegsw	p_bjo2k	g_wodief	g_vernoo	a_bedr~t	a_bedr~i	a_bedr~n
age	1.0000													
banen	0.0727	1.0000												
a_inw	-0.0027	-0.0374	1.0000											
p_nw_all	-0.0318	-0.0228	0.0379	1.0000										
g_ink_po	0.0536	0.0498	-0.2738	-0.7296	1.0000									
p_opl_mi	-0.0325	0.0305	0.0610	0.1159	-0.4037	1.0000								
p_opl_ho	0.0372	0.0605	-0.3228	-0.5061	0.7250	-0.3921	1.0000							
p_leegsw	-0.0475	0.0783	-0.2841	0.0317	0.1541	0.1025	0.3544	1.0000						
p_bjo2k	0.0248	0.0326	-0.0925	-0.1603	0.3800	-0.1510	0.1698	0.0561	1.0000					
g_wodief	-0.0956	-0.0007	0.0008	0.3338	-0.3843	0.1090	-0.4637	0.0929	-0.1377	1.0000				
g_vernoo	-0.0539	0.0846	-0.2415	0.0360	0.0554	0.1990	0.2388	0.4331	-0.0082	0.1941	1.0000			
a_bedr_tot	0.0261	0.0495	0.4013	-0.1855	0.2844	-0.1425	0.5188	0.1819	0.0904	-0.2942	0.1978	1.0000		
a_bedr_gi	0.0146	0.0675	0.3802	-0.0582	0.1258	0.0006	0.3653	0.2626	0.0551	-0.1570	0.3302	0.9224	1.0000	
a_bedr_mn	0.0312	0.0505	0.2406	-0.2532	0.4169	-0.2373	0.6460	0.1645	0.1377	-0.3409	0.1829	0.9665	0.8265	1.0000

Appendix C: Robustness Check Survival Analysis

Appendix C: Robustness Check Survival Analysis (survive 5 years)

	All Firms		**Retail & Horeca**		**Business Services**	
VARIABLES	R'dam 5y	Zuid 5y	R'dam 5y	Zuid 5y	R'dam 5y	Zuid 5y
Firm-Internal (control):						
number of jobs	0.445***	0.227***	0.304***	0.313	0.260***	0.013
	(0.033)	*(0.076)*	*(0.066)*	*(0.249)*	*(0.089)*	*(0.061)*
Neighborhood (markets):						
population size	-0.000	-0.000**	-0.000	-0.000**	-0.000*	-0.000
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
share non-Western	0.265	-3.771**	2.190	-1.852	1.787**	-0.557
	(0.514)	*(1.602)*	*(1.496)*	*(3.110)*	*(0.751)*	*(2.562)*
average income	-0.026**	-0.235***	0.027	-0.216	0.031*	-0.266*
	(0.012)	*(0.076)*	*(0.038)*	*(0.174)*	*(0.018)*	*(0.159)*
share educated (sec.)	7.501***	-2.348	5.167	10.003	2.401	3.367
	(1.441)	*(3.878)*	*(3.901)*	*(9.137)*	*(1.843)*	*(8.127)*
share educated (high)	13.312***	-1.171	2.285	-5.607	1.548	12.954
	(0.987)	*(5.477)*	*(2.433)*	*(9.642)*	*(1.388)*	*(11.637)*
Neighborhood (living):						
share vacant houses	-0.144***	-0.186***	-0.081	-0.283**	-0.044*	-0.194**
	(0.018)	*(0.049)*	*(0.053)*	*(0.133)*	*(0.024)*	*(0.096)*
share new houses	-1.294***	9.739***	0.500	14.305	-0.508	6.352
	(0.257)	*(3.525)*	*(1.048)*	*(8.783)*	*(0.377)*	*(5.755)*
reported crime (theft)	-0.089***	-0.054	-0.077	-0.090	-0.065***	0.016
	(0.018)	*(0.039)*	*(0.0476)*	*(0.094)*	*(0.022)*	*(0.089)*
reported crime (vand.)	-0.042***	-0.008	-0.030*	-0.032	-0.015**	-0.032
	(0.005)	*(0.012)*	*(0.016)*	*(0.028)*	*(0.006)*	*(0.038)*
Neighborhood (control):						
total number of firms	-0.000	0.002*				
	(0.000)	*(0.001)*				
number of firms: R & H			0.003	0.016*		
			(0.002)	*(0.008)*		
number of firms: B S					0.001	0.009
					(0.001)	*(0.011)*
Constant	*2.301***	*10.30****	*-2.313*	*6.786*	*-0.032*	*5.228*
	(0.901)	*(3.612)*	*(2.503)*	*(6.776)*	*(1.251)*	*(5.567)*
Observations	32,363	9,182	4,553	1,558	10,379	1,995
Number of Startups	8,175	2,418	1,238	433	2,658	535

Standard errors in parentheses

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

Appendix D: Robustness Check Growth Analysis

Appendix D (1/3): Robustness Check Startup Growth Analysis

	Startups in General					
	Rotterdam			Rotterdam-Zuid		
VARIABLES	2011-2017	2012-2017	final model	2011-2017	2012-2017	final model
Firm-Internal (controls):						
age	0.0367***	0.042***	0.033***	0.056***	0.054***	0.053***
	(0.007)	(0.008)	*(0.007)*	(0.013)	(0.014)	*(0.015)*
age2	-0.001	-0.002	-0.002*	-0.003	-0.003*	-0.004**
	(0.001)	(0.001)	*(0.001)*	(0.002)	(0.002)	*(0.002)*
neighborhoods (markets):						
population size	-0.000***	-0.000***	-0.000***	0.000	0.000	-0.000
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
share non-Western	0.436***	0.413***	0.474***	0.269	0.331	0.151
	(0.156)	(0.155)	*(0.147)*	(0.279)	(0.290)	*(0.325)*
average income	0.000	-0.000	0.001	0.011	0.012	0.011
	(0.003)	(0.003)	*(0.002)*	(0.009)	(0.009)	*(0.010)*
share educated (sec.)			0.953***			0.037
			(0.185)			*(0.570)*
share educated (high)			0.205			-0.800
			(0.177)			*(0.603)*
neighborhoods (living):						
share vacant houses		0.002	-0.009***		-0.004	-0.009
		(0.003)	*(0.003)*		(0.005)	*(0.007)*
share new houses	0.054	-0.025	0.134	0.205	0.232	0.264
	(0.109)	(0.115)	*(0.116)*	(0.380)	(0.416)	*(0.549)*
reported crime (theft)	0.000	0.001	0.002	-0.003	-0.002	-0.001
	(0.003)	(0.003)	*(0.002)*	(0.003)	(0.003)	*(0.003)*
reported crime (vand.)	-0.004***	-0.004***	-0.005***	0.002	0.002	0.000
	(0.001)	(0.001)	*(0.001)*	(0.002)	(0.002)	*(0.003)*
Nieghborhood (control):						
total number of firms	0.000***	0.000***	0.000***	-0.000	-0.000	0.000
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
Constant	1.52***	1.510***	1.182***	1.085***	1.072***	1.342***
	(0.129)	(0.128)	(0.156)	(0.327)	(0.340)	(0.454)
Observations	95,731	88,504	78,924	29,983	27,838	24,767
Number of startups	31,808	30,879	29,362	10,881	10,584	9,931
R-squared	0.005	0.005	0.007	0.004	0.004	0.005

Standard errors in parentheses

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

Appendix D, continued (2/3): Robustness Check Startup Growth Analysis

	Startups in Retail & Horeca					
	Rotterdam			Rotterdam-Zuid		
VARIABLES	2011-2017	2012-2017	final model	2011-2017	2012-2017	final model
Firm-Internal (controls):						
age	0.092***	0.071***	0.084***	0.038**	0.046**	0.071***
	(0.021)	(0.020)	*(0.021)*	(0.019)	(0.021)	*(0.024)*
age2	-0.009***	-0.007**	-0.011***	-0.004	-0.006**	-0.011***
	(0.003)	(0.003)	*(0.003)*	(0.003)	(0.003)	*(0.003)*
neighborhoods (markets):						
population size	0.000	-0.000	-0.000	0.000	0.000	0.000
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
share non-Western	0.332	0.440	0.928	0.551	0.546	0.856
	(0.553)	(0.516)	*(0.569)*	(0.561)	(0.583)	*(0.640)*
average income	0.017**	0.019***	0.019***	0.030**	0.030*	0.030*
	(0.008)	(0.007)	*(0.007)*	(0.015)	(0.016)	*(0.016)*
share educated (sec.)			1.729***			0.612
			(0.599)			*(0.935)*
share educated (high)			0.251			0.611
			(0.564)			*(0.996)*
neighborhoods (living):						
share vacant houses		-0.006	-0.009		0.000	0.006
		(0.008)	*(0.009)*		(0.009)	*(0.012)*
share new houses	-0.144	0.046	-0.075	-0.025	-0.236	-1.081
	(0.331)	(0.328)	*(0.398)*	(0.638)	(0.691)	*(0.839)*
reported crime (theft)	0.006	0.009	0.010	-0.001	-0.002	-0.001
	(0.007)	(0.007)	*(0.007)*	(0.005)	(0.005)	*(0.006)*
reported crime (vand.)	-0.001	0.001	-0.002	0.000	-0.001	-0.007*
	(0.002)	(0.002)	*(0.002)*	(0.003)	(0.003)	*(0.004)*
Nieghborhood (control):						
a_bedr_gi	0.000	0.000	-0.000	-0.002	-0.002	-0.001
	(0.000)	(0.000)	*(0.000)*	(0.001)	(0.001)	*(0.001)*
Constant	1.387***	1.382***	0.852	0.677	0.711	0.347
	(0.402)	(0.377)	(0.525)	(0.580)	(0.613)	(0.780)
Observations	16,227	15,012	13,460	5,687	5,279	4,708
Number of startups	5,966	5,713	5,378	2,235	2,155	2,006
R-squared	0.005	0.003	0.007	0.003	0.004	0.011

Standard errors in parentheses

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

Appendix D, continued (3/3): Robustness Check Startup Growth Analysis

	Startups in Business Services					
	Rotterdam			Rotterdam-Zuid		
VARIABLES	2011-2017	2012-2017	final model	2011-2017	2012-2017	final model
Firm-Internal (controls):						
age	0.023**	0.026***	0.025**	0.070*	0.094**	0.037
	(0.011)	(0.010)	*(0.011)*	(0.037)	(0.039)	*(0.038)*
age2	0.001	0.001	0.000	-0.005	-0.003	0.003
	(0.002)	(0.001)	*(0.001)*	(0.005)	(0.005)	*(0.005)*
neighborhoods (markets):						
population size	-0.000	-0.000	0.000	0.000	0.000	0.000
	(0.000)	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*	*(0.000)*
share non-Western	-0.163	-0.145	-0.215	0.303	0.446	0.180
	(0.219)	(0.184)	*(0.228)*	(0.795)	(0.861)	*(0.830)*
average income	-0.005	-0.006**	-0.008**	-0.005	0.004	0.003
	(0.004)	(0.003)	*(0.003)*	(0.025)	(0.025)	*(0.024)*
share educated (sec.)			0.946***			1.923
			(0.292)			*(1.498)*
share educated (high)			0.184			-0.377
			(0.266)			*(1.415)*
neighborhoods (living):						
share vacant houses		-0.005	-0.013***		0.017	0.001
		(0.003)	*(0.004)*		(0.015)	*(0.017)*
share new houses	0.098	0.100	0.227	-0.262	-0.515	0.968
	(0.144)	(0.128)	*(0.163)*	(1.061)	(1.178)	*(1.504)*
reported crime (theft)	-0.003	-0.002	-0.001	-0.010	-0.001	0.002
	(0.004)	(0.003)	*(0.004)*	(0.009)	(0.009)	*(0.009)*
reported crime (vand.)	-0.001*	-0.003***	-0.004***	-0.007	-0.007	-0.010
	(0.001)	(0.001)	*(0.001)*	(0.007)	(0.007)	*(0.007)*
Nieghborhood (control):						
a_bedr_mn	0.000***	0.000***	0.000**	-0.001	-0.002	-0.003
	(0.000)	*(0.000)*	*(0.000)*	(0.002)	(0.002)	*(0.002)*
Constant	1.667***	1.723***	1.473***	1.703*	1.227	0.939
	(0.175)	(0.147)	(0.235)	(0.921)	(0.965)	(1.159)
Observations	30,378	28,061	25,014	6,578	6,080	5,401
Number of startups	10,178	9,883	9,417	2,408	2,324	2,172
R-squared	0.005	0.009	0.010	0.005	0.007	0.007

Standard errors in parentheses

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