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Determinants of Human Capital

A study on Swedish municipalities

Bachelor's thesis within Economics

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Abstract

It is widely accepted that human capital plays a positive role in a country's and region's economic growth and productivity. In recent times, regions are in need of new ways to keep their competitive advantage when faced with modern day challenges such as globalization or technological advances. People and their skills represent valuable assets for their region and can help provide the edge it necessitates to improve its performance or even outperform others. It is, thus, essential to try and understand what determines the accumulation of human capital in a region in order to help improve the existing stock.

In a study on Swedish municipalities, we analyse the importance of several determinants of human capital accumulation. For this reason we created a human capital index, based on education, creativity and health. This allows us to capture broader aspects of effective workforce. We used cross-sectional regressions, which resulted in a very interesting outcome. The determinant with the biggest impact turned out to be cultural diversity, followed by specialization in knowledge-based manufacturing.

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1 Introduction

There has been much research on the impact of human capital on economic growth and productivity. However, instead of adding redundant information about a subject that has already been extensively explored, we chose a different approach, in which we aim to study the determinants of human capital.

The understanding of human capital has been developing over time. When this concept was first introduced, it was considered disgraceful [Becker, 1964/1993]. If any economist suggested that people should be approached in the same manner as capital – being a contributing factor in production – general public regarded this as extremely inappropriate. People saw it in the same way as slavery and dismissed any thought of it.

The researcher who coined the term was Theodore Schultz. In his work, Schultz (1961, p. 1) argued that investment in human capital "accounts for most of the impressive rise in the real earnings per worker." Another great contributor in the field was Jacob Mincer (1958), who noticed that the huge dispersion of earnings could be significantly explained by his model of human capital. However, according to the Nobel committee, the most noteworthy contribution to economics in the field of human capital was done by Gary Becker [1964/1993]. His view was that human capital is directly useful in the production function. In other words, according to Becker, human capital increases worker's productivity in all tasks, though possibly differentially in different tasks, organizations, and situations. The role of human capital in the production process is complex, but it can be represented by a unidimensional object, such as the stock of knowledge or skills. Since 1960s, these economists inspired countless others to follow this line of research and at present there are thousands of studies focusing on various aspects of human capital.

One of the most interesting aspects of human capital is that it is embodied in individuals and can therefore not be separated from the individual. Thus, the distribution of human capital rests on one's mobility across locations and firms [Becker 1964/1993]. On one hand, this implies that it is extremely rare to loose one's knowledge and skills as opposed to losing their house or financial assets, therefore when someone invests money into his education, it is generally an insured investment.[1] On the other hand, if there is a significant

[1] An interesting parallel between human capital and 'regular' capital investments is that they both depreciate. It is undoubtedly a different kind, value and time pattern, but it was empirically proven to exist (Becker

change in working environment, it can be difficult to relocate or reinvest one's human capital.[2]

Today, it is widely acknowledged that human capital is of utmost importance for the economic performance of regions. Lucas (1988) and Romer (1990) drew attention to this fact in their endogenous growth theory, which proves that countries and regions which exhibit higher levels of human capital should expect higher growth rates than areas with inferior levels. Moreover, according to the World Economic Forum (2013)[3], human capital that is efficiently put into use is more important determinant of economic success than any other resource. But the question remains: how can regions attract human capital?

This question will be the focus of this thesis. Since it is generally known how beneficial human capital is to the whole society, it could be useful to understand its formation. In this way, implications can be drawn for policymakers to adjust their actions towards more successful accumulation of human capital in their respective regions. We attempt to shed light on these implications to help develop efficient policies for creation and/or accumulation of human capital. Thanks to extensive statistical data gathering in Sweden, we were able to focus on Swedish municipalities (290).

In this paper, we combine different pillars of human capital into one human capital index. This gives us a more holistic picture capturing broader aspects of human capital. Berry and Glaeser (2005) proved that in recent years there has been a divergence in the levels of human capital in different cities, implying the presence of variable factors.

Instead of developing a model for static human capital, we would like to understand the dynamic development of human capital over time.

Results show that it is relatively easy to explain high level of education, but it is more difficult for health or creativity. Overall, our model for human capital managed to show some significant determinants which can be later incorporated into regional policies. For human capital index, these were especially cultural diversity and specialization in knowledge-based manufacturing.

1964/1993, Groot 1998). Therefore if a person does not work or study or use his human capital in any other way, it will diminish over time.

[2] Example by Becker [1964/1993] talks about highly skilled workers from Hong Kong, who could not invest only part of their capital abroad (after takeover by China) – they had to move themselves.

[3] http://www3.weforum.org/docs/WEF_HumanCapitalReport_2013.pdf

Our paper is structured as follows. Firstly, we present a review of the most important theories in the literature on the subject of human capital. We continue by offering a quick introduction into the Swedish context. The next part presents the most relevant factors that should affect human capital, followed by measurements behind our human capital index. Further section present variables of our regression, as well as the outcomes. The thesis is concluded by policy recommendations based on the analysis of the results.

2 Theoretical background

2.1 Individual level

Even though research about human capital started around 1960s, already Adam Smith (1776) argues that a "general stock" of every country can be divided into three sections, one of them being a fixed capital. After listing the obvious – machines, buildings and land, he continues with "useful abilities of all inhabitants or members of the society" [Smith, 1776/1976, p. 282]. He stresses that people have expenses during their education, as they learn necessary skills and it can be taken as an investment in the person. This acquired skill is beneficial for the worker, as well as for the whole society and can be compared with machines which increase productivity – it has to be invested in, but it brings profit in return after sufficient amount of time. This has been confirmed by Backman (2013a, p. 13), who also claims that "The foundation of the human capital theory lies in the fact that individuals and firms invest in human capital based not on present gains but on future pecuniary and non-pecuniary returns."

Schultz (1961) defines human capital as "something akin to property". His view was to develop further the concept of labour force in its classical meaning, and he conceptualized "the productive capacity of human beings is now vastly larger than all other forms of wealth taken together" (p. 2). Most researchers have accepted his view. In line with his perspective, other researchers have shown that human capital has close ties with knowledge, skills, education, and abilities (Garavan et al., 2001; Youndt et al., 2004).

The accumulation of knowledge and skills has an important role for human capital, which resulted in acceptance of learning as an essential factor for the increase in human capital. At present, it is conventional that the "conceptual foundation of one's human capital is based on something like knowledge and skills acquired by an individual's learning activities" (Kwon, 2009, p. 3). Keeping in mind that knowledge can broadly comprise of factors of human capital such as skills, experience, and competency, it is widely recognized that human capital and 'knowledge in a broader meaning' are synonymous expressions.

After long debates, there seems to be a general opinion that there is a considerable amount of private returns to human capital (Moretti, 2004a). The majority of Moretti's empirical

results indicate that all else equal, persons who have an extra year of education earn on average 8-12 per cent more per year.

2.2 Regional level

Florida (2002a) noticed that having highly educated and productive people is more important to regional growth than reducing costs of doing business. It is the people who are the motor behind regional growth and clustering of these educated people (with high human capital) is even more important than clustering of firms, because they are "less constrained by traditional determinants such as strategic water-way location, the abundance of raw materials or the proximity to dense concentrations of populations" (Kotkin, 2001 quoted in Florida, 2002a, p. 221).

Human capital influences the society and its individuals through spillovers. Moretti (2004a, p. 8) states that besides private returns, human capital can have significant social returns which are not reflected in the former and are exceeding them. In his view, social returns are "the sum of all benefits that accrue to society resulting from an increase in the overall level of education". Even though these returns might be difficult to measure due to the fact that quantifying spillovers and externalities is in general problematic, Moretti (2004a) considers three types of externalities in the presence of which the private returns differ from the social ones. Firstly, he is taking into consideration productivity spillovers. Then, he considers the effect education has on criminal activities concluding that it may reduce the probability of engaging in activities which create negative externalities. Lastly, the externalities on voting and policy making are taken into consideration.

The first type of externalities, production externalities, arise as a result of individuals with a high level of human who increase both their own productivity and that of those with lower levels of human capital. Backman (2013a) asserts that the externality is internalized in this case and that it is not a market failure. The same outcome can also take place when the overall productivity in a region can increase due to the overall level of human capital. (Lucas, 1988; Rauch, 1993; Glaeser, 1998). Studies have reached the conclusion that the initial level of human capital matters as there is a limit that needs to be attained before gaining any benefits from human capital externalities (Baumol, 1986; Azariadis and Drazen, 1990).

Another type of externalities are pecuniary externalities which arise due to exchanges on the market. Human capital externalities occur as a result of physical and human capital being interdependent according to Acemoglu (1996; 1998). If the overall human capital level increases, this will lead to firms investing more in physical capital. As a result, those with lower levels of human capital will work with more physical capital due to matching being costly (Acemoglu, 1996).

Human capital can have negative externalities as well. For example, it can happen when a human capital determinant like education has the function of only an indicator of unobserved ability rather than increased productivity (Spence, 1973).

Consumption externalities have a significant importance according to Haveman and Wolfe (1984). These externalities encompass a variety of welfare effects in the social environment which have a positive impact on most of the population. Blundell et al. (1999) observe one of the primary benefits represented by a higher rate of democratic participation and social unity which depends on the education level and the literacy rate of the population. Since individuals can gather information more easily due to human capital they can consequently make possibly better choices in elections which, as a result, will benefit the whole society (Friedman, 1962; Smith, 1776; Hanushek, 2002). Moretti (2004a) considers that the positive effect that education has on crime levels is one of the most important social returns from education. There are a number of other social benefits that come with an elevated level of human capital such as public services of a higher quality (i.e. well-functioning schools), amenities (theatres and restaurants) (Gemmell, 1997; Glaeser, et al., 2001), and people being more informed and more implicated in matters such as the personal, family, and public health improvements (Gemmell, 1997).

2.3 Determinants of human capital

2.3.1 Size

According to Fujita et al. (1999) and Krugman (1996), higher densities of population can be associated with higher intensity of economic activities through agglomeration economies. Glaeser and Gottlieb (2009) emphasize that density boosts productivity due to agglomeration economies and propose a few reasons why agglomeration economies can exist. These are reduced transportation costs for goods, reduced transportation costs for people and an easier transmission of ideas.

Rauch (1993) observed that big cities are likely to be associated with more general human capital. In what concerns Sweden, Bjerke (2012) argues that the regions which deal with a decreasing population growth encounter difficulties in both attracting and retaining individuals with higher education.

Qian et al. (2012) assert that in regions that have a higher population density there is an easier access to other individuals. As a result, there is a higher opportunity for face-to-face communication which is the main channel through which knowledge can spill over leading to increases in human capital.

Agglomerations reduce transaction costs which leads to economic efficiency (Quigley, 1998). This means a better possibility of matching worker skills with job requirements and reduced searching costs for employers in their pursuit for employees with appropriate skills. Acemoglu (1996) considers the increase in the stock of human capital to have a direct positive impact on the return on the human capital to a worker in a city.

In their 2001 paper, Glaeser and Maré assert that cities stimulate the accumulation of human capital. Glaeser (1999) states that the rate of interactions with high-skill individuals can be increased by urban density. Cities could enable coordination and could provide opportunities for specialization, which in turn would lead to higher wages, but only after some time (Becker and Murphy, 1992). Urban density may enable workers to find the optimal jobs for themselves, and urban wages may increase faster due to a better coordination of labour markets (Glaeser and Maré, 2001).

2.3.2 Expenditure on education

Education expenditure has been empirically proven to increase human capital for instance by Jung and Thorbecke (2003) for the case of Tanzania and Zambia. The notion behind this is that expenditure on education influences the distribution of additional human capital stock amidst various household groups through improved labour skills. Idrees and Siddiqi (2013, p. 174) agree, that "education expenditures are crucial for human capital formation."

According to the 1995 pamphlet from the IMF on Unproductive Public Expenditures, public expenditures in basic infrastructure represent a crucial precondition for capital accumulation in the private sector. Public spending in education or health increase the human capital formation.

2.3.3 Cultural diversity and Tolerance

For another determinant of human capital we included cultural diversity. Florida (2002b), Mellander and Florida (2006) and Florida et al. (2008) argue that social diversity signals lower barriers to entry of outside talent with different backgrounds. As a result, regions with higher levels of social diversity may be more attractive to talented individuals with higher levels of human capital.

Florida et al. (2007) furthermore claim that tolerance is one of three important magnets for creative people, since it represents a multicultural society that is open to minorities and therefore provides opportunities for ideological development. He also finds that tolerance and openness, along with universities and amenities, affects the distribution of human capital, the rates of innovation and regional development. The intuition in this case is that the more open a place is to newness (ideas and people), the more talent it will be likely to capture.

Florida and Gates (2001) found a positive association between concentrations of gay households and regional development. As a result, Mellander and Florida (2006) argue that diversity within regions enables a more open-minded and tolerant cultural, social, and economic environment.

2.3.4 Urban amenities

Amenities are considered as location-specific goods and services directly incorporated into the utility functions of an individual and consist of things such as diversity of consumer goods and services, architecture, recreation areas, public services, scenic views, natural resources, crime rates, and congestion (Glaeser et al. 2001). Glaeser et al. (2001) emphasize, that in order to grow, regions must actively try to attract high human capital individuals by providing – among else – rich variety of consumer goods and services, because cities with more restaurants and live performance theatres per capita have grown quicker in at least US and France.

Lloyd and Clark (2001) and Florida (2002a, 2002b, 2002c) pointed out the importance of lifestyle (entertainment, nightlife, culture) when it comes to attracting and retaining talent. Regions that offer a wider and more diverse range of services have more to offer to diverse groups of people.

According to Marlet and Van Woerkens (2004) individuals who are more creative and highly educated have a higher income and take part more actively in city life, therefore they spend a larger share of their incomes in local bars, restaurants and theatres, creating amenities and quality-of-place and stimulating employment growth in local services. Tiebout (1956) showed that the preference of amenities can be illustrated through the choice of the city to live in.

2.3.5 Industry structure

Studies in OECD countries show that the more rapid the introduction of knowledge-intensive means of production, such as those based on information technologies, the greater the demand for highly skilled workers (OECD, 1996). Thus, regions with better industry structure should attract people with higher human capital.

According to OECD (1999), all industries rely on knowledge inputs to different extents. In general, "knowledge-based industries" means industries with an intensive input of technology and human capital. Due to imperfect availability of data and to limited means of comparison between countries, finding the most appropriate service sectors in order to measure how impactful knowledge is has been difficult. Nonetheless, technology intensity has been used with the aim of classifying manufacturing industries.

2.3.6 Proximity to institutions of higher education

In his work, Moretti (2004b) used an indicator for the presence of a land-grant college in a city. His results indicate that the metropolitan areas of USA, with or without land-grant[4] colleges or universities have similar demographic characteristics in most aspects. Another implication of the same model is that the presence of such an institution is associated with higher shares of college graduates, but lower shares of individuals with high school diplomas or other colleges (which are not land-grant). These results appear to be in line with the opinion that the presence of a land-grant university is a factor of higher rates of college attainment, and not the other way around. Moreover, Abel and Deitz (2011) prove that universities can influence the growth in local human capital levels by increasing both the supply (graduates) of and demand (researchers, teachers) for highly educated individuals within urban areas. This is both temporarily if they move for a limit time and

[4] A land-grant college or university is an institution which has been designated by its state legislature or Congress to receive the benefits of the Morrill Acts of 1862 and 1890.

long-term, if they decide to stay in the region. The same study ascertains that academic R&D activities also play a role in the growth in an area's human capital stock, which can mean that a demand for highly skilled individuals is created through spillovers into the area's economy. Regions with greater higher education activities most often also have a larger share of workers employed in high human capital occupations (Abel and Deitz, 2011). The main results of this study show that there is a relationship between the activities of universities and the composition of local labour markets. It appears that more degrees obtained in a high human capital field results in more workers in comparable occupations.

2.4 Background

2.4.1 Institutions

An education reform in 1987 led to a spatial decentralization of Sweden's institutions of higher education. In reality it meant building more schools[5] in order to increase the accessibility to higher education institutions for all inhabitants. According to research of Andersson et al. (2004), the '87 reform meant that almost all[6] of the population now lives within 200km of a university or college. The main reason behind this movement was increasing current regional employment and investing into future – through spillovers and externalities that could bring regional expansion, for example through potential start-up companies (Andersson et al., 2004). Unfortunately, Lundquist (2001) found little or no statistical relationship between location of start-ups and location of higher-education institutions in Sweden.

Furthermore, in 2000 the government established a political goal which stated that half of the generation below 25 years should obtain a degree from higher education (Johansson et al., 2003). Moreover there are no tuition fees in Sweden. On the contrary, there is an extensive system of allowances, grants and loans for all students. All in all, one can see

[5] From 11 institutions of higher education, universities and institutes of technology with affiliated colleges in 1977 to 47 institutions in 2015 (http://www.studeravidare.se/skolor)
[6] 8 759 227 out of 8 841 583

that there is a good geographical as well as financial access to higher education, resulting in an overall high level of human capital.

Figure 1 shows the geographical positioning of Swedish universities.[7] From this map, we can observe that there is a discrepancy in the number of universities situated in the southern part of Sweden and those located in the north. This significant difference is a consequence of the difference in population concentration, since there are a lot more inhabitants in the south compared to the north. Borgegård (2002) writes that there is only 14 per cent of population living north of Gävle, which covers 60 per cent of country's area.

Figure 1: Location of Swedish universities

2.4.2 Broader perspective of human capital

Sweden has been ranked among the first countries in the European Human Capital Index (first place in 2006, 4th place in 2007). Looking through the global lens, The World Economic Forum in collaboration with Mercer (2013) calculated the fifth highest human capital in the world for Sweden in 2013. According to the Lisbon Council's paper on Human Capital Index, Sweden's success is due to a number of factors. For example, 90 per cent of all 25 to 34 year olds and 80 per cent of all 45- to 54-year-old individuals have attained at least a secondary education qualification, the highest rates in Europe. Sweden spends around 1.7 per cent of its GDP on tertiary education (overcome only by Finland and Denmark) – which is almost twice as much as Italy with 0.9 per cent of their GDP. Also, individuals in Sweden aged between 44 and 64 spend 358 hours per year in adult educational activities with job relevance. In addition to that, Sweden invests twice as many financial resources in school, university and adult education as Italy or Spain, with the result that Swedish employees possess twice as much human capital as measured by the index than their Italian or Spanish counterparts. If we were to compare Sweden's

[7] http://studera.nu/globalassets/sverigekarta/sverigekarta_studera-nu-590.gif

performance to that of another Nordic country, Denmark ranks really high in this index as well, being put second after Sweden. They have a similar level of employment of their human capital of around 63 per cent, with Sweden having a 64 per cent level. To conclude, Denmark is quite successful with spending on tertiary education, which for this sub-measurement puts it on the first place in all Europe.[8]

2.5 Measuring Human Capital in a region

Kwon (2009) asserts that the standard way to measure human capital stock accepted by most economists has been largely split into three: output-based, income-based and cost-based approach. School enrolment rates, scholastic attainments, adult literacy, and average years of schooling are some examples of output-based approach; cost-based approach has its grounds on calculating costs for obtaining knowledge, while income-based approach is closely linked to each individual's benefits obtained by investment in education and training.

Through their understanding of the importance of human capital, several countries have tried to effectively and efficiently measure their human capital in order to be able to understand their current status and afterwards implemented ways to improve their human capital (Kwon, 2009). Kwon (2009) further continues, that even if it appears necessary to measure human capital, traditional methods of measurement are somehow limited.

Taking into consideration the drawbacks of the simple education attainment to measure human capital, the OECD representatives (from The 3rd OECD World Forum on "Statistics, Knowledge and Policy") are trying to find the most appropriate and precise proxies for human capital. Human capital is quite difficult to identify and measure in a direct way. A number of researchers use indirect measures. Recently, there has been a tendency to expand human capital measurement towards both financial potential and quality of life (one's wellbeing, social networks, motivation) in order to capture all aspects. Kwon (2009) states that the definition of human capital should consider both monetary and non-monetary characteristics.

In following sections we shall focus closely on the three separate pillars of our index.

[8] Data gathered from The Lisbon Council Policy Brief from 2006

2.5.1 Education

One of the more common measures of human capital is the average years of education of the labour force (Kyriacou, 1991, Barro and Lee, 1993, 2000). The main drawback of this estimate is the unequal amount of opportunity cost (or forgone earnings) of one year of primary school and one year of university (Judson, 2002). Moreover, Moretti (2004a) considers that workers from a city with well-educated labour force are likely to have a number of skills which will make them more productive than workers with the same level of education, but who come from a city with less-educated labour force.

Judson (2002) compares this way of measuring human capital with a measurement of physical capital, where instead of evaluating different types of buildings, only their total number is measured. He instead suggests measuring the physical capital by the cost of machines and different types of buildings – hence calculating the cost of separate levels of education (primary, secondary and higher), which is then used to estimate the value of human capital stock according to its replacement value. This controls for differences in reforms in cheap primary education versus arguably more expensive higher education, because it allows to treat them differently. Moreover, it was proven to be robust, significant and positively correlated with output growth (Judson 2002).

Another way of measurement is through the level of education of a person or through the percentage of the population holding a certain degree (Glaeser et al., 1995; Glaeser and Maré, 2001; Glaeser, 2005).

Blundell et al (1999, p. 6) state that "training is distinguished from formal school and post school qualifications (which are viewed as education) and is generally defined in terms of courses designed to help individuals develop skills that might be of use in their job." Mincer (1958) considers that when occupation is used as a classification of human capital, then the occupational groups have to be ranked with respect to the amount of training they presuppose. Therefore, training can be an indicator of the type of skills a person possesses. Blundell et al. (1999) consider as the most debated issue the question of whether the higher level of education or training of an individual determines his higher earnings or whether it is the ability of having greater earning which results in choosing to have more education or training.

Blundell et al. (1999) further assert that the individuals who are employed in industries which progress quickly from a technological point of view will have increased returns to education. One explanation for this could be the fact that workers with a higher education level are more likely to respond to technological change and, as a result, they have an increased productivity in high-tech firms.

2.5.2 Occupations

According to Backman (2013a), the method of measuring human capital based on education is actually measuring the amount of skill than an individual possesses, so it can be regarded as a vertical approach if we were to make use of the assumption that an individual's amount of skill is equal to the educational level that individual has attained (education level as a labour supply factor). On the other hand, the occupation of a person indicates what kind of skills he possesses (horizontal differentiation). It can indicate as well what occupations are valued and in demand by firms (labour demand factor). As it appears that are not any exhaustive definitions for human capital, the best approach would be to see these definitions as complementary to each other instead of interchangeable.

Florida (2002a) believes that the standard measure for human capital is insufficient, because it does not capture enough of accumulated experience, creativity, innovativeness etc. Building upon Jacobs (1985), who noticed that cities spur economic growth according to their ability to attract creative people, Florida suggests another measure, developed in a number of works (Florida 2002a, b, c, 2008). Florida (2002a) argues that the economy is transforming and is in need of creative people, or people who work in creative occupations. More relevantly to our paper, Florida (2002a) adds that in order to succeed, cities must aim at attracting these creative individuals – by providing good lifestyle and sufficient consumption to its residents.

The 'creative class' measures individuals who "engage in complex problem solving that involves a great deal of independent judgment and requires high levels of education or human capital" (Florida, 2008, p. 625). Since there were already articles confirming better performance of this measure over educational attainment in Sweden (Mellander and Florida, 2006) and for Netherlands (Marlets and Van Woerken, 2004), we would like to use it as one of the aspects forming our human capital index.

2.5.3 Health

Among various determinants of human capital, Schultz (1962) also discusses the economic impact of health. According to him, health facilities and services broadly include all expenditures that affect life expectancy strength and stamina, and the vigour and vitality of a people.

Grossman (1972) constructed a model for the optimal investment needed to increase longevity. Although many writers have suggested that health can be viewed as one form of human capital (Mushkin 1962; Becker 1964; Fuchs 1966), Grossman has been one of the first to create a model for the demand for health capital itself. The fundamental assumption of his model is that health can be seen as a durable capital stock which produces an output of healthy time. He claims that health capital is different from other forms of human capital and it argues that stock of knowledge of person can affect his market and nonmarket productivity, while his stock of health determines the total amount of time he can spend producing money earnings and commodities.

The starting point for the area of study which sees health as a form of human capital is that an individual's mortality rate, as well as his health state is greatly influenced by the individual himself. Becker (2007) focuses his study mainly on mortality and the key basis of his analysis is "optimal behavior by consumers where they maximize utility over time, subject to the resources they have, and to actions they can take to affect their survivor rates at different ages." (p. 29). According to Becker's results (2007), the value of life is likely to decrease with age and interest rates, but increase with income, and is higher when "period utility functions are more concave" (p. 29).

This analysis showed that an increased survivorship for an adult would lead to higher investments in education as the expected returns would also be higher. Higher survivorship can also lead according to Becker (2007) to an increased investment in goods that add to an individual's future utility and discourage investments in harmful goods. Becker (2007) considers that an individual who has higher survivorship also has lower discount rates which result in more savings and he believes that this is a reason why a longer life expectancy is paired with good habits and greater education.

Becker's study (2007) main results summarized were that individuals who have better survivorship prospects during childhood are more likely to receive more education and

thus have higher earnings, they would save more, they would have more positive habits, and they would have better probabilities of surviving during adulthood as well.

Bloom, Canning and Sevilla's research (2001) showed that a good health has a positive, sizeable and statistically significant impact on the aggregate output. Bleakley (2010) finds that health is both human capital itself and an input to producing other forms of human capital. Nonetheless, there is a reverse causality occurrence between human capital and health since the healthier a person is at the time of birth the more likely that individual will be to receive more schooling later in life (Victora et al., 2008).

According to Becker (2007), the subject of health as human capital relies on three interrelated dimensions. Firstly, an analysis of the ideal investments in health by all stakeholders: individuals, drug companies and governments (also discussed by Ehrlich and Becker, 1972; Ehrlich, 2000). Secondly, there should be development on the literature that analyses the amounts that people are willing to spend for improvements in their probabilities of surviving different ages (Usher 1973; Rosen, 1988; and Murphy and Topel, 2006). Lastly, Becker (2007) underlines the significance of complementarities in relating health to education and the other types of human capital investments, and in linking investments in health to discount rates in order to progress in fighting different diseases (Dow et al., 1999; and Murphy and Topel, 2006).

Extensive historical and contemporary studies in both low- and high-income countries show that health influences labour productivity per unit time worked, and labour supplied per adult year to market work, and longevity (Fogel, 1994, Strauss and Thomas, 1995, Schultz and Tansel, 1997).

Adult health can also be measured by general morbidity (Schultz, 2003).[9] The common measures of adult morbidity are self-reported and subjective and are therefore regarded by some researchers as unreliable (Johansson, 1991). Another measure of adult morbidity is days of work missed due to illness (Schultz, 2003).

[9] Poor/fair/good/excellent health.

3 Data, Variables and Method

All data used in this thesis originate from Statistics Sweden[10] - the main governmental statistical administrative agency. The dataset covers data on all municipalities in Sweden[11] from the year 2001, with addition to data on Education, Creativity and Health from 2010.[12]

3.1 Human capital index

In this thesis we chose to measure human capital as an overall index based on three separate pillars. According to the World Economic Forum (WEF), which makes its own human capital index, "Using human capital index is a relatively new measure for capturing and tracking the state of human capital development".[13] An index is compiled using a more comprehensive array of indicators than the classical definitions of human capital. In consequence, human capital index captures multi–dimensional concept.

We compiled a much simpler index than WEF, based only on three pillars and without further segregation. The first pillar captures education measured by share of population holding at least a BA degree, which equals to finished three years at a higher education institution (*edu*). The second pillar takes into consideration creative citizens expressed by a share of people working in creative occupations based on the occupational categorization SSYK[14] (*creat*). Finally it consists of a health proxy represented by number of days spent sick instead of working, in average per employed person (*health*).

The methodical creation of our index follows the Global Innovation Index[15]. Firstly we normalized all three pillars into [0,100] scale, where 100 was the best outcome and 0 the worst by the following formulas:

$$\frac{respective\ value - min}{max - min} \times 100 \qquad (1.1)$$

[10] http://www.scb.se/en_/
[11] Except Heby, Kalix, Knivsta and Nykvarn, which we were forced to exclude because of insufficient data.
[12] Data on creativity is actually from 2011, but it should not be significantly different from 2010.
[13] http://www3.weforum.org/docs/WEF_HumanCapitalReport_2013.pdf
[14] Swedish Standard Classification of Occupations (Standard för svensk yrkesklassificering).
[15] Made by Cornell University, INSEAD, the World Intellectual Property Organization (WIPO) and others; available at http://www.globalinnovationindex.org/content.aspx?page=gii-full-report-2014

for "good" measures, meaning that the high value represents positive situation (in our case education and creativity) and

$$\frac{max - respective\ value}{max - min} \times 100 \tag{1.2}$$

for "bad" measure, where high value represents negative situation (in our case health). Then we calculated mean average of the three values for every municipality. Clearly these three pillars interact, but since the exact mechanisms are hard to define, we did not use different weights. After we received the value of human capital index (*HCI*) for separate years, we made a relative change (*diff_HCI*) to use as regressant based on following equation:

$$diff\_HCI = \ln HCI_{2010} - \ln HCI_{2001} \tag{2.1}$$

3.2 Variables

We used the same equation to calculate differences in the levels of education, creative class and health:

$$diff\_edu = \ln edu_{2010} - \ln edu_{2001} \tag{2.2}$$

$$diff\_creat = \ln creat_{2010} - \ln creat_{2001} \tag{2.3}$$

$$diff\_health = \ln health_{2010} - \ln health_{2001} \tag{2.4}$$

We decided to use logarithmic transformation through the natural logarithm for some variables in order to reduce the non-linear relationships, fight heteroscedasticity, but also to facilitate the interpretation of coefficient, which will then be equal to the elasticities.

Population density (*pop_dens*) is a control variable of number of inhabitants of a particular region, capturing the size of a region. According to Qian et al. (2012), the population density is likely to be positively associated with human capital, as it reflects an easy access to other people and face-to-face communications through which knowledge can spill over. Qian et al. (2012) consider that while the population density does not necessarily represent an ideal measure - as it cannot capture the variation of densities - it is nonetheless regarded as 'customary' in the literature (Crescenzi et al., 2007). This variable is regressed with natural logarithm.

Education expenditure *(edu_exp)* is money spent on education in thousands of Swedish crowns. Lin (1998) claims, that an increase in education expenditure which increases the time spent in school doubtlessly results in higher human capital, whereas if increasing spending on school reduces time spent in school, it can still increase human capital if the initial spending was low enough. Thus we expect a positive relationship. This variable is regressed with natural logarithm.

Cultural Diversity *(cult_div)* is a Theil entropy measure based on nationality. There are ten subgroups and include Sweden, other Nordic countries, EU15 (except Nordic countries), Europe (except EU15 and the Nordic countries), Africa, North America, South America, Asia, Oceania, and Russia. This variable is regressed with natural logarithm.

The equation employed for the Theil index is the following:

$$\text{cult\_div}_m = - \sum_{c=1}^{12} \frac{i_c}{i_m} \ln\left(\frac{i_c}{m}\right) \quad (3)$$

where *i* represents number of inhabitants, *m* is for municipality and *c* means the category that a person can belong to according to his ethnicity. Higher values of entropy are imply more diversified municipality. The distribution of this entropy value ranges from zero to *l*n(c).

Inglehart (2003) found out that openness toward the gay and lesbian communities is the best available indicator of tolerant attitudes currently available. Therefore, we use *tolerance* measure based on an index published by the Swedish Federation for Lesbian, Gay, Bisexual and Transgender (LGBT) Rights - RFSL. This index was built from a survey questionnaire asking about municipal operations, schools, training, LGBT community infrastructure, exposure to hate crimes and tolerance towards LGBT people within all municipalities. Unfortunately due to infrequent measurements of these data, we had to use index from 1998.

Amenities measures the percentage of employment in a given municipality with activities in the restaurant, cultural, and entertainment sector (two-digit SNI codes 55-56, 90-93). The variable captures consumption externalities that differ between locations.

To find out in which municipalities is knowledge concentrated, we use Location Quotients (LQs) as a measure of specialization for knowledge-based manufacturing and

services, approach developed by Hildebrand and Mace (1950). This measure is used as an estimate of employment in particular sector (in our case knowledge-based industries) relatively to the reference unit (in our case the whole country of Sweden). The LQ was calculated based on following equation:

$$LQ_i = \frac{\frac{e_{i,k}}{e_k}}{\frac{e_i}{e}} \quad (4)$$

where

$e_{i,k}$ = Employment in sector *i* in a particular municipality *k*
e_k = Total employment in the particular municipality *k*
e_i = Employment in sector *i* in the whole country
e = Total employment in the country

The interpretation of this measure is quite straightforward. If LQ equals 1, the employment in knowledge-based manufacturing or services in particular municipality is the same as average within the country. If LQ is higher than 1, that municipality is specializing in knowledge-based industries more than most of the country and conversely, if LQ is lower than 1, there is relatively low employment in the knowledge based industries.

LQ_manu stands for knowledge-based manufacturing and *LQ_serv* for knowledge-based services. Both are calculated according to employment in occupations with SNI codes 24, 29-34 & 60, 61, 64-67, 70, 72, 85, 90-93 respectively. This measure follows Backman and Karlsson (2013), where it is denotes as KIBS.

We decided to capture the effect of distance to universities by creating three dummy variables *(dum_muni, dum_fa, dum_neigh).* For the first dummy (*dum_muni),* a value equal to 1 means the presence of university directly in the municipality, 0 means that there is no university located there. If *dum_fa* is 1, it represents the presence of a university in the functional (FA) region[16] in which the municipality is located, while a value equal to 0 represents the absence of university in the respective FA region. Lastly, *dum_neigh*

[16] There are 72 FA regions in Sweden and one FA regional usually includes several municipalities.

takes on the value 1 when a university is located in a neighbouring FA region[17] and 0 when there is no university located in any neighbouring area.

Table 1 summarizes all variables used in our regressions, as well as their expected signs.

Table 1: Variables

		Expected sign
diff_HCI	Relative difference in human capital index between 2001 and 2010	
diff_edu	Relative difference of share of population with BA degree or above between 2001 and 2010	
diff_creat	Relative difference of share of population working in creative occupations between 2001 and 2011	
diff_health	Relative difference of number of days spent on health-leave per worker between 2001 and 2010	
pop_dens	Population density	+
edu_exp	Expenditure on education in thousands of Swedish crowns	+
cult_div	Cultural diversity – Theil entropy measure, based on nationality calculated in equation 3	+
tolerance	Attitude towards and opportunities for LGBT people	+
amenities	Share of employment in culture, restaurants and entertainment based on SNI	+
LQ_manu	Location quotient for knowledge-based manufacturing based on SNI codes 24, 29-34	+
LQ_serv	Location quotient for knowledge-based services based on SNI codes 60, 61, 64-67, 70, 72-75, 85, 90-93	+
dum_muni	Dummy for presence of university in the same municipality	+
dum_fa	Dummy for presence of university in the same FA region	+
dum_neigh	Dummy for presence of university in the neighboring FA region	+ / -

3.3 Method

Inside *Table 2*, you can find the descriptive statistics for all the variables we use. From the descriptives of independent variables, one can observe that all the municipalities had an increase in the share of educated persons *(diff_edu)*.The same cannot be said about share of creative persons, which in some municipalities increased their numbers, while in others decreased *(diff_creat)*. On average, it was positive. With health one can observe that similarly to education, it increased in all municipalities (number of days spent sick

[17] Taking into consideration geographical borders.

(diff_health) decreased). Human capital in general experienced a decrease in some municipalities, but in most of them it has increased *(diff_HCI)*.

Notice that the most deviated variable is population density (*pop_dens)*, which implies that the population is quite scattered over Sweden. From the dummies for distance to universities, it can be seen that even though the majority of municipalities do not have their own university *(dum_muni)*, however, there is at least one university in most FA regions *(dum_fa)* and almost all of them have close access to university in a neighbouring region *(dum_neigh)*.

Table 2: Descriptive Statistics

	Minimum	Mean	Maximum	Std. Deviation	Variance
diff_edu	0.032	0.405	0.609	0.095	0.009
diff_creat	-0.222	0.035	0.248	0.073	0.005
diff_health	-2.11	-1.084	-0.58	0.220	0.048
diff_HCI	-0.51	0.059	0.901	0.181	0.033
pop_dens	0.26	125.84	4013.55	420.06	176453
cult_div	0.147	0.434	1.321	0.192	0.037
edu_exp	7.747	12.711	17.655	1.387	1.924
tolerance	2.09	2.633	3.97	0.301	0.091
amenities	0.022	0.063	0.237	0.026	0.001
LQ_manu	0.01	1.046	6.52	0.965	0.931
LQ_serv	0.3	0.847	1.42	0.190	0.036
dum_muni	0	0.16	1	0.371	0.138
dum_fa	0	0.78	1	0.415	0.172
dum_neigh	0	0.96	1	0.193	0.037

For our regression, we use a cross-sectional analysis. The essential aspect of a cross-sectional study is that by using it, we can compare different population groups at a single point in time. However, cross-sectional studies may not provide definite information about cause-and-effect relationships. This is because such studies offer a snapshot of a single moment in time; they do not consider what happens before or after the snapshot is taken.

For the dependent variable in our regression, we calculated the difference of HC index over time.

To ensure the robustness of our model, we decided to run four different regressions, where the right-hand-side does not change, but we use all the pillars of the human capital index separately, as well as the index itself. In all of them we have the dependent variable as a relative change between two points in time.

The equation is as follows:

$$ln\, Y_{2010} - ln\, Y_{2001} = \alpha + \beta_1 \ln pop\_dens_{2001} + \beta_2 \ln edu\_exp_{2001} + \beta_3 \ln cult\_div_{2001} + \beta_4 tolerance_{2001} + \beta_5 amenities_{2001} + \beta_6 LQ\_manu_{2001} + \beta_7 LQ\_serv_{2001} + \beta_8 dum\_muni_{2001} + \beta_9 dum\_fa_{2001} + \beta_{10} dum\_neigh_{2001} + \varepsilon \quad (5)$$

Where *Y* stands for education, creativity, health and human capital index respectively.

4 Empirical results

Before presenting our results from our estimations, we first discuss several tests we did to check the validity of our econometrical model. In order to check for multicollinearity, we created a correlation matrix based on Pearson correlations presented in *Table 3*. If multicollinearity is present, it is impossible to allocate the individual effects of the collinear variables, which results in inefficient estimates with high variance. Our data looks quite well, with only one value above 0.5, therefore presenting a danger of highly correlated variables. It belongs to the correlation between *tolerance* and *dum_muni* of 0.515. Since the value is only slightly above 0.5, it should not inflate the variances so much. We confirm this by a robustness test, where we compared values of all variables with regression containing both variables, then excluding *tolerance* and later excluding *dum_muni* for all four regressors respectively (12 regressions in total). We found no significant difference and the signs were always the same, therefore we use both variables in the same estimation. As a second check for multicollinearity, we conducted the VIF test and since the variance inflation factors are all below 2, it confirms that multicollinearity is truly of no problem.

Table 3: Correlation matrix

	diff_ edu	diff_ creat	diff_ health	diff_ HCI	pop_ dens	cult_ div	edu_ exp	toleran ce	amenit ies	LQ_ manu	LQ_ serv	dum_ muni	dum _fa	dum_ neigh
diff_edu	1													
diff_creat	.213**	1												
diff_health	-.037	.172**	1											
diff_HCI	.173**	.225**	-.806**	1										
pop_dens	-.392**	-.088	.069	-.062	1									
cult_div	-.484**	-.204**	.275**	-.333**	.488**	1								
edu_exp	.241**	-.126*	-.201**	.088	-.343**	-.345**	1							
Tolerance	-.166**	.106	-.075	.079	.261**	.193**	-.273**	1						
Amenities	-.070	-.132*	-.323**	.198**	.088	-.100	.109	.159**	1					
LQ_manu	.021	.149*	.289**	-.233**	-.044	.171**	-.124*	-.025	-.330**	1				
LQ_serv	-.399**	-.105	-.230**	.177**	.286**	-.005	-.074	.292**	.346**	-.382**	1			
dum_muni	-.289**	.063	-.034	.019	.171**	.249**	-.340**	**.515****	.089	.020	.382**	1		
dum_fa	-.241**	.033	.179**	-.138*	.136*	.182**	-.303**	.130*	-.147*	.068	.011	.236**	1	
dum_neigh	-.094	.005	.147*	-.122*	.058	.184**	-.234**	-.013	-.153**	.057	-.137*	-.009	.245**	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed)

It is interesting to observe such a high correlation of 0.806 between the dependent variables *diff_health* and *diff_HCI*. It suggests that health is really important and has big impact on human capital.

There is no reason to be concerned in case of high correlation between the dependent variables. On the contrary, there has to be a relationship, since we derive human capital from the other three dependent variables. The same applies for correlation between dependent and independent variables – it is a good sign showing that there is a relationship between them – what is expected when making a regression.

Table 4: Multicollinearity

Variable	*Tolerance*	*VIF*
pop_dens	.622	1.608
cult_div	.649	1.541
edu_exp	.700	1.429
tolerance	.687	1.455
amenities	.792	1.263
LQ_manu	.764	1.308
LQ_serv	.601	1.665
dum_muni	.575	1.738
dum_fa	.836	1.197
dum_neigh	.866	1.155

To test for heteroscedasticity, we analysed the histogram of residuals associated with dependent variable (*Figure A1*). We can see that it follows a normal distribution with some small divergence. Since this control was inconclusive, we looked also at scatterplot of standardized residuals versus standardized predicted values (*Figure A2).* There we can see slight spreading out of these plots on the right side, so it might suggest the presence of heteroscedasticity. After using a formal Breusch-Pagan and White test, we concluded that there is heteroscedasticity present in the model. Hence in order to avoid bias of standard errors (resulting from their non-constant variance), we use robust standard errors.

4.1 Analysis

Table 5 presents a summary of our four models and their results.

Table 5: Results of OLS regressions for respective dependent variables with robust standard errors

	HCI	Edu	Creat	Health
(Constant)	0.249 (0.476)	0.997*** (0.152)	0.277* (0.156)	-0.554 (0.502)
pop_dens	-0.016 (0.016)	-0.032*** (0.005)	0.000 (0.005)	0.021 (0.019)
cult_div	-0.126*** (0.044)	-0.034** (0.017)	-0.059*** (0.017)	0.080 (0.051)
edu_exp	-0.174 (0.158)	-0.160*** (0.046)	-0.132** (0.052)	-0.101 (0.171)
tolerance	0.057 (0.038)	0.026 (0.022)	0.033** (0.016)	-0.051 (0.046)
amenities	0.447 (0.364)	-0.176 (0.164)	-0.306* (0.157)	-1.508*** (0.503)
LQ_manu	-0.024** (0.011)	-0.009** (0.004)	0.009 (0.006)	0.034** (0.013)
LQ_serv	0.050 (0.064)	-0.200*** (0.030)	-0.049 (0.031)	-0.091 (0.085)
dum_muni	0.014 (0.038)	-0.015 (0.014)	0.012 (0.013)	-0.036 (0.043)
dum_fa	-0.021 (0.027)	-0.006 (0.011)	-0.001 (0.012)	0.030 (0.035)
dum_neigh	0.009 (0.092)	0.018 (0.018)	0.002 (0.024)	-0.016 (0.094)
N	286	286	286	286
Adj R^2	0.181	0.476	0.119	0.215
F-value	8.505	20.827	4.655	7.266

***. Parameter is significant at the 0.01 level
**. Parameter is significant at the 0.05 level
*. Parameter is significant at the 0.1 level

Our statistics for adjusted R^2 and F-statistics imply that our models are definitely not perfect, but they explain a sufficient amount of the studied regressants. All of the models were in overall significant with unmeasurable p-values on four decimal places.

The model explaining the difference in education which controls for population density has the best fit. This is consistent with Glaeser et al. (2005), who claim that education, or rather universities are crucial in the creation of initial advantages in human capital.

To keep it organized, we structure the following section according to regressants, which should also be determinants for human capital.

Becker et al. (1999) assume that it is likely that the population density raises the production of human capital as a higher density results into larger market and more specialization. Our results for population density (*pop_dens)* are insignificant for human capital, but their relationship appears to be negative, opposing to initial expectations.

Cultural diversity (*cult_div*) seems to be the most significant contributor to both separate pillars and the overall index. In all cases, it is negatively affecting the regressant (when taken into consideration that health has reverse/negative affect on human capital index). This implies that parents of different nationalities actually decrease overall stock of human capital, which is contrary to our expectations, since we were counting on higher diversity leading to more ideas and creative thinking, which is one of the pillars of human capital. Upon reflection, immigrants to Sweden are usually from less developed countries and they also may have issues with education and overall integration into the society resulting mainly from cultural distance and language barriers.

Even though expenditure on education (*edu_exp*) is not significantly affecting the human capital index, we found significant negative effect on the pillars of education and creativity. Unfortunately since the creative occupations are so diverse, it is hard to make general assumptions. Moreover, there is also an ambiguity connected to private vs. public ownership of schools (and thus unobserved differences in their expenses).

Tolerance follows our expectations about the sign of coefficient and we have confirmed outcomes presented by Mellander and Florida (2006). Communities which are more open towards LGBT tend to have higher human capital, creativity and overall health. This follows the findings of Lee et al. (2004), who found high positive correlations of tolerance[18] and human capital. The relationship is positive for education as well, however it is insignificant, therefore we cannot draw any conclusions.

Despite the expectations of Glaeser et al. (2001) and results from Mellander and Florida (2006), we did not find any significant effect of *amenities* on human capital – even though it is positive as it should be. We only significantly proved that it negatively affects creativity and measurement of health (which go into opposite direction in the index that is why it cannot result in significant results). However, when analysing this result we

[18] Measured by Diversity or Gay index.

must keep in mind that we are looking at amenities on a municipal level, while Glaeser (2001) looks at cities. By looking at amenities on an aggregate level we might encounter some issues as municipalities might be too large as they incorporate several urban areas.

Contrary to what we expected, regions which specialize in knowledge based manufacturing (*LQ_manu*) have actually lower growth of human capital. A far reaching speculation could be that specialization leads to routine, which hinders personal development. Moreover, higher specialization in knowledge based manufacturing tends to be in regions with less healthy population. Since knowledge-based manufacturing usually results in expensive products (watches, jewellery, medical equipment), workers might be exposed to high stress and tensions resulting from extreme concentration.

To conclude our variable analysis, we will present results of dummies for proximity to universities. Interested readers can find a summary of models where we used only one dummy, for presence of university in the same FA region in *Table* A3 in appendix. In this model, we did not find a significant relationship of this dummy with any independent variable, however, we now find a significant relationship for tolerance and HCI and health.

When we used three different dummies, neither of them became significant (except one negative relationship with education for *dum_fa*), because their effects were spread out and not captured by a single variable. Our hypothesis that the presence of university in the same municipality (*dum_muni*) leads to more human capital was confirmed. On the other hand, presence of university in the same FA region (including respective municipality) has occurred more in municipalities with lower human capital. This might happen because the positive effect of the presence in the same municipality of a certain region is already captured by *dum_muni*, so *dum_fa* is left to capture only municipalities which do not have its own university (which according to previously stated results would be legitimately leading to less development of human capital).[19] Finally, the dummy which captures the presence of university in a neighbouring region is insignificant and the standard error is considerably higher than the actual value of coefficient, which is very close to zero.

[19] Remember we calculate the change, not the actual levels.

In comparison, Moretti (2004b) found out that proximity to universities does not make much difference in personal characteristics (which could be also understood in the sense of human capital).

What we can address, is the slight divergence of our subject from most of research. Within the timeframe of 9 years, many things could have happened that affected accumulation of human capital irrespectively from the measured determinants. Moreover, our research concerned only one country, so the differences are sometimes not so major that they could really make a difference, even when they are important. On the other hand, having similar amounts of most of the determinants allows us to study more closely the effect of change in one variable. Moreover, it is worth noting the fact that the initial stock of human capital can have a great impact on the results. The changes in human capital are dependent on the initial stock. Most of the time, regions with an already elevated level of human capital may experience a smaller change than a region with a low level to begin with. Therefore, as we do not take look at the initial stock in our study, difficulties in the interpretation of the results might occur. But most importantly, since we do not study human capital stock, but its accumulation over time, the usual determinants might not work in the exact manner as expected.

We ran the same model, but instead of difference in time, we only run the regressions with absolute values of human capital index, education, creativity and health for 2001.

As can be seen in *Table 6*, this model follows more our expectations about signs of the determinants and it includes more significant relationships. The significant positive relationships with human capital index can now be observed with population density, cultural diversity, knowledge-based manufacturing and services and dummy for presence of university in the same municipality; whereas significant negative relationship is with education expenditure and dummy for presence of university in the same FA region. The separate pillars of HCI have also much more significance, as well as values of coefficients.

Table 6: Parameters for absolute amounts in 2001

	HCI 2001	edu 2001	creat 2001	health 2001
(Constant)	57.838***	-0.047	0.136*	-59.034***

	(18.865)	(0.041)	(0.081)	(22.202)
pop_dens	3.859*** (0.664)	0.015*** (0.002)	0.027*** (0.003)	0.531 (0.674)
cult_div	3.986** (1.971)	-0.004 (0.005)	0.018** (0.009)	-5.157** (2.130)
edu_exp	-19.686*** (6.278)	0.002 (0.013)	0.004 (0.027)	32.859*** (7.326)
tolerance	-0.482 (2.022)	-0.007 (0.006)	-0.013 (0.010)	-2.546 (1.885)
amenities	24.440 (23.244)	0.144** (0.056)	0.172 (0.105)	14.438 (23.344)
LQ_manu	1.642*** (0.557)	0.002 (0.001)	0.005* (0.003)	-1.571*** (0.502)
LQ_serv	21.337*** (4.343)	0.085*** (0.013)	0.171*** (0.020)	6.261* (3.759)
dum_muni	7.772*** (2.127)	0.009 (0.006)	0.041*** (0.009)	-5.374*** (1.896)
dum_fa	-4.28*** (1.254)	-0.001 (0.002)	-0.016** (0.007)	4.814*** (1.373)
dum_neigh	-2.094 (2.281)	-0.007 (0.005)	-0.016 (0.013)	-0.247 (2.958)
N	286	286	286	286
Adj R^2	0.652	0.668	0.732	0.334
F-value	39.232	25.244	61.256	19.763

***. Parameter is significant at the 0.01 level

**. Parameter is significant at the 0.05 level

*. Parameter is significant at the 0.1 level

5 Conclusion

The purpose of this paper was to analyse the determinants of accumulation of human capital. For this aim we chose to study Swedish municipalities and the difference between their level of education, creative class and health over time. We combined these three pillars into a human capital index and used it in the regression together with suggestions on possible determinants that we extracted from existing literature.

Based on the results from our analysis, we came up with the following suggestions for policymakers wishing to increase accumulation of human capital in their region:

Since the expenditure on education is insignificantly different from zero, it seems like education expenditure has practically no impact on human capital. Therefore we suggest to sufficiently evaluate every decision about investment in education, since high amounts of financial assets do not mean efficient use of them – one can make a good investment and affect the quality of education with few resources, as well as one investment in thousands of crowns on something that is not necessary could not make any change at all.

Instead of calculating the absolute stock of human capital, we looked at its development over time and that brought us to some quite unexpected results. Hence, we strongly encourage researchers to look more into the determinants of accumulation of human capital. It would be interesting to see whether similar analyses will bring similar results. If yes, theories need to be developed to explain these notions. Concretely, we would be interested in explaining the negative relationships among education expenditure and creativity, specialization in knowledge based services and education.

Economists interested in this area could for example compare regions from different countries, which we were not able to do because of insufficient data and resources. Multinational analyses would be more relevant to draw general conclusions and thus more helpful on a global scope.

6 Appendix

6.1 Heteroscedasticity

Figure A1: Histogram of residuals associated with dependent variable

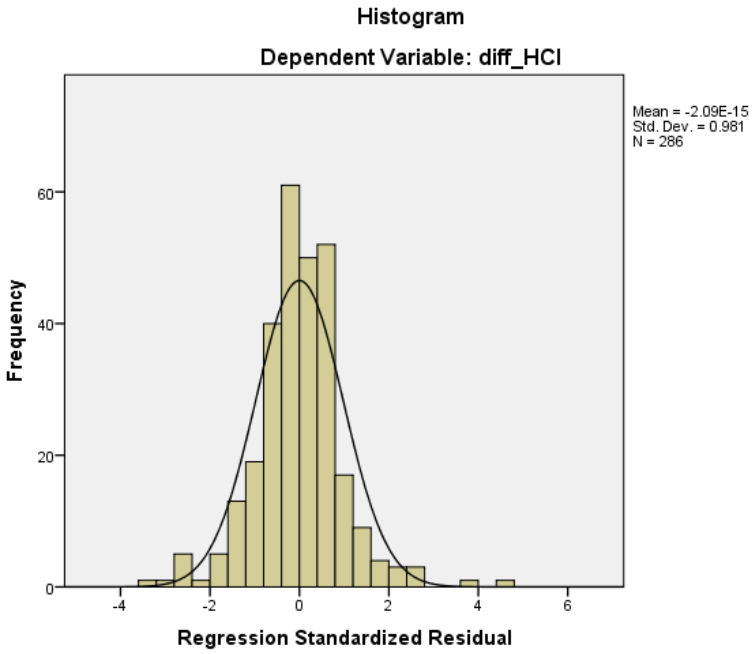
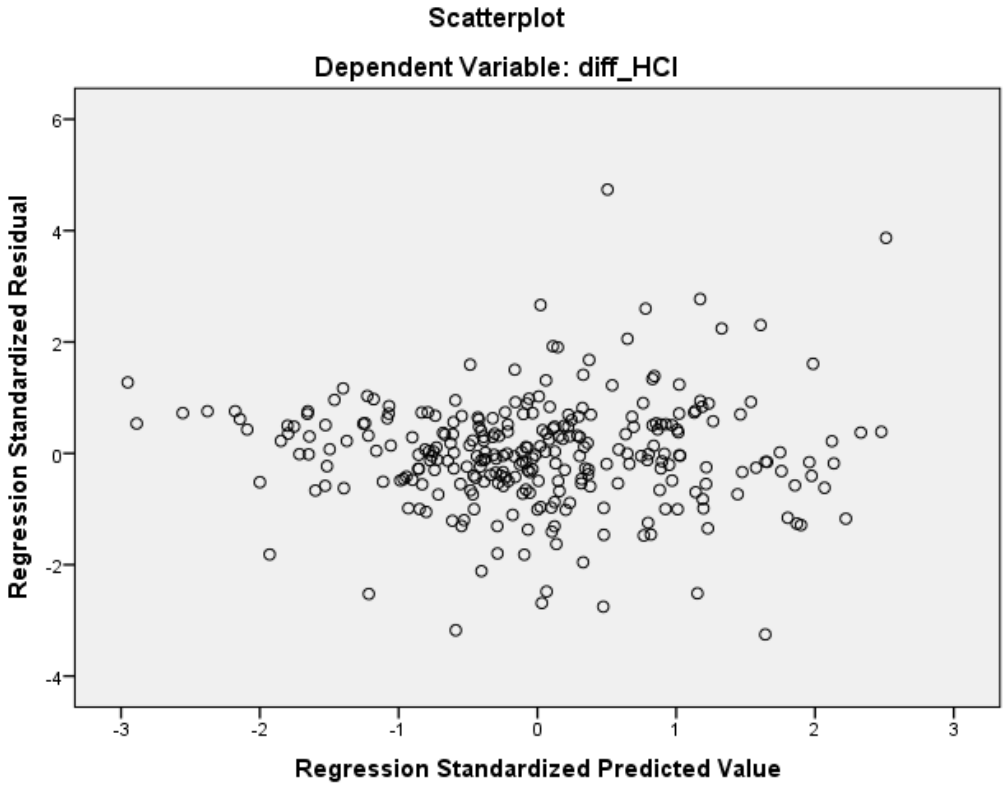


Figure A2: Scatterplot of standardized residuals versus standardized predicted values



6.2 Empirical analysis

Table A3: Summary of models with one dummy for distance to universities

	HCI	Edu	Creat	Health
(Constant)	0.266 (-0.423)	1.012** (-0.147)	0.286* (-0.152)	-0.591 (-0.470)
pop_dens	-0.016 (-0.016)	-0.030** (-0.005)	-0.001 (-0.004)	0.022 (-0.018)
cult_div	-0.124** (-0.042)	-0.037** (-0.017)	-0.057** (-0.016)	0.073 (-0.049)
edu_exp	-0.185 (-0.143)	-0.150** (-0.045)	-0.141** (-0.050)	-0.074 (-0.159)
tolerance	0.062** (-0.030)	0.018 (-0.021)	0.039** (-0.014)	-0.066* (-0.039)
amenities	0.444 (-0.364)	-0.182 (-0.167)	-0.307* (-0.158)	-1.501** (-0.496)
LQ_manu	-0.024** (-0.011)	-0.010** (-0.004)	0.009 (-0.006)	0.033** (-0.013)
LQ_serv	0.057 (-0.059)	-0.212** (-0.028)	-0.042 (-0.028)	-0.112 (-0.079)
dum_fa	-0.019 (-0.027)	-0.008 (-0.011)	0.001 (-0.011)	0.023 (-0.034)
N	286	286	286	286
Adj R^2	0.187	0.476	0.123	0.218
F-value	8.124	26.446	5.451	9.061

**. Parameter is significant at the 0.05 level

*. Parameter is significant at the 0.1 level

7 List of references

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