STOCKHOLM SCHOOL OF ECONOMICS

Department of Economics

Bachelor´s Thesis – Course 659

Spring 2013

Working for the Man

A cross-sectional study of single industry towns' effect on entrepreneurship

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Abstract

Over the last decades, the once prominent single industry towns have gained an unfortunate status as myopic and conformist communities with an adverse entrepreneurial climate. Although the rich history and the economic transitions of single industry towns are well documented in research, limited effort has been made to empirically establish the towns' assumed negative relationship with entrepreneurship. Building upon this notion, we use econometric methods to investigate if this perception is applicable to single industry towns in modern Sweden. By using data on a municipal level, we find a significant and negative relationship between single industry towns and entrepreneurship. The results are supported through an instrumental variable approach. Even though the risk of omitted variables prevents us from inferring a causal relationship, we conclude that single industry towns have a systematic and negative relationship with entrepreneurship.

Key words: Single industry towns, entrepreneurship, regional growth, geographical economics

JEL codes: R11, L11, L26, O14

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Presentation: June 7, 2013

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Acknowledgment

We would like to thank out tutor Erik Meyersson, at the Stockholm Institute of Transition Economics at the Stockholm School of Economics, for valuable support. We also thank Örjan Sjöberg, Professor at the Department of Economics at the Stockholm School of Economics, for inspiration and guidance.

We would also like to express our gratitude to Juanna Joensen, Assistant Professor at the Department of Economics at the Stockholm School of Economics, and finally Håkan Lyckeborg, Lecturer at the Center of Economic Statistics at the Stockholm School of Economics and a friend in need.

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1. Introduction

In 1660, Degerfors iron works was founded and during the ensuing three century-long history of industrial production, the entwined community became known for a culture of brotherhood, solidarity and vocational pride. In 2013, Degerfors is a town with one of the lowest levels of entrepreneurship in Sweden, and the unique culture developed in this town is generally perceived to be a reason of these low levels. Although this development is typical for single industry towns[1] in Sweden, the perception of single industry towns' influence on entrepreneurship has not been empirically established. At the same time, entrepreneurship has gained increased emphasis in economic research and policymaking due to its connection with economic growth (Glaeser and Kerr, 2009). Thus, to provide sound decision support for entrepreneurial stimulation efforts there is reason to study the effect of single industry towns and further explain why regional discrepancies of entrepreneurship may prevail.

Up to this point related economic research has predominantly focused on economic transitions and assessed how communities cope with restructuring (O'Hagan and Cecil, 2007, p. 19). However, one study has been conducted to measure entrepreneurship in a region with single industry towns through a statistical method (Hedfeldt, 2008). The paper concludes that there are large discrepancies in entrepreneurship levels between municipalities in the region and that only the region's male population shows entrepreneurship levels noticeably below the national average (Hedfeldt, 2008 p. 70). This paper sets out to test, and further extend the knowledge of, this relationship by using econometric techniques and expanding the geographical scope to a national level.

In an attempt to shed light on the reasons why entrepreneurship levels differ in single industry towns, we study determinants of entrepreneurship in an occupational choice framework. The framework recognises individuals as utility maximisers that choose between entrepreneurship and employment depending on the expected utility outcomes of the alternatives. By applying previous research and our own reasoning, to analyse how single industry towns affect determinants of entrepreneurship, we land in the hypothesis that single industry towns have a

[1] A single industry town is a locality whose economic activity is formed around a dominant employer (a mill), typically within primary industries. The expression includes both localities with active mills and localities whose mills have closed but have influenced the population for a long period of time. The Swedish expression for a single industry town is *bruksort*.

negative effect on the level of entrepreneurship and that this effect remains even after the mill[2] has closed.

To test this hypothesis, we study if entrepreneurship, measured as new business registrations, systematically differs for municipalities with single industry towns. More precisely, we conduct an ordinary least squares regression in which we control for differences in geographical and regional endowments to account for predetermined entrepreneurial conditions. Because of the difficulty in controlling for factors that correlate with entrepreneurship and single industry towns, we complement our study with an instrumental variable approach. We rely on the close connection between early-days iron refining sites and single industry towns to construct a relevant instrument based on ferrous metal deposits.

The results of these regressions suggest that single industry towns are systematically associated with lower levels of entrepreneurship. We obtain a relationship corresponding to roughly 10% below the national average of new business registrations. However, with a remaining risk of unobserved factors we are tentative to draw conclusions about the magnitude and causality of the relationship between the two variables. Rather, we interpret the stability of the results as a sign of a robust, negative relationship between single industry towns and entrepreneurship.

The paper proceeds as follows. The next section presents the background of Swedish single industry towns as well as a review of previous research and literature on single industry towns and entrepreneurship. Subsequently, the third section discusses the occupational choice model used as theoretical framework, and the discussion through which we formulate our hypotheses. In the fourth and fifth section, we provide information about the data and discuss our empirical method. The sixth section presents and discusses our results and the seventh section discusses the robustness of the instrumental variable approach. The eighth and final section concludes by presenting possible limitations of the study, policy implications and suggestions for future research.

[2] We refer to a mill as the dominant enterprise in the single industry town.

2. Previous Research

2.1 Research on entrepreneurship in single industry towns

For more than a century, single industry towns were the propulsion of Sweden's industrial development. This rich heritage has made the towns scrutinised in economic, economic history and cultural geography research (Hedfeldt, 2008, p. 30). Since the steel crisis[3] in the 1970's, single industry towns have been on a downward economic spiral, which has triggered researchers to examine economic transitions and restructuring in these regions (Barnes and Hayter, 1994, p. 7). Although low levels of entrepreneurship are frequently mentioned in these papers, little attention has been paid to investigate single industry towns' impact on entrepreneurship.

One researcher who has addressed the relationship between single industry towns and entrepreneurship in a Swedish context is Hedfeldt (2008), although with a primary focus on women's entrepreneurship. The geographical scope of the paper is Bergslagen, a region abundant with single industry towns and which is associated with low levels of entrepreneurship. The study is conducted through a statistical analysis on registry-based longitudinal data and qualitative interviews. The results show that the region's share of entrepreneurs, or self-employed, are 1.7 percentage points lower than the national average for the male population and 0.4 percentage points lower for the female population. The author concludes that only the male population shows entrepreneurial levels that are noticeably below the Swedish average. Another finding in the paper, that according to Hedfeldt (2008) contradicts the general perception of low levels of entrepreneurship in the region, is that there were large differences in entrepreneurship between the municipalities. The study is based on the assumption that municipalities in Sweden are directly comparable since the used method does not consider inherent differences between municipalities that could cause differences in the levels of entrepreneurship.

2.2 Economic development of single industry towns

A single industry town is recognised as a locality whose economic activity is formed around a dominant employer, typically within primary industries. The expression includes both localities with active mills and towns whose mills have closed but have influenced the population for a long period of time (Hedfeldt, 2008, p. 30; Andersson, 2008, p. 23; Moderaterna, 2012, p. 5). The terminology for these towns is diverse and includes the expressions single industry towns, resource towns, mill towns and one-company towns.

[3] The steel crisis was a recession in the global steel market in the 1970s (Blair, 1997).

The history of Swedish single industry towns can be traced back to the Middle Ages. In the 17th and 18th century the development accelerated when a large number of mills were established. Many of these mills were refining sites of iron (Bergdahl, Isacson, and Mellander, 1997). The industries were generally located in isolated places endowed with ore, forest and waterpower (Hedfeldt, 2008). Gradually, these establishments grew into large employers[4] (Andersson, 2008, p. 23).

Because of the mills' dominant position in the communities, a strong relationship was formed between employers and employees that resulted in a distinctive working culture, known as the mill spirit[5]. The mill spirit was characterised by strong affiliation for the community, friendship and loyalty (Jacobsson, 1976). The mills were dominant not only in the sense that they provided the majority of the work opportunities, they also offered benefits and social activities such as housing, healthcare and the possibility to engage in team sports (Bergdahl et al., 1997). The reasons why the mills handled many of the tasks that today are run by the government was both the remotness of many single industry towns and the employers' motivation to tie the workforce to the town (Ekman, 1996). Consequently, the relationship between workforce and employer extended beyond the borders of the workplace and was present in everyday life, even for people not employed in the mill (Hedfeldt, 2008, p. 30). Due to the availability of low-skilled work opportunities the need for higher education was limited. The persisted low levels of education are today considered to be a legacy of the mill spirit (Andersson, 2008, p. 29).

In the latter half of the 19th century a major wave of consolidation hit the single industry towns, a period that became known for the death of single industry towns[6]. During this period, many small mills were forced out of business because of their inability to meet the increased foreign competition (Andersson, 2008, p. 24). During the 1920 and 30s, a large part of the employee benefits was reduced and in connection with this process workers started to organise in unions (Andersson, 1997, p 24). A second wave of mill closures occurred 50 years later with the steel crisis in the 1970s. What followed were high levels of unemployment and outflows of people from these towns (Hedfeldt, 2008, p. 39).

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[4] Due to the economies of scales in the concerned industries the establishments often grew into large enterprises.
[5] Translated by the authors. The Swedish expression for mill spirit is *bruksanda.*
[6] The Swedish expression for the period is *bruksdöden.*

As implied, single industry towns are dependent on their mill (O'Hagan and Cecil, 2007, p. 20). The narrow economic base makes these economies prone to boom and bust cycles in a way that diversified economies are not. The vulnerability has increased in pace with globalisation and new technologies as resources have become more easily substituted and production more easily moveable (Barnes and Hayter, 1994, p. 298). Today a fraction of the single industry towns in Sweden have active mills. In single industry towns where the mill has closed the municipality is often an important employer (Hedfeldt, 2008). This process of change has put significant pressure on single industry town's residents and policymakers to revitalise the communities. It was in this context of restructuring single industry towns the mill spirit first became considered as an obstacle for future development (Andersson, 2008, p. 24).

2.3 Culture and entrepreneurship in single industry towns

In a qualitative study by Karlsson and Lönnbring (2007), the mill spirit is described as a uniform culture with a negative effect on the number of newly started companies. The authors state that the culture impedes entrepreneurship since people do not want to stand out from the crowd and individual success is viewed upon as inappropriate. Similar research in the field finds that these towns show a lack of individual initiatives and scepticism of what is perceived as foreign (Bergdahl et al., 1997). According to the European commission (1995), the mill spirit is partly responsible for the low levels of small and medium sized companies in Bergslagen. On the other hand, Ekman (1996) argues that the conservative spirit associated with the single industry towns is in fact something that can be found in many of Sweden's rural regions.

In accordance with Bergdahl et al. (1997), Barnes and Hayter (1994, p. 294) claim that single-industry towns often have a history that lacks individual initiative, causing structural constraints on entrepreneurship. They argue that when emphasis lies on receiving orders rather than giving them it may hinder entrepreneurial initiatives. The argument is based on Lucas (1971) who describes that decision-making and other entrepreneurial activities are commonly located outside of single industry towns. Barnes and Hayter (1994, p. 294) further discuss the lack of entrepreneurial role models in these towns and state that in order to learn one usually needs someone to learn from which, given the narrow economic base of single industry towns, is difficult to find.

2.4 Theories on entrepreneurship

The study of entrepreneurship largely originates from the near century old work of Schumpeter. This field of study has maintained its prominence into modern times due to the link between entrepreneurship and economic growth (Glaeser, Kallal, Scheinkman, and Shleifer, 1992; Delgado, Porter, and Stern, 2010a, 2010b; Rosenthal and Strange, 2003, 2010). Schumpeter (1965) defines entrepreneurship as individuals who exploit market opportunities through technical and/or organisational innovation. These actions would lead to a "creative destruction", through which entrepreneurial innovations would wreck already established firms. However, the net gains from this dynamic would be positive due to the accompanied increase in productivity. Therefore, this is considered to be the motor of long-term economic growth (Schumpeter, 1942), or the free market's messy way of delivering progress (Cox and Alm, 2008). Thus the Schumpeterian view revolves around opportunity-based and economic growth driven entrepreneurship. This view excludes companies created out of necessity that arise when the economic climate is too hard for employment (Poschke, 2008, p. 4). Poschke suggest an U-shaped relationship; businesses are created when there are plenty of opportunities or scarce opportunities.

Scholars define entrepreneurship differently. Knight (1971) argues that entrepreneurship revolves around risk-appetite, and states that an entrepreneur is willing to risk a safe financial situation and invest both time and capital on an uncertain outcome. Hisrich (1990) incorporates the risk aspect as well, but is less strict in the demand on innovation and opportunity compared with Schumpeter, and characterises an entrepreneur as "someone who demonstrates initiative and creative thinking, is able to organize social and economic mechanisms to turn resources and situations to practical account, and accepts risk and failure". Schumpeter, Knight and their peers wrote detailed, well informed books explaining the value of entrepreneurship: however, they did not give it a clear, empirically usable definition (Glaeser and Kerr, 2010). The classification issue for researchers lies within the complexity of measuring innovation (Hisrich, 1990).

2.5 Regional determinants of entrepreneurship

Empirical evidence supports that there are wide variations in entrepreneurship within countries (Reynolds, 1992; Davidsson, Lindmark, and Olofsson, 1994). A prevalent explanation for this discrepancy is regional cluster theory. According to Saxenian (1994) entrepreneurship is spurred in regions with an abundance of small firms as they cause further entrepreneurship by reducing the effective cost of entry through the existence of suppliers, venture capitalists and entrepreneurial culture. Related studies confirm that regions with many owner-managed firms lead to higher rates of new firm formation (Davidsson et al. 1994; Reynolds, Storey, and Westhead, 1994). Also Chinitz (1961) argue that large companies affect a region's level of entrepreneurship negatively through the establishment of a less entrepreneurial culture and a lower social status associated with entrepreneurship. Furthermore, a handful of studies find that small firms that are geographically close facilitate entrepreneurship through a social infrastructure of contacts and networks (Aldrich and Brickman Elam, 1995; Field, 2003; Renzulli, Aldrich, and Moody, 2000). Building upon Saxenian (1994) and Chinitz (1961), Glaeser and Kerr (2009) provide empirical evidence for entrepreneurship's connection, measured as average establishment size, with regional economic growth. More precisely, the scholars show that a 10% increase in the number of firms per worker in 1977 at the city level is associated with a 9% increase in employment growth between 1977 and 2000.

Regional institutions, such as universities and libraries, together with government policy, play a critical role in the formation of new firms (Davidsson, Terjesen and Yang, 2008). Regional entrepreneurship may be wrecked if local institutions get locked in a process of rigidity and inflexibility (Grabher, 1993). According to Leslie and Kargon (1994) this is the case for single industry towns. They further discuss that the low levels of entrepreneurship in these towns reflect an absence of role models, knowledge about how firms are created and awareness of how successful economic activity is generated (Leslie and Kargon, 1994). Related studies by Wagner and Sternberg (2004) found that people with entrepreneurial role models are more likely to start companies[7].

An alternative explanation for regional differences in entrepreneurship, suggested by Glaeser and Kerr (2010), is that some regions may have a greater supply of entrepreneurs for a range of reasons. The scholars propose that these reasons could be differences in age and education of a region's population, or inherited regional cost advantages, such as coastal access and a favourable climate.

2.6 Individual determinants of entrepreneurship

Occupational choice models are a common foundation in studies about why an individual becomes an entrepreneur. This theory views individuals as utility maximisers who choose

[7] The impact of entrepreneurial role models has been established for parents (Figueiredoa et al., 2002), in-laws (Dunn and Holtz-Eakin, 2000) and friends (Delmar and Davidsson, 2000).

between self-employment (entrepreneurship) and employment. Grilo and Thurik (2006) have developed an occupational choice framework in which four types of determinants of entrepreneurship are identified[8]. The first is entrepreneurial efficiency (Jovanovic, 1982, 1994; Lucas, 1978; Murphy, Shleifer and Vishny, 1991; Holmes and Schmitz, 1990). Entrepreneurs perform many tasks, especially in the start-up phase, and therefore they have to be "jacks of all trade" to some extent (Lazear, 2004).

The second determinant of entrepreneurship involves risk (Knight, 1971; Kihlstrom and Laffont, 1979). Parker (1996) found that more risk-averse individuals are more likely to become employed and less risk-averse individuals are more likely to become entrepreneurs. Moreover, the risk-appetite of individuals is not constant over time and can change depending on the economic climate (Rampini, 2004). Included in the risk dimension, is the relative payoff between entrepreneurship and employment. The general perception that a high economic payoff for entrepreneurship leads an individual to become an entrepreneur is confirmed in several studies (Rees and Shah, 1986; Dolton and Makepeace, 1990; Bernhardt, 1994; Taylor, 1996). However, economic parameters do not seem to fully determine the occupational choice since conflicting results have been presented by Gill (1988) and Earle and Sakova (2000). According to research on necessity-based entrepreneurship, entrepreneurial activity should rise when unemployment increases because of the increase in relative payoff for entrepreneurship (Parker, 1996).

The third discussed factor is liquidity constraints impact on entrepreneurship. According to Taylor (2001, p. 539), capital constraints can prohibit potential entrepreneurs from starting up a business, restrict the growth of existing activities and also result in the failure of an enterprise. The final view considers that a multitude of factors, such as preferences, abilities and resources of individuals, determine the utility of entrepreneurship (Grilo and Thurik, 2006). For instance, preferences for autonomy (Hamilton, 2000) and commuting time to work (Karlsson and Lekvall 2002) are non-economic factors that have been found to influence the occupational choice.

2.7 Summary

In conclusion, previous related research primarily uses qualitative methods to explain single industry towns' relationship with entrepreneurship. The economic papers devoted to the subject instead place emphasis on these towns' restructuring and transition processes. These economic

[8] For alternative occupational choice models see Kihlstrom and Laffont (1979), van Praag and Cramer (2001), and Parker (2004).

papers and related literature have developed a consensus that single industry towns are associated with low levels of entrepreneurship but there has been no attempt to econometrically test the relationship. In this paper, the relationship is examined through econometric techniques in an attempt to disentangle the effect of single industry towns. Our results build further on those established by Hedfeldt (2008), who investigates this relationship in a Swedish context. The foundation for our reasoning is primarily found within research on regional clusters and the cultural traits of the single industry towns.

3. Theory

3.1 Occupational choice framework

In this section, we connect previous literature on single industry towns with previous research on regional entrepreneurship to explain how single industry towns may affect entrepreneurship. To structure which determinants of entrepreneurship that could be affected by single industry towns, we adapt an occupational choice framework proposed by Grilo and Thurik (2006). In this framework, first introduced in section 2.6, individuals are utility maximisers that become either employed or entrepreneurs depending on the utility associated with the two alternatives. To recapture, the framework suggests determinants of entrepreneurship that can be categorised in four dimensions, i) entrepreneurial ability ii) risk and return iii) liquidity constraints and iv) an eclectic dimension that includes individual preferences, abilities and resources. In a translation of the reasoning by Grilo and Thurik (2006), Carlsén and Zhou (2012) formulated the following occupational choice equation:

$$UD_i = U_{ei}\left[A_{ei} * \frac{E(E_e)}{r_e}; NMP_{ei}\right] - U_{wi}\left[A_{wi} * \frac{E(E_w)}{r_w}; NMP_{wi}\right]$$

The model assumes that individual (*i*) is indifferent in the choice between entrepreneurship and employment when the expected utility for the two alternatives are equal. Hence, if (UD_i), the utility difference between utility of entrepreneurship (U_{ei}) and the utility of employment (U_{wi}), is >0, then the individual *(i)* becomes an entrepreneur. The utility of entrepreneurship (U_{ei}) is a function of the individual's entrepreneurial abilities (A_{ei}), the general level of expected earnings as entrepreneur ($E(E_e)$), the general risk associated with entrepreneurship (r_e) and the non-monetary returns to entrepreneurship (NMP_{ei}). Analogous, the utility of employment (U_{wi}) is a function of the individual's abilities for employment (A_{wi}), the general level of expected earnings as employee ($E(E_w)$), the general risk associated with employment (r_w) and the non-monetary returns to employment (NMP_{wi}). We adapt the equation by incorporating the liquidity constraint in the risk component. The fourth dimension in the framework, regarding the individual's preferences, abilities and resources, corresponds to the non-monetary returns component in the equation.

3.2 Single industry towns' impact on the occupational choice model

In the remaining part of this section we discuss how the presence of single industry towns affect the different components in the presented occupational choice equation, and hence, affect the choice of becoming an entrepreneur. On the basis of this discussion we formulate our hypothesis of the single industry towns' effect on entrepreneurship. We argue that single industry towns affect the occupational choice through; lower entrepreneurial ability (A_{ei}) relative to employment, higher general risk associated with entrepreneurship (r_e) relative to employment, and lower non-monetary returns to entrepreneurship (NMP_{ei}) relative to employment. Based on previous research, we do not find that expected earnings of entrepreneurship ($E(E_e)$) relative to employment differ for single industry towns.

Entrepreneurial ability relative to employment ability

We judge that the lack of individual initiative decreases entrepreneurial ability in single industry towns, even after the mill has closed. Lazear (2004) argues that an entrepreneur must be "jacks of all trade" and we reason that individual initiative must be an important component of this trait. Accordingly, Barnes and Hayter (1994) claim that the single industry towns' lack of individual initiative hinders local entrepreneurship. Similar conclusions are drawn in a Swedish context in which researchers have expressed a view of impaired individual initiative in single industry towns (Bergdahl et al., 1997). These views date back to Lucas (1971) who states that single industry town populations historically have not developed entrepreneurial skills, such as decision-making, since activities relating to these skills were handled outside of the towns. The historically poor entrepreneurial abilities are intergenerationally transmitted through lack of role models (Chinitz, 1961).

Another aspect, that correlates with single industry towns, influencing entrepreneurial ability is education (Robinson and Sexton, 1994; Cooper and Dunkelberg, 1987). However, education is also likely to affect employment ability and therefore the net effect of increased education is unclear. Education is a form of human capital and people with higher educational levels have been found in studies to have a positive impact on the performance of new companies (Cooper and Dunkelberg, 1987; Cooper, Gimeno-Gascon and Woo, 1994). The empirical studies of the direct relationship between education and entrepreneurship however yield ambiguous results; some scholars find a negative relationship and others find a positive one (Grilo and Thurik, 2006). The first group of scholars, arguing for a positive impact, are considered to represent the more conventional view (Parker, 2004). Furthermore, Swedish policy makers seem to agree that increased levels of education are linked to higher levels of entrepreneurship and work to promote increased education levels in rural Sweden and single industry towns (Moderaterna, 2012).

Expected earnings of entrepreneurship relative to employment

We do not find support in research for the idea that expected earnings for entrepreneurship or employment differ for single industry towns. Scholars have investigated if particular places or industries have greater returns to entrepreneurship as a potential explanation to why entrepreneurial levels differ between regions (Glaeser and Kerr, 2009; Saxenian, 1994). Nevertheless they conclude this theory to be insufficient. This implies that the differences in returns to entrepreneurship do not explain levels of entrepreneurship in single industry towns. On the other hand, differences in entrepreneurship could derive to relatively high expected earnings of employment compared to entrepreneurship. In a historic perspective this is a plausible explanation considering the high wages for industrial workers (Barnes and Hayter, 1994, p. 297; Hedfeldt, 2008, p. 20). Even though there are still active mills, we reason that the increased competition in these industries is expected to have levelled potential discrepancies with other types of employment.

Risk associated with entrepreneurship relative to employment

We hypothesise that the single industry towns' populations are more risk-averse and therefore perceive entrepreneurship less attractive. According to Kihlstrom and Laffont (1979) and Parker (1996) risk-averse individuals are more prone to choose employment before entrepreneurship. Attitude towards risk is affected by parental background. Higher level of parental education is shown to have a positive relationship with the willingness to take on risk (Dohmen, Falk, Huffman, Sunde, Schupp and Wagner, 2005). As previously discussed, single industry towns generally have lower levels of education[9], and thus these towns are likely to have more risk-averse populations. The risk-averse behaviour is also expected to persist even after closure of the mill due to intergenerational transmission (De Paola, 2013). Another factor that can make risk-aversion increase is a deteriorating economic climate (Rampini, 2004). The hardship single industry towns have endured as a result of mill closures, with periods of unemployment, has therefore presumably caused these populations' risk-aversion to increase.

[9] See Table 10 in the Appendix for correlation between education levels and single industry towns.

To continue, we consider factors that affect the actual risk of the occupational choice and conclude that single industry towns have higher effective cost of market entry that increases the risk of entrepreneurship. Returning to the work of Saxenian (1994), an abundance of small firms reduce the effective cost of entry through the existence of suppliers, venture capitalists and entrepreneurial culture. Thus, relatively high cost of entry in regions that do not have an abundance of smaller firms, such as single industry towns, decrease the net returns to entrepreneurship. In that sense, the general risk of engaging in entrepreneurship could be perceived higher for single industry towns and make the choice of entrepreneurship less attractive. We acknowledge that the risk of employment in single industry towns is likely to have increased as a result of the numerous closures in primary industries. However, when considering the social safety net in Sweden, the relative risk of entrepreneurship compared to employment is expected to be higher in single industry towns.

Non-monetary returns of entrepreneurship relative to employment

We deem that the non-monetary returns to entrepreneurship are negatively influenced by the culture and norms in single industry towns or, analogously, that the non-monetary returns to employment are particularly high. The mills' function as local governments in the single industry towns made them important institutions that greatly impacted the local population. Thus, the single industry towns developed in a distinctive institutional environment that we argue still affect the local population.

The cultural traits of the mill spirit make a parallel to the framework for cultural identification proposed by Hofstede (1984) useful. In this framework culture can be categorised on an individualism-collectivism scale. Individualism emphasises personal freedom and achievements while collectivism emphasises interdependencies of individuals in a larger group. It can be argued that the mill spirit belongs to a collectivistic culture due to the explicit emphasis on sharing, strong affiliation to the community and a concern with group welfare (Bergdahl et al., 1997; Morris, Davis and Allen, 1994). The expressed resistance towards non-unionised entrepreneurship is in our view a further indication of a collectivistic culture (Hedfeldt, 2008, p. 20; Barnes and Hayter, 1994, p. 296). Research suggests that individualistic cultures are associated with more entrepreneurship than collectivistic cultures (Mitchell, Smith, Seawright and Morse, 2000; Gorodnichenko and Roland, 2010). Hence, we reason that single industry towns are likely to be linked to lower levels of entrepreneurship.

Our argumentation is supported by the work of Chinitz (1961), who describes an aura of second-class citizenship associated with the small businessman, or entrepreneur, in a region otherwise dominated by big businesses. This reasoning is also in line with the view found in the research by Davidsson, Lindmark and Olofsson (1996) who report that single industry town residents agree that entrepreneurship contributes poorly to social welfare.

3.3 Concluding remarks and hypothesis formulation

Based on the discussion about single industry towns' impact on the occupational choice equation, we hypothesise that:

Single industry towns have a negative effect on entrepreneurship.

More precisely, we believe that this effect is linked to single industry towns; decreased entrepreneurial abilities (A_{ei}), increased risk associated with entrepreneurship (r_e) and decreased non-monetary returns to entrepreneurship (NMP_{ei}), compared to employment. The largest effect is expected to relate to the lack of small business clusters that increases the risk associated with entrepreneurship and the cultural traits that lower the non-monetary returns to entrepreneurship. The former is most relevant for single industry towns with active mills, while the latter is expected to persist even after the mill has closed. From this reasoning we form our second hypothesis:

Single industry towns have a negative effect on entrepreneurship, even after the mill has closed.

In the following sections, we attempt to establish and quantify these hypotheses.

4. Data Presentation

In this study we use cross-sectional data on Sweden's 290 municipalities collected from Statistics Sweden (SCB) and the Sweden Company Registration Office (SCRO). The data from SCB concerns population sizes, geographical measures and education levels and the data from SCRO contains information about new business registrations. This data has been collected on a yearly basis between 1993 and 2011. Variable definitions and sources are provided in Table 1. In Table 2 and Table 3 we present statistical descriptions of the variables.

Collecting data on a municipal level is sensible since the administrative system in Sweden is built around municipalities and they are thereby the lowest regional level for which a range of statistical data is publically available. Another reason for this geographical scope is that municipalities are the governmental body that is closest to the citizens in the political system and can encourage entrepreneurship through their role as policymakers.

Our entrepreneurship data is collected from SCRO and defined as number of new business registrations between 1993 and 2011. The data is then put in relation to the municipality's population in working age[10]. New business registrations include registrations for limited liability companies, economic associations, partnerships and one-man businesses. The data includes new business registrations that are filed for administrative purposes, such as holding companies.

The data on Swedish single industry towns is collected from Harmens's register available at the National Archives of Sweden (Harmens, 2006). The register is based on data concerning single industry towns before 1860, compiled by Lars Harmens[11]. Since the register only covers single industry towns that were founded before 1860 we have complemented this list with information from Wikipedia, an online encyclopaedia open for the public to edit (Wikipedia, 2013). We acknowledge that Wikipedia has limitations due to its open content. The data gathered from this encyclopaedia concerns identification of single industry towns. To the furthest extent we have confirmed the collected data from this site with alternative sources such as the database Retriever for company information in Sweden and literature on single industry towns, see Table 11 in Appendix. In this process we were also able to distinguish which single industry towns that have active mills. The dataset contains 267 single industry towns distributed across 131 municipalities, displayed in Table 9 and Table 12 in Appendix.

[10] SCB defines working age as between 16 and 74 years old.
[11] Lars Harmens was an actuary and inspector of mines (Umeå universitetsbibliotek).

The extent to which a municipality is influenced by single industry towns is not easily measured. Previous studies in the field leave us with little guidance as they narrow their geographical scope to the single industry town abundant region Bergslagen, with the assumption that these municipalities are equally influenced by single industry towns. Given the difficulties in measuring the influence of the mills both within the single industry town itself, and within the municipality we have simplified by collecting data on those municipalities which have at least one single industry town. We have considered the issue of sample selection bias since the data is based on subjective definitions of the mill's dominance and historical importance, and the risk of omitted single industry towns. We judge our variable not to be significantly biased since we have conducted extensive further research to validate each town and to search for potentially omitted single industry towns. Furthermore we have plotted municipalities with single industry towns on a map to see if clusters of municipalities with single industry towns appear to have missing municipalities within, see Figure 1.

Table 1: Variable definitions

Variable	Variable Name	Definition	Source
NBD	New business density	New business registrations per 1000 inhabitants (16-74 years old), on average between 1993 and 2011	Swedish Companies Registration Office
SIT	Presence of single industry towns	Dummy if a municipality has a single industry town	Harmen's register and Wikipedia
ASIT	Presence of active single industry towns	Dummy if a municipality has an active single industry town	Harmen's register and Wikipedia
LPDE	Log population density	Logaritm of number of people per square kilometer, on average between 1993 and 2011	Statistics Sweden
FODEN	Forest density	Share of municipality's total area that is forestland	Statistics Sweden
FADEN	Farmland density	Share of municipality's total area that is farmland	Statistics Sweden
CST	Coastal acccess	Dummy if a municipality has coastal access	Statistics Sweden
COS	County seat	Dummy if a municipality has a history as a county seat	Statistics Sweden
EDUL	Education level	Share of population in working age (16-74 years old) with a higher education	Statistics Sweden
FMD	Ferrous metal deposits	Dummy if a municipality has ferrous metal deposits	Geological Survey of Finland

Table 2: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
NBD	290	10.8	2.9	6.6	28.3
SIT	290	0.5	0.5	0	1.0
ASIT	290	0.2	0.4	0	1.0
LPDE	290	3.3	1.6	0	8.3
FODEN	290	0.6	0.2	0	0.9
FADEN	290	0.2	0.2	0	0.8
CST	290	0.3	0.4	0	1.0
COS	290	0.1	0.3	0	1.0
EDUL	290	0.2	0.1	0.1	0.5
FMD	290	0.2	0.4	0	1.0

Table 3: Descriptive statistics by region

	STHLM	UPSL	SÖDML	ÖSTG	JÖNK	KRBRG	KALMR	GOTL	BLKNG	SKÅNE	HALND	VGÖTL	VÄRML	ÖRBRO	VÄSML	DALRN	GÄBOG	VÄNOR	JÄMTL	VÄBOT	NOBOT	SWE
NBD	15.32	10.77	10.51	9.83	8.82	8.85	8.85	10.25	9.89	12.17	11.10	10.57	9.80	9.28	9.72	11.33	9.81	9.85	12.07	10.2	10.45	10.84
	(4.05)	(1.95)	(2.46)	(1.73)	(1.12)	(0.84)	(2.39)	(-)	(2.47)	(2.80)	(1.98)	(2.62)	(1.78)	(1.71)	(1.25)	(1.99)	(1.29)	(1.40)	(2.95)	(1.33)	(1.91)	(2.86)
SIT	0.19	0.50	0.56	0.38	0.31	0.88	0.50	1.0	0.40	0.36	0.33	0.35	0.69	0.67	0.70	0.47	0.90	1.0	0.25	0.27	0.43	0.45
	(0.40)	(0.54)	(0.53)	(0.51)	(0.48)	(0.35)	(0.52)	(-)	(0.55)	(0.49)	(0.52)	(0.48)	(0.49)	(0.49)	(0.48)	(0.52)	(0.32)	(-)	(0.46)	(0.46)	(0.51)	(0.50)
ASIT	0.04	0.38	0.22	0.23	0.23	0.13	0.25	1	0.20	0.12	0.17	0.08	0.38	0.58	0.40	0.40	0.50	0.71	0.13	0.07	0.29	0.23
	(0.20)	(0.42)	(0.44)	(0.44)	(0.44)	(0.35)	(0.45)	(-)	(0.44)	(0.33)	(0.41)	(0.28)	(0.50)	(0.51)	(0.52)	(0.51)	(0.53)	(0.49)	(0.35)	(0.26)	(0.47)	(0.42)
LPDE	5.81	3.51	3.81	3.11	3.25	2.88	2.90	2.89	3.96	4.54	3.76	3.78	2.90	3.12	3.53	2.37	2.65	2.45	0.67	1.10	1.08	3.34
	(1.42)	(0.88)	(0.85)	(0.88)	(0.50)	(0.49)	0.49	(-)	(0.41)	(1.01)	(0.86)	(1.07)	(1.06)	(0.86)	(0.87)	(1.10)	(0.86)	(0.83)	(1.11)	(1.18)	(1.27)	(1.60)
FODEN	0.49	0.67	0.63	0.66	0.73	0.84	0.73	0.53	0.71	0.28	0.62	0.60	0.80	0.75	0.67	0.83	0.87	0.89	0.73	0.79	0.71	0.65
	(0.20)	(0.14)	(0.08)	(0.22)	(0.20)	(0.05)	(0.25)	(-)	(0.19)	(0.27)	(0.13)	(0.20)	0.10	(0.18)	(0.16)	(0.07)	(0.03)	(0.01)	(0.15)	(0.11)	(0.17)	(0.24)
FADEN	0.10	0.20	0.20	0.23	0.09	0.05	0.12	0.27	0.15	0.49	0.21	0.19	0.09	0.13	0.20	0.05	0.05	0.03	0.01	0.02	0.01	0.16
	(0.09)	(0.13)	(0.06)	(0.20)	(0.03)	(0.03)	(0.10)	(-)	(0.13)	(0.22)	(0.09)	(0.15)	(0.06)	(0.14)	(0.14)	(0.14)	(0.02)	(0.01)	(0.02)	(0.03)	(0.01)	(0.18)
CST	0.54	0.38	0.33	0.23	(-)	(-)	0.42	1.0	0.80	0.48	0.83	0.18	(-)	(-)	(-)	(-)	0.40	0.71	(-)	0.27	0.29	0.27
	(0.51)	(0.52)	(0.50)	(0.44)	(-)	(-)	(0.51)	(-)	(0.45)	(0.51)	(0.41)	(0.39)	(-)	(-)	(-)	(-)	(0.52)	(0.49)	(-)	(0.46)	(0.47)	(0.45)
COS	0.04	0.13	0.11	0.08	0.08	0.13	0.08	1.0	0.20	0.06	0.17	0.08	0.06	0.08	0.10	0.07	0.20	0.29	0.13	0.07	0.14	0.10
	(0.20)	(0.35)	(0.33)	(0.28)	(0.28)	(0.35)	(0.29)	(-)	(0.45)	(0.24)	(0.41)	(0.28)	(0.25)	(0.29)	(0.32)	(0.26)	(0.42)	(0.49)	(0.35)	(0.26)	(0.36)	(0.30)
IOD	0.12	0.50	0.44	0.08	0.08	(-)	(-)	(-)	(-)	(-)	(-)	0.41	0.06	0.58	0.50	0.60	0.70	(-)	(-)	(-)	0.36	0.17
	(0.33)	(0.53)	(0.53)	(0.28)	(0.28)	(-)	(-)	(-)	(-)	(-)	(-)	(0.20	(0.25)	(0.51)	(0.53)	(0.51)	(0.48)	(-)	(-)	(-)	(0.50)	(0.38)
EDUL	0.24	0.16	0.15	0.14	0.12	0.12	0.13	0.17	0.16	0.18	0.15	0.14	0.13	0.12	0.12	0.13	0.12	0.15	0.14	0.14	0.15	0.15
	(0.10)	(0.10)	(0.03)	(0.05)	(0.04)	(0.05)	(0.04)	(-)	(0.05)	(0.08)	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.03)	(0.04)	(0.04)	(0.05)	(0.04)	(0.06)

Note: Mean values, Standard deviations in paranthesis

5. Method and Econometric Framework

5.1 OLS method

In this section we introduce an econometric method to test our hypothesis that single industry towns have a negative relationship with entrepreneurship. We start with a simple ordinary least squares regression (OLS), which we later extend by including geographical and regional control variables. In an attempt to correct for potentially biased estimates, we apply an instrumental variable approach. Finally, we implement a modification of the OLS model to study the effect of single industry towns in which the mill has closed.

Our first step is to run the OLS without any control variables. This specification establishes a baseline correlation between entrepreneurship and municipalities with single industry towns and contrasts our results to those established by Hedfeldt (2008). For a full description of the variable names see Table 1. Model 1 is specified as follows:

$$NBD_i = \beta_0 + \beta_1 SIT_i + \varepsilon_i$$

$\mathrm{NBD_i}$ is the outcome variable of entrepreneurship; $\mathrm{SIT_i}$ denotes if there is a single industry town in the municipality; and ε_i is the error term[12].

In an effort to disentangle the impact of single industry towns, we include control variables that represent conditions before the single industry towns were established. The reason for this is that variables that represent the conditions after a single industry town was established risk being outcomes of its presence. Building on our reasoning in section 3.2, single industry towns are likely to affect a number of factors in the occupational choice model. For example, if single industry towns impact levels of education, which in turn causes a shift in the expected utility of entrepreneurship, controlling for this transmission channel[13] would remove a part of the effect of single industry towns. Therefore, these variables are excluded from the model.

Drawing on previous research of how entrepreneurial activity is affected by geographical endowments we deem variables that measure geographical features (remoteness, rural conditions

[12] To correct for heteroscedasticity we use robust standard errors for all regressions.

[13] A transmission channel is throughout the thesis recognised as a factor affected by single industry towns and in turn affecting entrepreneurship.

in terms of farmland or forestland, coastal access and if the municipality contains the county seat) to be appropriate (Glaeser and Kerr, 2009). These measures are primarily predetermined and hence we judge them to be exogenous to a large extent. Thus, they control for inherited differences between the municipalities. Model 2 is specified as follows:

$$NBD_i = \beta_0 + \beta_1 SIT_i + \delta geofactors_i + \varepsilon_i$$

NBD_i is the outcome variable of entrepreneurship; SIT_i denotes if there is a single industry town in the municipality; $geofactors_i$ is a vector of the geographical control variables; and ε_i is the error term.

At this point, regional dummy variables are added in an attempt to account for region-specific factors that influence entrepreneurship. As an example, regions in southern Sweden could have entrepreneurial advantages due to close trade with Denmark that is not captured in the geographical variables. Model 3 is specified as follows:

$$NBD_i = \beta_0 + \beta_1 SIT_i + \delta geofactors_i + \gamma regionaldummies_i + \varepsilon_i$$

NBD_i is the outcome variable of entrepreneurship; SIT_i denotes if there is a single industry town in the municipality; $geofactors_i$ is a vector of the geographical control variables; $regionaldummies_i$ is a vector of dummy regional control variables; and ε_i is the error term.

5.2 Outcome variable

The variable employed to measure entrepreneurship is annual new business registrations per 1000 inhabitants in working age[14], between 1993 and 2011 on average in a municipality. We consider this variable to be a broad and non-static measure of entrepreneurship. Due to the difficulty in defining entrepreneurship there is no clear and empirically viable measure. Alternative measures include share of population that is self-employed and number of independent establishments in an area. A problem with the first measure is that not all self-employed are entrepreneurs[15], while the second measure is static and does not capture the scale of an enterprise or its success (Glaeser and Kerr, 2010). Due to limited availablilty of data we are unable to compare results between the different measures.

[14] SCB defines working age as between 16 and 74 years old.
[15] See discussion regarding entrepreneurial definitions in section 2.4.

5.3 Explanatory variables

In the following section, we further explain the variable of interest and the control variables we use in this paper to account for a municipality's inherited entrepreneurial conditions.

Measuring the influence of a single industry town is difficult. The dummy variable SIT_i is constructed by denoting if a municipality has at least one single industry town, in which case the variable takes the value 1. The reason why we do not count the number of single industry towns per municipality is that the effect of single industry towns is expected to be largely diminishing. We find that the primary effect lies in going from having zero single industry towns to having one single industry town. Therefore, for brevity, we choose to use this simple measure even though we could have accounted for a diminishing effect. Another possible measure would be the share of the local population employed in a mill. However, we deem this measure to be more likely to suffer from endogeneity since mill employment risk to be affected by factors that correlate with entrepreneurship, such as industrial business cycles.

Municipalities have different levels of geographical endowments that make entrepreneurship more or less feasible. A dummy variable for coastal access is included since this endowment facilitates trade and attracts low fixed cost industries that have higher levels of entrepreneurship (Glaeser, Kerr and Ponzetto, 2010, p. 19).

We also include two geographical variables that measure the share of a municipality's acreage that constitutes farmland and forestland, respectively. Similarly to coastal access, these variables represent inherited cost differences and conditions for different types of business landscapes (Glaeser and Kerr, 2009). In addition, we have identified these variables as indicators of proximity to other people since they are associated with sparsely populated land. Thus, the acreage variables also indicate how rural a municipality, which in turn affects entrepreneurship.

On a related note, population density indicates how urban an area is and has been shown to have a positive effect on entrepreneurship (Reynolds et al., 1994; Wagner and Sternberg, 2004). Measures of remoteness are considered relevant as entrepreneurial activity is said to be higher in densely populated regions due to a faster flow of knowledge and greater provision of ancillary services and inputs (Fritsch, 2013). We judge this variable to have a diminishing effect and use the logarithmic values. It is worth noting that population density risks to be endogenous, since a region's population could be a result of various factors that correlate with entrepreneurship. However, we deem population density to be relatively constant over time between municipalities.

A dummy variable denoting if a municipality contains the county seat is included to account for access to important institutions, such as universities and governmental administration, which facilitate entrepreneurship. These county seats have often held this status for centuries, that is, before many of the single industry towns formed, making the variable less likely to be endogenous.

5.4 Entrepreneurship, single industry towns and ferrous metal deposits

With a concern that the OLS regression suffers from omitted variable bias, even after adding control variables for geographical and regional factors, we turn to an instrumental variable approach based on deposits of ferrous metals.

We reason that there are several factors that correlate with both entrepreneurship and single industry towns. To recapture, the OLS model only includes variables that represent conditions before the establishment of the single industry towns. Factors we would want to control for include the levels of entrepreneurship, institutions, and urbanisation in municipalities before the establishment of the single industry towns. The initial level of entrepreneurship as well as these attributes could systematically differ between municipalities and have made current entrepreneurship more feasible in certain areas, and hence be omitted variables. Moreover, single industry towns do not affect all conditions after their establishment. For example, regional politics are likely to affect entrepreneurship and could be an outcome of single industry town presence, but it could as well be an outcome of other factors. By not controlling for these factors the estimates risk being biased.

Another scenario could be that external events after the establishment of the industry, such as industrial business cycles, have been more likely to affect single industry towns due to their narrow economic base. Consequences of these external events could have altered current conditions for entrepreneurship. Thus, we identify a risk of unobserved omitted variables, and furthermore, the data for the ones identified is difficult to obtain.

The instrumental variable

The instrument introduced, in an attempt to correct for a bias, is based on the existence of ferrous metal deposits in a municipality's land area. Previous research regarding the history of single industry towns state that they often, although not exclusively, origin from early days refining sites of iron (Bergdahl et al. 1997). Moreover, these refining sites are naturally linked to the existence of ferrous metals. Worth noting is that mills not directly linked to iron often originated from these sites as well. We expect that a municipality with land area containing ferrous minerals is more likely to have a single industry town and therefore we find the instrument to be relevant.

In order for the instrument to be valid it also has to fulfil the exclusion restriction, that is; the instrument's influence on entrepreneurship must exclusively operate through its effect on single industry towns, conditional on the other variables included in the model. The predetermined nature of the instrument is beneficial in this regard, as ferrous metal deposits do not risk being outcomes of other variables. By nature these deposits are randomly distributed, while ore extraction is more likely to be correlated with other factors. The deposits are likely to correlate with geographical endowments, but with the geographical control variables included in the model this risk is to a large extent accounted for. Intuitively, the deposits should not affect entrepreneurship in any other way than through the single industry towns. However, we acknowledge that an instrument is not automatically exogenous simply because it is based on predetermined factors. The identified pathways that could imply endogeneity issues are discussed in section 7.

Ferrous metal deposits data

The data for the instrument is obtained from a Metallogenic Map of the Fennoscandian Shield (Geological Survey of Finland, 2009). This map contains information on 168 major metallogenic areas in the Nordic region, of which 41 are located in Sweden. Based on this map, we have been able to construct a dummy variable that takes on the value of 1 if a municipality's land area contains ferrous metal deposits. The map of Sweden is based on data collected by the Geological Survey of Sweden and contains both exploited and unexploited deposits. Again, this trait is advantageous since it adds to the exogeneity of the instrument. Despite the geographical thoroughness of the map the dummy variable becomes, at best, a rough estimate. The instrument does not consider the amount of ore in a deposit within a municipality and which surrounding areas a mineral deposit could affect. Another concern is to what degree the variable contains incorrect data due to our misjudgement in the data transformation from the map. Nevertheless, we judge these disadvantages not to be severe enough to rule out the instrument.

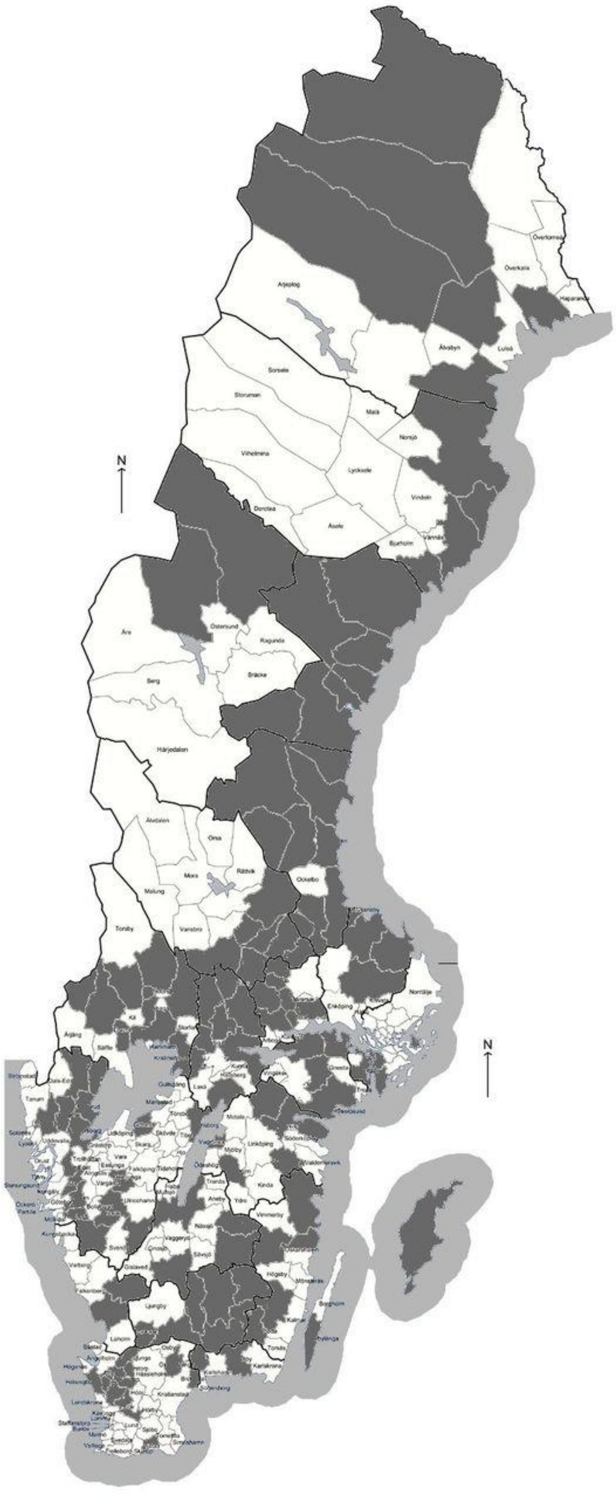

*Figure 1***.** Sweden’s 131 municipalities with at least one single industry town. Adapted from Sveriges hemslöjdskonsulter med textilinriktning, by P. Högberg, 2013, Retrieved 5 May, 2013, from http://www.hemslojd.org/vavstugor/sverige.htm. Copyright Sveriges hemslöjdskonsulter med textilinriktning 2013. Adapted with permission.

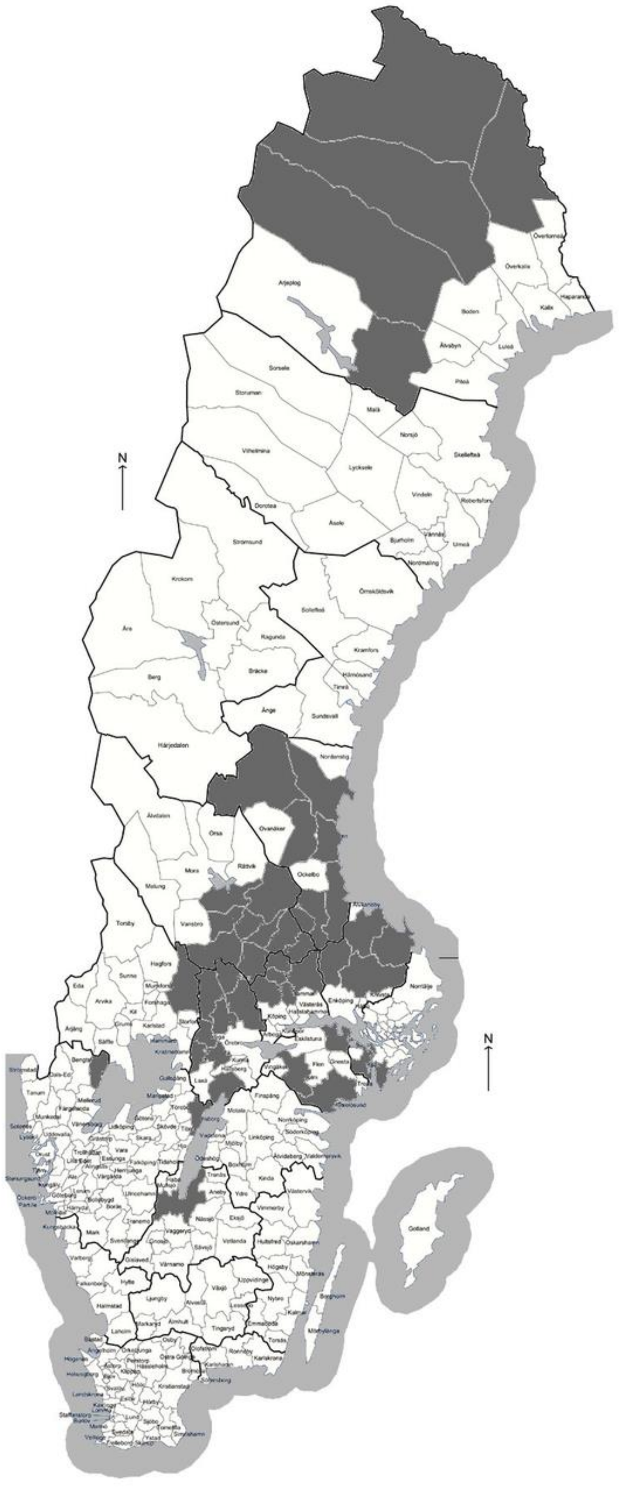

Figure 2. Sweden’s 50 municipalities with ferrous metal deposits. Adapted from Sveriges hemslöjdskonsulter med textilinriktning, by P. Högberg, 2013, Retrieved 5 May, 2013, from http://www.hemslojd.org/vavstugor/sverige.htm. Copyright Sveriges hemslöjdskonsulter med textilinriktning 2013. Adapted with permission.

5.5 Econometric method for the instrumental variable

In contrast with our OLS regression, the single industry town variable is now modelled as an endogenous variable through a two stage least squares regression. To account for endogeneity issues we use the existence of ferrous metals as instrument. In the first stage, the single industry town variable is regressed against the instrument and all other exogenous variables included in Model 3 from the OLS regression, ergo all geographical and regional control variables. The first stage regression is specified as follows:

$$\widehat{SIT}_i = \beta_0 + \beta_1 FMD_i + \delta geofactors_i + \gamma regionaldummies_i + v_1$$

$\widehat{SIT}_i$ is the outcome variable for predicted values of the single industry town variable*;* FMD_i is a dummy variable if a municipality have ferrous metal deposits*;* $geofactors_i$ is a vector of the geographical control variables; $regionaldummies_i$ is a vector of dummy regional control variables; and v_1 is the error term.

In the second stage regression, the variable for new business registrations is regressed against predicted single industry towns' presence from the first stage regression, and all exogenous variables. The second stage regression is specified as follows:

$$NBD_i = \beta_0 + \beta_1 \widehat{SIT_i} + \delta geofactors_i + \gamma regionaldummies_i + \varepsilon_1$$

NBD_i is the outcome variable for entrepreneurship*;* $\widehat{SIT_i}$ is the predicted values from the first stage*;* $geofactors_i$ is a vector of the geographical control variables; $regionaldummies$ is a vector of dummy regional control variables; and ε_i is the error term.

5.6 Single industry towns with closed mills

With the aim to answer our second hypothesis that single industry towns have a negative effect on entrepreneurship even after the mill has closed, we continue by making an adjustment to the OLS model. To separate the single industry town effect between active and closed mills, a dummy variable that takes on the value 1 if a municipality has a single industry town with an active mill ($ASIT_i$) is added as a control variable. In this way we wish to examine if a single industry town's effect on entrepreneurship remains even after the mill has closed. The regression is specified as follows:

$$NBD_i = \beta_0 + \beta_1 SIT_i + \beta_2 ASIT_i + \gamma geofactors_i + \delta regionaldummies_i + \varepsilon_i$$

NBD_i is the outcome variable for entrepreneurship; SIT_i denotes if there is a single industry town in the municipality; $ASIT_i$ measures if there is a single industry town with an active mill in the municipality; $geofactors_i$ is a vector of the geographical control variables; $regionaldummies_i$ is a vector of dummy regional control variables; and ε_i is the error term.

6. Results

In this section, we present and discuss the results of our regressions. The results from the OLS regressions on the relationship between single industry town and entrepreneurship are presented in Table 3. We then continue with an instrumental variable approach, presented in Table 4 and Table 5. Finally, we finish by making a moderation of the OLS model to study the effect of single industry towns with closed mills. This alteration is done in an attempt to nuance the effect on single industry towns and is reported in Table 7.

6.1 OLS relationship between single industry towns and entrepreneurship

As implied by Table 3, the coefficient for the single industry town variable is negatively and significantly correlated with entrepreneurship. When gradually including geographical and regional control variables to the model, the estimated effect of single industry towns on entrepreneurship is markedly lowered but still economically and statistically significant.

Beginning with the simple regression of Model I, an increase in the single industry town variable is estimated to have a negative and significant correlation with new business registrations of 1.7 fewer registrations per 1000 inhabitants. The average level of new business registrations in Sweden is 10.8 registrations per 1000 inhabitants. Thus, the result indicates a 16% drop of new business registrations compared to the national average if a municipality has at least one single industry town. This result is in line with the negative correlation found by Hedfeldt (2008). Hedfeldt concludes that municipalities in Bergslagen, that all have at least one single industry town, have 1 percentage point lower share of self-employed compared to Sweden as a whole. In percentage, the results imply 13% lower share of self-employed in Bergslagen compared to the national average[16].

In Model 2, geographical control variables are added to account for different endowments that affect predetermined entrepreneurial conditions. Unsurprisingly, population density, coastal access and county seat are positively correlated with new business registrations, while a higher proportion of farmland or forestland is negatively correlated. All geographical control variables are significant. The result shows a considerable decrease in the single industry town coefficient to -1.1 new business registrations per 1000 inhabitants, however the coefficient remains significant. This represents 10% lower levels of new business registrations compared to national average for

[16] Calculation based on Bergslagen's share of self-employed in 2003 of 6.57% compared with Sweden's share of self-employed in 2003 of 7.55% (Hedfeldt, 2008, p. 71).

a municipality that has at least one single industry town. The reduced magnitude of the coefficient indicates that geographical parts of the error term caused the single industry town coefficients estimates in Model 1 to be negatively biased. This likely reflects that municipalities with single industry towns are often remotely located in rural areas.

Regional dummies are introduced in Model 3 to capture region-specific factors that affect entrepreneurship. The single industry town coefficient remains stable at -1.0 new business registrations per 1000 inhabitants and significant. This suggests that region-specific factors explain little of single industry towns' effect on entrepreneurship, once the geographical variables are included.

The single industry town coefficient in Model 3 indicates that municipalities with a history of single industry towns are associated with roughly 9% lower levels of new registered businesses compared to the national average when controlling for geographical and regional effects. The 95% confidence interval for the coefficient of industry density ranges within -1.5 and -0.4 new business registrations. We interpret this as support for a significant negative effect. However, due to the likelihood of omitted variables we are unable to draw conclusions about the causal effect of single industry towns. As mentioned, there are a number of alternative explanations for the low levels of new business registrations. For instance, the level of urban development in terms of institutions affects entrepreneurship and could also systematically correlate with single industry towns. The issue of potential omitted variables leads us to the instrumental variable results presented in the following section.

Table 4

OLS Estimates of single industry towns' effect on entrepreneurship

VARIABLES	Model 1 New business density	Model 2 New business density	Model 3 New business density
Single industry town	-1.742***	-1.095***	-0.974***
	(0.308)	(0.275)	(0.267)
Log population density		0.331***	0.0825
		(0.118)	(0.149)
Farmland density		-7.189***	-5.841***
		(1.771)	(1.232)
Forestland density		-6.897***	-5.711***
		(1.663)	(0.941)
Coastal access		1.154***	1.157***
		(0.329)	(0.325)
County seat		1.067**	1.581***
		(0.538)	(0.450)
Regional dummies	No	No	Yes
Constant	11.61***	15.41***	17.72***
	(0.258)	(1.527)	(1.218)
Observations	290	290	290
R-squared	0.092	0.437	0.557
Adjusted R-squared	0.089	0.425	0.513

Note: OLS estimation. New business density is measured as number of new business registrations per 1000 inhabitants of working age (16-74 years) on average between 1993 and 2011. Single industry town is a dummy if a municipality has a single industry town. Region dummies correspond to the 21 regions in Sweden. Robust standard errors in parentheses. Significance level of * p<10%; ** p<5%; *** p<1%.

6.2 IV relationship between single industry towns and entrepreneurship

The result from the instrumental variable regression is interpreted as support for the negative and significant relationship between single industry towns and entrepreneurship.

The first stage regression is reported in Table 5, where Model 1 shows that the instrument is significant at the 1% level. Furthermore, the F-statistic of the excluded instrument in the first stage is above 10 (28.7), reassuring us that our instrument is not too weak (Bound, Jaeger, and Baker, 1995). The second stage regression is reported in Table 6 and indicates a negative relationship between single industry towns and entrepreneurship. The result shows a decline of 1.2 new business registrations per 1000 inhabitants for municipalities that have a single industry town, when controlling for geographical and regional effects. This implies 11% lower levels of business registrations compared to the national average. The significance for the point estimate is 7%. Thus, the coefficient estimate for single industry town variable is less significant than in the OLS regression but we deem that it supports the established negative relationship. We reason that a plausible explanation for the decrease in significance is the blunt instrument with few observations[17]. Moreover, the control variables have signs that correspond to the OLS estimates.

As Table 6 indicates, the IV estimate of the variable of interest is still negative but now of larger magnitude compared to the OLS estimate. The standard errors of 0.7, in relation to the single industry town coefficient of -1.2, imply that we must be cautious with conclusions about its magnitude. For the sake of clarity, there are a few possible explanations for a larger estimate. First, a simple explanation is that the IV regression corrected for an upward bias. Another explanation for the larger magnitude could be that ferrous metal deposits reflect iron ore industries, which possibly have a stronger impact on entrepreneurship due to larger mill sizes and industry-specific culture. A less positive explanation is that ferrous metal deposits could be negatively associated with other aspects that are connected with entrepreneurship. If this explanation is true, the first condition for instrumental variables is violated and would imply a biased estimate. Considering this risk, we refrain ourselves from interpreting the results as the causal effect of single industry towns on entrepreneurship. Rather, we interpret the consistent sign and at least comparable magnitude of the single industry town coefficient compared with the OLS results as support for the previously found negative and considerable relationship.

[17] Sweden has 50 municipalities with ferrous metal deposits in their land area.

6.3 Impact of single industry towns with closed mills on entrepreneurship

The result from the regression in which we control for single industry towns with active mills imply that a negative effect remains after the mill has lost its dominant position. However the reduced significance of the single industry town coefficient makes us tentative in our conclusion.

The result presented in Table 7 shows that the single industry town coefficient drops to -0.6 new business registrations per 1000 inhabitants when controlling for single industry towns with active mills. This result implies that a municipality containing a single industry town with a closed mill has 6% fewer business registrations compared to the national average, once geographical and regional factors are accounted for. The significance of the coefficient is just above 5% and the confidence interval ranges between -1.2 and 0.0. Hence, we are unable to rely on the coefficient estimate since it is imprecise and can take on values up to 0. The coefficient for single industry towns with active mills is negative and significant at the 5% level, corresponding to 7% fewer new business registrations compared to the national average.

The result indicates a lasting effect on entrepreneurship after a mill has closed. Possible interpretations of this effect are that the cultural heritage of the mill remains even after closure or that a depressed entrepreneurial climate as a result of the closure affects entrepreneurship. The interpretation is, however, complicated by the high correlation between the two single industry town variables. We are unable to rule out that the core effect of single industry towns solely lies within single industry towns with active mills.

6.4 Summary

Our interpretation of the results from the OLS regressions is a negative and significant relationship between single industry towns and entrepreneurship. The single industry town coefficient roughly suggests entrepreneurship levels 9% below national average in terms of new business registrations, when geographical and regional factors are accounted for. Thus, these findings support our first hypothesis and are in line with previous research. The IV regression result is coherent with the OLS results and implies that single industry towns have a negative relationship with entrepreneurship, corresponding to 11% below the national average. We take this as support for the negative effect of single industry towns but refrain ourselves from further conclusions about causality and precise magnitude because of the reduced significance and remaining concern for omitted variables. Moreover, in line with our second hypothesis we find indications that single industry towns continue to have a negative impact on entrepreneurship even after the mill is closed. However, the impreciseness of the test makes it difficult to draw a conclusion.

Table 5

OLS Estimates of first stage and reduced form regressions

VARIABLES	Model 1 First stage Single industry town	Model 2 Reduced form New business density
Ferrous metal deposits	0.470***	-0.587
	(0.0876)	(0.409)
Log population density	0.0667**	0.0125
	(0.0327)	(0.152)
Coastal access	-0.0291	1.194***
	(0.0714)	(0.333)
Farmland density	-0.0296	-5.831***
	(0.270)	(1.259)
Forestland density	0.656***	-6.341***
	(0.202)	(0.942)
County seat	0.0343	1.557***
	(0.0987)	(0.460)
Regional dummies	Yes	Yes
F-test	28.72	No
Constant	-0.553**	18.30***
	(0.267)	(1.244)
Observations	290	290
R-squared	0.301	0.538
Adjusted R-squared	0.231	0.493

Note: OLS estimation. New business density is measured as number of new business registrations per 1000 inhabitants of working age (16-74 years) on average between 1993 and 2011. Single industry town is a dummy if a municipality has a single industry town. Ferrous metals deposits is a dummy variable that measures if a municipality has deposits of ferrous metals. Region dummies correspond to the 21 regions in Sweden. Robust standard errors in parentheses. Significance level of * p<10%; ** p<5%; *** p<1%.

Table 6

OLS Estimates on comparisons between the OLS and IV regressions of single industry towns' effect on entrepreneurship

	Model 1	Model 2
	OLS	IV – 2SLS
VARIABLES	New business density	New business density
Single industry town	-0.974***	-1.249*
	(0.267)	(0.707)
Log population density	0.0825	0.0958
	(0.149)	(0.154)
Coastal access	1.157***	1.158***
	(0.325)	(0.356)
Farmland density	-5.841***	-5.868***
	(1.232)	(1.688)
Forestland density	-5.711***	-5.521***
	(0.941)	(1.569)
County seat	1.581***	1.600***
	(0.450)	(0.570)
Regional dummies	Yes	Yes
Constant	17.72***	17.61***
	(1.218)	(1.564)
Observations	290	290
R-squared	0.557	0.555
Adjusted R-squared	0.513	0.511

Note: OLS estimation. New business density is measured as number of new business registrations per 1000 inhabitants of working age (16-74 years) on average between 1993 and 2011. Single industry town is a dummy if a municipality has a single industry town. Ferrous metal deposits is a dummy variable that measures if a municipality has deposits of ferrous metals. Region dummies correspond to the 21 regions in Sweden. Robust standard errors in parentheses. Significance level of * p<10%; ** p<5%; *** p<1%.

Table 7

OLS Estimates on single industry towns' effect on entrepreneuship with a distiction between active and closed mills

VARIABLES	Model 1 OLS New business density	Model 2 OLS New business density
Single industry town	-0.974***	-0.602*
	(0.267)	(0.315)
Active single industry town	No	-0.807**
		(0.369)
Log population density	0.0825	0.100
	(0.149)	(0.148)
Farmland density	-5.841***	-5.950***
	(1.232)	(1.224)
Forestland density	-5.711***	-5.694***
	(0.941)	(0.934)
Coastal access	1.157***	1.189***
	(0.325)	(0.323)
County seat	1.581***	1.541***
	(0.450)	(0.448)
Regional dummies	Yes	Yes
Constant	17.72***	17.57***
	(1.218)	(1.211)
Observations	290	290
R-squared	0.557	0.570
Adjusted R-squared	0.513	0.520

Note: Note: OLS estimation. New business density is measured as number of new business registrations per 1000 inhabitants of working age (16-74 years) on average between 1993 and 2011. Single industry town is a dummy if a municipality has a single industry town. Active single industry town is a dummy if a municipality has an active single industry town in the municipality. Region dummies correspond to the 21 regions in Sweden. Robust standard errors in parentheses. Significance level of * p<10%; ** p<5%; *** p<1%.

7. Discussion of Robustness

In this section we discuss potential caveats with the instrumental variable approach and present how the model responds to an alteration of control variables.

Potential endogeneity issues

In order for the estimates to be unbiased the instrument must be exogenous, conditional on the other variables included in the model. Although the predetermined nature of the proposed instrument is helpful in this regard, we acknowledge that it does not by default make it exogenous. In fact, a few worrisome aspects are identified.

A related paper by (Glaeser, Kerr and Kerr, 2012) uses proximity to mineral and coal deposits in 1900 as an instrument for entrepreneurship, defined as average establishment size*,* to estimate the effect on employment growth. They argue that not only do the coal and mineral deposits lead to larger establishments within the given industry it also results in larger establishments throughout the city. This reasoning introduces one concerning aspect to our instrument, namely that the metallogenic land area could correlate with large establishments in general for the surrounding region. Following previous research, these large establishments could crowd out entrepreneurship (Chinitz, 1961).

Moreover, the instrument risks to be endogenous, in a similar way as single industry towns, due to its close connection with iron related mills. Failure to correct for industry-specific business cycles could be one unfortunate outcome of this association. For example, ferrous metal deposits' connection to steel production makes these land areas correlated with industry-specific external shocks, which in turn can affect entrepreneurship. The steel crisis in the 1970's resulted in unemployment and emigration from single industry towns and such factors are not unlikely to have a negative impact on the entrepreneurial climate. However this is partly mitigated by the fact that our data only stretches back to 1993, since the major shocks that affected Swedish single industry towns occurred earlier in time.

Considering the potentially worrisome pathways, ferrous metal deposits are imperfect as instrument since the instrument risks to correlate with factors, besides single industry towns, which affect entrepreneurship. Thus we are careful with conclusions about causality.

Robustness test

To assess the robustness of the result from the instrumental variable model we include an identified omitted variable.

It can be argued that education is an omitted factor since the level of education is recognised as particularly low in single industry towns[18] (Hedfeldt, 2008) and as education is assumed to affect entrepreneurship (Parker, 2004). We do not control for this in the OLS or IV regressions since we reason that education is likely to be affected by the presence of the single industry towns. Controlling for this would risk obstructing single industry towns' effect on entrepreneurship. However, if a large fraction of the single industry towns' effect is manifested through the level of education, controlling for education should lead to a change in the single industry town coefficient, in magnitude or significance. If the single industry town coefficient continues to show a significant and considerable relationship with entrepreneurship, when the effect of the transmission channel education is locked, we interpret this as a sign of robustness of the results. We conduct the test by adding education to the second stage instrumental variable regression[19]. Education is defined as the share of the population in working age with a higher education on average between 1993 and 2011.

Table 8 presents the result of adding education to the second stage IV regression. The result shows a magnitude and significance level similar to the result obtained in Model 1 of the original IV regression. We interpret the small change in magnitude of the explanatory variables and the kept significance of the single industry town variable as signs of robustness.

It would also be desirable to use other specifications of the instrumental variable to test the sensitivity of the result. A possible alternative measure, to increase the accuracy of the variable, is to count the amount of ferrous metal deposits in a spatial ring surrounding the studied area, a method used by Glaeser et al. (2012). Unfortunately, we were unable to use this method since we do not have data on a city level.

[18] See Table 10 in the Appendix for confirmation of low education levels in our dataset.

[19] See section 5.6 for presentation of the original instrumental variable regression.

Table 8

OLS Estimates of single industry towns' effect on entrepreneurship in a robustness test with level of education

VARIABLES	Model 1 2SLS - IV New business density	Model 2 2SLS - IV New business density
Single industry town	-1.249*	-1.424**
	(0.707)	(0.625)
Education level	No	20.19***
		(2.915)
Geographical variables	Yes	Yes
Regional dummies	Yes	Yes
Constant	17.61***	15.02***
	(1.564)	(1.480)
Observations	290	290
R-squared	0.555	0.632
Adj. R-squared	0.511	0.594

Note:OLS estimation. New business density is measured as number of new business registrations per 1000 inhabitants of working age (16-74 years) on average between 1993 and 2011. Single industry town is a dummy if a municipality has a single industry town. Education level measures the share of population in working age that has a higher education. Regional dummies correspond to the 21 regions in Sweden. Robust standard errors in parentheses. Significance level of * p<10%; ** p<5%; *** p<1%.

8. Conclusion

8.1 Limitations

We have identified limitations in the data. Preferably, the single industry town data would describe in more detail to what extent these towns have influenced a municipality to enable more precise conclusions. Our variable of single industry town influence is blunt and only captures if a municipality has at least one single industry town. This broad measure captures nearly half of Sweden's municipalities, which highlights the variable's impreciseness as a municipality could have a diverse business environment where one area is highly affected by single industry towns while other areas are not. A remedy for this would be to conduct the study on a more narrow geographical area or to collect data on the number of people employed in the mill over time but this data is difficult to attain.

Another limitation is the entrepreneurship data. The data contains all types of new business registrations, including enterprises started for administrative purposes[20], enterprises that only operate a short period of time and enterprises that are created out of necessity[21]. This makes it difficult to connect the entrepreneurship levels with economic growth. The dataset for new business registrations do not take into consideration how many of the registrations that become lasting business activities, a feature that would better represent actual created entrepreneurial activity. The issue of necessity-based firms is to some extent mitigated by studying Sweden, since a country with a well-developed social safety net makes it more likely that the business registrations reflect opportunity-based entrepreneurship.

Furthermore, the absence of measureable entrepreneurial data does not necessarily imply an absence of entrepreneurial activities, as proposed by Davidsson et al. (2008). The paper notes that in the otherwise entrepreneurial Småland region, the municipality of Älmhult stood out with unexpectedly low levels of new firm formation. The municipality is the site for the birth and headquarters of IKEA. Arguably, this successful business has created all the employment needed in the area and thus reduced the need for others to create their own enterprises. The example illustrates that low levels of entrepreneurship is not necessarily a sign of low regional growth.

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[20] Businesses that are filed for administrative purposes do not mirror new business activities and risk to be deceptive when measuring entrepreneurship. However, given that an important driver for administrative registrations is fiscal purposes, the geographical scope of Sweden mitigates this issue.

[21] Recalling from section 2.4, necessity-based firms arise when there is a lack of other income options, as when unemployment is high.

8.2 Policy implications

Given that policymakers aspire to stimulate entrepreneurship, the empirical results in this paper could provide a rationale to pay extra attention to single industry towns. Furthermore policymakers should be aware not to have too narrow a focus in their stimulus policies.

The acknowledgement of entrepreneurship's impact on economic growth has made policymakers keen to develop strategies to stimulate entrepreneurship. Our results indicate that single industry towns have a negative relationship with entrepreneurship. Hence, the low levels of entrepreneurship could have negative consequences for the concerned municipalities. This view is coherent with recent action by the Swedish governing party Moderaterna. In 2012, the party initiated a project with the aim to find solutions to the challenges, identified by the party, the single industry towns are facing (Moderaterna, 2012, p. 3). The decision base for this policy is qualitative research on a limited number of single industry towns. The low levels of education and entrepreneurship were identified as areas of improvements (Moderaterna, 2012). Our study gives empirical evidence to the existence of this issue and distinguishes single industry towns from other rural areas. Worth noting is that even though policymakers often entwine the problem of low education and entrepreneurship our result suggest that lower levels of entrepreneurship prevail even when holding educational levels fixed[22]. This mirrors the multifaceted ways a single industry town can affect entrepreneurship, of which education is just one part.

8.3 Suggestion for future research and concluding remarks

The key finding in this paper is that single industry towns have a significant and negative relationship with entrepreneurship. The results indicate that municipalities with at least one single industry town have roughly 10% less new business registrations compared with the national average, when geographical and regional factors are accounted for. Although this estimate is rough and possibly biased we judge the effect to be relevant to take into consideration. In contrast with earlier studies that use qualitative methods and comparative statistical analysis to distinguish the entrepreneurship levels in these regions, we land in this conclusion through an econometric study. Although the concern of omitted variables prevents us from stating a causal relationship between the two variables, the conducted method goes far in disentangling the unique effect of single industry towns.

[22] See the robustness discussion in section 7 and results in Table 8.

Our study clustered different types of industries but an interesting approach would be to study the influence of certain types of industries. Policymakers would benefit from this knowledge to have better decision support for allocation of regional help. In order to increase validity to the perception of single industry towns as less entrepreneurial, future research could attempt to establish the relationship internationally. Future studies could also set out to measure this effect more thoroughly, preferably using data on a city level. Furthermore, the instrument of ferrous metal deposits would be more advantageous if it could be assessed at a more precise geographic level. Hence, in this way the relationship between single industry towns and entrepreneurship could be disentangled further.

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10. Appendix

Table 9: Municipalities with single industry towns

Municipality				
Ale	Gotland	Kiruna	Nykvarn	Tierp
Alvesta	Grums	Klippan	Nyköping	Timrå
Arvika	Gällivare	Kramfors	Nynäshamn	Tingsryd
Askersund	Gävle	Kristinehamn	Olofström	Tranemo
Avesta	Götene	Krokom	Oskarshamn	Umeå
Bengtsfors	Hagfors	Köping	Ovanåker	Uppsala
Bjuv	Hallstahammar	Lerum	Oxelösund	Uppvidinge
Boden	Halmstad	Lessebo	Partille	Valdemarsvik
Bollnäs	Hammarö	Lilla Edet	Perstorp	Vetlanda
Borlänge	Hedemora	Lindesberg	Piteå	Vänersborg
Borås	Helsingborg	Ljusdal	Robertsfors	Värmdö
Boxholm	Herrljunga	Ljusnarsberg	Ronneby	Värnamo
Bromölla	Hofors	Ludvika	Sandviken	Västervik
Degerfors	Hudiksvall	Mark	Skellefteå	Västerås
Eda	Hultsfred	Markaryd	Skinnskatteberg	Växjö
Eksjö	Hylte	Mellerud	Smedjebacken	Ystad
Emmaboda	Hällefors	Munkedal	Sollefteå	Åmål
Eskilstuna	Härnösand	Munkfors	Strängnäs	Ånge
Eslöv	Härryda	Mörbylånga	Strömsund	Åstorp
Fagersta	Höganäs	Nora	Sundsvall	Åtvidaberg
Falun	Jokkmokk	Norberg	Sunne	Älmhult
Filipstad	Jönköping	Nordanstig	Surahammar	Älvkarleby
Finspång	Kalix	Nordmaling	Svalöv	Örebro
Flen	Karlsborg	Norrköping	Säter	Örkelljunga
Forshaga	Karlskoga	Norrtälje	Söderhamn	Örnsköldsvik
Färgelanda	Karlstad	Nybro	Södertälje	Östhammar
				Östra göinge

Table 10:

OLS Estimation on the relationship between education levels and single industry towns

	Model 1
	OLS
VARIABLES	Education level
Single industry town	-0.0202***
	(0.007)
Observations	290
R-squared	0.022

Note:OLS estimation. Education level measures the share of the population in working age (16-74 years old) that has a higher education. Single industry town is a dummy if a municipality has a single industry town. Standard errors in parentheses. Significance level of * p<10%; ** p<5%; *** p<1%.

Table 11: Sources for identification and confirmation of single industry towns

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Table 12: List of single industry towns in Sweden

Single industry town	Municipality										
Alby	Ånge	Fagersta	Fagersta	Hasslarp	Helsingborg	Långshyttan	Hedemora	Rydboholm	Borås	Söderfors	Tierp
Alsterbro	Nybro	Fagervik	Timrå	Herräng	Norrtälje	Länna	Uppsala	Rådanefors	Färgelanda	Sörforsa	Hudiksvall
Alsterfors	Uppvidinge	Fengersfors	Åmål	Hillebola	Tierp	Lögdö	Timrå	Rånäs	Norrtälje	Sörstafors	Hallstahammar
Ankarsrum	Västervik	Finspång	Finspång	Hissmofors	Krokom	Lövstabruk	Tierp	Sandarne	Söderhamn	Söråker	Timrå
Aspa	Askersund	Fiskeby	Norrköping	Hofors	Hofors	Mackmyra	Gävle	Sandviken	Kramfors	Teckomatorp	Svalöv
Avesta	Avesta	Flerohopp	Nybro	Horndal	Avesta	Malmberget	Gällivare	Sandviken	Sandviken	Timsfors	Markaryd
Axmarbruk	Gävle	Flygsfors	Nybro	HultsBruk	Norrköping	Marieberg	Kramfors	Segmon	Grums	Tobo	Tierp
Bengtsfors	Bengtsfors	Fors	Avesta	Huseby	Alvesta	Marmaverken	Söderhamn	Sennan	Halmstad	Tollered	Lerum
Billingsfors	Bengtsfors	Forsbacka	Åmål	Huskvarna	Jönköping	Morgårdshammar	Smedjebacken	Sibbhult	Östra göinge	Torpsbruk	Alvesta
Bispberg	Säter	Forshaga	Forshaga	Husum	Örnsköldsvik	Mossgruvan	Ljusnarsberg	Sibo	Bollnäs	Tunadal	Sundsvall
Björneborg	Kristinehamn	Forsmark	Östhammar	Hybo	Ljusdal	Munkedal	Munkedal	Sikfors	Hällefors	Tuna-Hästberg	Ludvika
Blombacka	Karlstad	Forsvik	Karlsborg	Hyllinge	Åstorp	Munkfors	Munkfors	Silverdalen	Hultsfred	Turbo	Hedemora
Bläse	Gotland	Fredriksberg	Ludvika	Hyltebruk	Hylte	Munksund	Piteå	Skebobruk	Norrtälje	Töre	Kalix
Blötberget	Ludvika	Fridafors	Tingsryd	Håksberg	Ludvika	Målerås	Nybro	Skelleftehamn	Skellefteå	Ulriksfors	Strömsund
Bodaglasbruk	Emmaboda	Frånö	Kramfors	Hällefors	Flen	Mölnbacka	Forshaga	Skoghall	Hammarö	Ulvshyttan	Säter
Bodträskfors	Boden	Frövi	Lindesberg	Hällekis	Götene	Mölnlycke	Härryda	Skromberga	Bjuv	Utansjö	Härnösand
Bodås	Hofors	Fåglavik	Herrljunga	Hävla	Finspång	Norberg	Norberg	Skultuna	Västerås	Vallvik	Söderhamn
Bollstabruk	Kramfors	Galtström	Sundsvall	Höganäs	Höganäs	Norrahammar	Jönköping	Skutskär	Älvkarleby	Vannsätter	Söderhamn
Bomhus	Gävle	Garpenberg	Hedemora	Högfors	Ljusnarsberg	Norrbyskär	Umeå	Skånes-Fagerhult	Örkelljunga	Vaplan	Krokom
Borggård	Finspång	Garphyttan	Örebro	Idkerberget	Borlänge	Norrsundet	Gävle	Skåpafors	Bengtsfors	Vargön	Vänersborg
Borgvik	Grums	Gimo	Östhammar	Iggesund	Hudiksvall	Nybybruk	Eskilstuna	Skärblacka	Norrköping	Vedevåg	Lindesberg
Borlänge	Borlänge	GlavaGlasbruk	Arvika	Jonsered	Partille	Nyhammar	Ludvika	Slite	Gotland	Vikmanshyttan	Hedemora
Boxholm	Boxholm	Graningebruk	Sollefteå	Kallinge	Ronneby	Nyhamn	Sundsvall	Smedjebacken	Smedjebacken	Vintjärn	Falun
Bredsjö	Hällefors	Grums	Grums	Karlholm	Tierp	Nykroppa	Filipstad	Sprängsviken	Kramfors	Virsbo	Surahammar
Brevensbruk	Örebro	Grycksbo	Falun	Karlsborg	Kalix	Nykvarn	Nykvarn	Stidsvig	Klippan	Vivstavarv	Timrå
Bromölla	Bromölla	Grytgöl	Finspång	Karlskoga	Karlskoga	Nymölla	Bromölla	Stjärnsfors	Hagfors	Voxnabruk	Ovanåker
Bruzaholm	Eksjö	Grängesberg	Ludvika	Kiruna	Kiruna	Nyvång	Åstorp	Stocka	Nordanstig	Vålberg	Karlstad
Bureå	Skellefteå	Grönhögen	Mörbylånga	Klavreström	Uppvidinge	Nävekvarn	Nyköping	Stockvik	Sundsvall	Västland	Tierp
Bångbro	Ljusnarsberg	Guldsmedshyttan	Lindesberg	Klemensnäs	Skellefteå	Oaxen	Södertälje	StoraVika	Nynäshamn	Yxsjöberg	Ljusnarsberg
Bäckhammar	Kristinehamn	Gullaskruv	Nybro	Klippansbruk	Klippan	Olofström	Olofström	Striberg	Nora	Zinkgruvan	Askersund
Böksholm	Växjö	Gunnarstorp	Bjuv	Kolsva	Köping	Oppboga	Lindesberg	Stråssa	Lindesberg	Åfors	Emmaboda
DalsLånged	Bengtsfors	Gunnebo	Västervik	Konga	Tingsryd	Orrefors	Nybro	Strömsberg	Tierp	ÅkersStyckebruk	Strängnäs
Dannemora	Östhammar	Gustavsberg	Värmdö	Koppom	Eda	Os	Värnamo	Strömsbruk	Nordanstig	Årnäs	Götene
Degerfors	Degerfors	Gustavsfors	Bengtsfors	Kosta	Lessebo	Pauliström	Vetlanda	Strömsnäsbruk	Markaryd	Åsensbruk	Mellerud
Degerhamn	Mörbylånga	Gusum	Valdemarsvik	Köpingebro	Ystad	Persberg	Filipstad	Ställberg	Ljusnarsberg	Åtvidaberg	Åtvidaberg
Deje	Forshaga	Gysinge	Sandviken	Köpmanholmen	Örnsköldsvik	Perstorp	Perstorp	Ställdalen	Ljusnarsberg	Älvkarleö	Älvkarleby
Delary	Älmhult	Gyttorp	Nora	Lesjöfors	Filipstad	Piteå	Piteå	Sundsbruk	Sundsvall	Ödeborg	Färgelanda
Domsjö	Örnsköldsvik	Gästrike-Hammarby	Sandviken	Lessebo	Lessebo	Porjus	Jokkmokk	Surahammar	Surahammar	Örtofta	Eslöv
Dynäs	Kramfors	Hagfors	Hagfors	LillaEdet	Lilla Edet	Ramnäs	Surahammar	Surte	Ale	Östanå	Östra göinge
Dömle	Forshaga	Hallstahammar	Hallstahammar	Limmared	Tranemo	Riddarhyttan	Skinnskatteberg	Svanö	Kramfors	Österbybruk	Östhammar
Edsbro	Norrtälje	Hallstanäs	Kramfors	Ljungaverk	Ånge	Robertsfors	Robertsfors	Svappavaara	Kiruna	Östrand	Timrå
Edsbruk	Västervik	Hallstavik	Norrtälje	Ljusfallshammar	Finspång	Rockhammar	Lindesberg	Svartvik	Sundsvall	Överum	Västervik
Edsvalla	Karlstad	Hammar	Askersund	Ljusne	Söderhamn	Rottneros	Sunne	Svartå	Degerfors		
Emsfors	Oskarshamn	Harg	Östhammar	Loddby	Norrköping	Rundvik	Nordmaling	Sågmyra	Falun		
Essvik	Sundsvall	Harnäs	Älvkarleby	Lugnvik	Kramfors	Rydal	Mark	Sävsjöström	Uppvidinge		

Figure 3. Metallogenic Map of the Fennoscandian Shield. Reprinted from Geological Survey of Finland, by P. Eilu, T. Bergman, T. Bjerkgård, V. Feoktistov, A. Hallberg, M. Korsakova, S. Krasotkin, G. Muradymov, P. Nurmi, A.M. Often, J-A. Perdahl, N. Philippov, J.S. Sandstad, V. Stromov, and M. Tontti, (comp.), 2009, Retrieved 2 May, 2013, from http://en.gtk.fi/export/sites/en/informationservices/databases/fodd/fs_metallogeny_20091118_final_400dpi_RGB.pdf. Copyright Geological Survey of Finland 2009. Reprinted with permission.