Mining booms impact on local labor markets in Norrbotten county, Sweden

Kristoffer Sundström
Axel Andrup

Economics, bachelor's level
2018

Luleå University of Technology
Department of Business Administration, Technology and Social Sciences
ABSTRACT
The objective of this thesis has been to analyze whether booms in the iron ore market has any significant effects on local labor markets in certain municipalities in Norrbotten County during the time period 2000-2016. Previous research has established that certain types of booms and busts influenced local labor markets. The analysis was done by using panel data and regression models where the results where compared over non-mining and mining municipalities. The results gave a vague response with both conclusive and inconclusive results over the variables investigated. The main conclusion is that although the mining industry is a big part of local labor markets in Norrbotten County, it is important for firms and policymakers to understand that the mining industry is not the only important factor and that decisions should not be entirely based on the mining industry and its markets.

Keywords: Boom, Labor markets, Mining, Iron ore, Norrbotten, Mineral demand, Mineral supply, Labor demand shock, Econometrics, Mining market, LKAB
SAMMANFATTNING


Nyckelord: Boom, Arbetsmarknader, Gruvdrift, Järnmalm, Norrbotten, Mineraledgefrågan, Mineralutbud, Arbetsafterfrågechock, Ekonometri, Gruvmarknaden, LKAB
# TABLE OF CONTENT

CHAPTER 1 INTRODUCTION................................................................................. 1
  1.1 Introduction.............................................................................................. 1
  1.2 Purpose...................................................................................................... 2
  1.3 Method....................................................................................................... 3
  1.4 Delimitations............................................................................................. 3
  1.5 Disposition................................................................................................. 3

CHAPTER 2 BACKGROUND............................................................................. 5
  2.1 The municipalities...................................................................................... 5
    2.1.1 The municipality of Kiruna ................................................................. 7
    2.1.2 The municipality of Gällivare ............................................................. 8
    2.1.3 The municipality of Luleå ................................................................. 9
    2.1.4 The municipality of Övertorneå ......................................................... 10
    2.1.5 The municipality of Arvidsjaur ......................................................... 11
  2.2 The Swedish mining industry................................................................. 12
    2.2.1 Luossavaara-Kiirunavaara Aktiebolag ............................................. 12
  2.3 Swedish trade unions.............................................................................. 13
    2.3.1 IF Metall ............................................................................................. 14
  2.4 Previous research.................................................................................... 14

CHAPTER 3 THEORY ....................................................................................... 16
  3.1 Nature of boom and bust cycles............................................................ 16
  3.2 Mineral markets...................................................................................... 17
    3.2.1 Mineral supply in the long and short run ........................................... 17
    3.2.2 Mineral demand ............................................................................... 18
  3.3 Labor market............................................................................................ 18
    3.3.1 Unemployment .................................................................................. 19
    3.3.2 Cyclical unemployment ................................................................... 20
    3.3.3 Trade Unions ................................................................................... 20
    3.3.4 Free time .......................................................................................... 21
    3.3.5 Tax wedge ........................................................................................ 22
    3.3.6 Labor demand shocks ....................................................................... 23

CHAPTER 4 METHOD ...................................................................................... 24
  4.1 General method ...................................................................................... 24
    4.1.1 Method criticism .............................................................................. 24
4.2 Econometrics issues........................................................................................................... 24
  4.2.1 Least Squares Dummy Variable Fixed Effects Model...................................................... 25
4.3 Econometrics specification................................................................................................. 25
4.4 Data.................................................................................................................................... 26
  4.4.1 Correlation matrices ........................................................................................................ 26
  4.4.2 Omitted variables ............................................................................................................. 27
4.5 Data and variable description.............................................................................................. 27
  4.5.1 Unemployment ................................................................................................................ 27
  4.5.2 Total earnings .................................................................................................................. 28
  4.5.3 Earnings per worker ......................................................................................................... 28
  4.5.4 Average yearly earnings ................................................................................................ 29
  4.5.5 Income tax level .............................................................................................................. 29
  4.5.6 Foreign born .................................................................................................................... 29
  4.5.7 Equalization and government grants and property taxes ................................................ 30
  4.5.8 Inflation rate ................................................................................................................... 30
  4.5.9 Boom dummy .................................................................................................................. 30
4.6 Descriptive statistics.......................................................................................................... 31
  4.6.1 Descriptive statistics for each municipality ..................................................................... 31
CHAPTER 5 RESULTS .............................................................................................................. 33
  5.1 Regression results .............................................................................................................. 33
    5.1.1 Regression results – Mining municipalities ..................................................................... 33
    5.1.2 Regressions results – Non-mining municipalities ............................................................. 35
CHAPTER 6 DISCUSSION ........................................................................................................... 38
  6.1 Discussion .......................................................................................................................... 38
    6.1.1 Boom dummy ................................................................................................................. 38
    6.1.2 Unemployment ............................................................................................................... 39
    6.1.3 Tax rate ........................................................................................................................ 40
    6.1.4 Inflation rate .................................................................................................................. 41
    6.1.5 Share of foreign born in the workforce ......................................................................... 41
    6.1.6 Government grants and property taxes ......................................................................... 41
    6.1.7 Average yearly income ................................................................................................ 42
    6.1.8 Fixed effects .................................................................................................................. 42
  6.2 General thoughts ............................................................................................................... 43
    6.2.1 Derived effects of the results ......................................................................................... 43
CHAPTER 7 CONCLUSIONS AND FURTHER RESEARCH .................................................. 46
7.1 Conclusions ................................................................................................................. 46
7.2 Suggestions for further research ................................................................................. 47
LIST OF REFERENCES ........................................................................................................ 48
APPENDIX .............................................................................................................................. i
Description of Table variables ....................................................................................... i
Correlation matrices .......................................................................................................... i
Descriptive statistics ........................................................................................................... iii
CHAPTER 1
INTRODUCTION

1.1 Introduction
During the years of 2003 to 2013 the biggest boom in the iron market was recorded. The boom lasted for approximately 10 years and can also be identified as the start of a super cycle. Research has shown that booms in other commodity markets has affected local communities and their labor markets which brings interest to the mining booms effects on labor markets in Norrbotten County.

The mining sector is a large industry in Sweden as it contributes with approximately 10 000 direct and 35 000 indirect jobs (Swedish Environmental Protection Agency, 2017). With Luossavaara-Kiirunavaara AB located in Norrbotten County the price fluctuations in the iron ore market has raised interest in the effects on the local communities in the county, especially since Luossavaara-Kiirunavaara AB is the second largest employer in the municipals of both Kiruna and Gällivare (Statistics Sweden, 2018a).

The effects of commodity booms and busts on local labor markets has not gone unnoticed as several studies has been done on the subject in different industries. Marchand (2012) investigates the energy boom-bust-boom effects on the local labor markets in Western Canada. Marchand concludes that boom years resulted in significant positive changes in both total employment and earnings per worker during the booms. During busts the trend was negative for both earnings per worker and total earnings. Black, McKinnish and Sanders (2005) investigated the economic impact of the coal boom and bust in local labor markets. The results presented in the paper show that both employment and earnings grew slightly faster during the identified boom years.

The effects of mining booms have been a subject for earlier research as Moritz, Ejdemo, Söderholm and Wårell (2017) has investigated job multipliers in northern Sweden during the latest mining boom. Moritz et al. find results which indicates that 100 jobs in the mining sector would lead to roughly 100 jobs in other sectors in Norrbotten County. This research suggests that the effects of mining operations are large and that these effects should not be overlooked.
The recent bankruptcy of the Northland Resources mine in the municipality of Pajala (Kaiding, 2014) further strengthen the questions about mining operations effects on local communities and their labor markets. Ejdemo and Söderholm (2008) estimated that the Northland Resource mining operation would lead to 1 575 jobs outside of the mining operation resulting in a job multiplier of 2.47 from the Northland Resource mining operations. Partly due to falling iron ore prices the results did not meet the expectations as Northland Resources went into bankruptcy during 2014 which resulted in the loss of 270 direct jobs (Kaiding, 2014; SVT, 2015).

Characteristics of local labor markets and research on booms and busts effects on other labor markets suggests that the effects of the iron ore market might be significant in Norrbotten County where municipals identified as mining municipals are expected to be dependent on iron ore mines operated by Luossavaara-Kiirunavaara AB.

It is important for both the municipals but also for Luossavaara-Kiirunavaara AB to understand how booms and busts in the iron ore market may affect the local labor market. With an understanding of the effects it could be possible for Luossavaara-Kiirunavaara AB and the municipals to address future problems or strengthen positive effects. This could possibly be done by policies from the municipality or actions from Luossavaara-Kiirunavaara AB.

1.2 Purpose

The purpose of this thesis is to investigate the possible effects that the recent boom in the iron ore market might had on the local labor markets. The conclusions in this thesis could be of use for future decision making when proposing new local policies. It is therefore believed that this thesis will function as a basis for future research and a basis to understand how municipals can strengthen or dampen effects in their labor markets. Based on the purpose of the thesis the following questions will be addressed:

- Has the recent boom in the iron ore market affected the local communities labor markets?
- Is there a difference between the effects on municipalities with and without mines during the boom?
1.3 Method
The thesis uses a quasi-experimental methodology as it is set out to investigate the possible effects of the recent mining booms effects on local labor markets in two different municipality groups. A quasi-experimental method is used when the goal is to examine the casual impact of specific effects without random assignment. The goal is to identify econometric models that can be used to estimate the boom years effect on different variables. The effects are compared between two different groups of municipalities, non-mining municipalities and mining municipalities.

1.4 Delimitations
The thesis focuses on five municipals in Norrbotten County, Sweden. The municipals are chosen due to their development over time and their characteristics. Kiruna and Gällivare are mining municipals and are expected to be dependent on the iron ore mining industry. Arvidsjaur and Övertorneå are chosen due to their development of residents which had a negative trend, which is also observed in mining municipals. Luleå is the major municipal of Norrbotten county and is the location of Luossavaara-Kiirunavaara AB’s headquarters as well as one of their two ports which raises interest to include Luleå as one of the municipals. The rest of the municipals in Norrbotten is excluded due to the limited time and to keep the comparison groups to approximately the same size.

The time series chosen is the years 2000 to 2016 which according to Radetzki and Wårell (2017) includes the third and latest commodity boom. The last boom and bust have been identified as the start of a super cycle due to their prolonged period of time where the last boom lasted approximately 10 years (Erten and Ocampo, 2012).

1.5 Disposition
The thesis starts with the first chapter which is an introduction to the subject and what the problem is and how it is studied with support of earlier research and economic theory. The second chapter describes the background to the problem. The third chapter explains the economic theory behind labor markets and explain the demand and supply shocks effects on labor markets. The theory chapter also explains the general behavior of booms and busts. In the fourth chapter explain the method and the econometric models is built up with the help of economic theory. In the fifth chapter the results are accounted for. In
the sixth chapter the results from the regressions are presented and discussed. In chapter seven the conclusions from the thesis is presented together with suggestions for further research.
CHAPTER 2  
BACKGROUND

2.1 The municipalities

Sweden has 290 municipals and 20 counties. These municipals and counties varies in size and characteristics. Both municipals and counties are managed by politicians and contribute with community services such as pre-school, school, public healthcare, social services and elderly care (SKL, 2018). With the expectations that labor demand varies between regions and municipalities it is of great importance to understand the local labor market characteristics when working with this thesis. Therefore, the labor market variables are presented in figures and analyzed. Descriptions of the labor industry categories are found in the appendix.
Figure 1. Unemployment rates, 2000-2016.

Figure 2. Total earnings in million Swedish crowns, 2000-2016.
Figure 3. Amount of people in the workforce, 2000-2016.

2.1.1 The municipality of Kiruna

Figure 4 presents the labor market in the municipality of Kiruna. The Figure shows that the manufacturing and extraction industry (B) is the largest employer in the municipal. The second biggest employer is the health and social care industry (Q) with about half the number of employees as the manufacturing and extraction industry. This combined with data on the largest employers in the municipal suggests that Luossavaara-Kiirunavaara AB is of great importance for the municipality (Statistics Sweden, 2018a).
Figure 4. Employees by industry, Kiruna municipality 2016.


Figure 1 illustrates that Kiruna had a declining unemployment rate during the years before the financial crisis in 2008 where the unemployment rate increased until it started to decline during 2010. This indicates that the financial crisis had an impact on the unemployment rate in the municipality of Kiruna.

Figure 2 illustrates that Kiruna had a positive trend in total earnings during the whole data set with an exception for year 2009 where they had a small decrease in total earnings.

Except for the mining industry being a big part of the labor market in Kiruna there is an interesting development in the number of individuals in the workforce. During the time period between 2000 and 2016 it is possible to see a decline in the number of individuals in the workforce, this is illustrated in Figure 3. This seems to be a trend for the small municipalities in the data set. The data also illustrates that the unemployment rate have a downward sloping trend.

2.1.2 The municipality of Gällivare

Figure 5 demonstrates the labor market in the municipality of Gällivare. The Figure has the same characteristics as the Table for the municipality of Kiruna and the manufacturing and extraction industry (B) is the most dominant employer in the labor market. The second biggest employer is the health and social care industry (Q) which also is the same as in Kiruna. This combined with data on the biggest employers in the municipality strengthen the expectations that Luossavaara-Kiirunavaara AB is an important employer in the Gällivare and Kiruna municipalities.
Figure 5. Employees by industry, Gällivare municipality 2016.


Figure 1 illustrates that the unemployment rate in the municipality of Gällivare is declining during the years of 2000-2007 except for year 2005. During the year of 2008 the financial crisis resulted in increasing unemployment rates until year 2010 where it declined again. This shows the same pattern for both Kiruna and Gällivare with an increasing unemployment rate during the financial crisis.

Figure 2 illustrates the same trend for Gällivare as it did for the municipality of Kiruna since the total earnings in Gällivare municipality have been increasing in the whole data set except for year 2009.

What is concluded from Figure 3 is that there is a decline in the number of people aged 16 to 64 during the last 17 years included in this data set. In addition to their downward sloping trend on the number of people in the identified workforce the data shows that the unemployment rate in the municipality is decreasing and that the labor market is getting more efficient as less individuals are unemployed which also can be seen in the municipality of Kiruna.

2.1.3 The municipality of Luleå

Figure 6 illustrates the labor market in the municipal of Luleå. The Table shows that the labor market in Luleå is the most diversified labor market of all five municipalities in the data set. Luleå also has the largest labor market in total number of employees. The industry with the most employees are the health and social care industry (Q).
Figure 1 illustrates that Luleå had a plateau in their unemployment rate during the years 2000-2005. During 2006-2007 the unemployment rate decreased before the financial crisis in 2008 and the unemployment rate increased during the crisis until it reached its peak during the year of 2009. As the municipalities for Kiruna and Gällivare, Luleå municipality had an increasing unemployment rate during 2007-2009. However, the increase in the unemployment rate is bigger in Luleå during 2007-2009 than in the mining municipalities.

Figure 2 illustrates that total earnings in Luleå increased during all years of the data set without any exceptions. The financial crisis does not seem to impact the total earnings in the municipality.

The number of people in the workforce in Luleå had a better trend than the municipalities Kiruna and Gällivare since the development in Luleå had been positive until 2009 but their development has slowed down and is now increasing after a decrease during the time period of 2010-2011 which is illustrated in Figure 3.

2.1.4 The municipality of Övertorneå

Figure 7 illustrates the labor market in the Övertorneå municipal. The number of employees is low precisely as in Arvidsjaur and the labor market are dominated by two industries where the largest is health and social care industry (Q). However, the labor market in the municipality of Övertorneå is more diversified than both Kiruna and Gällivare.
Figure 7. Employees by industry, Övertorneå municipality 2016.


Figure 1 illustrates the same trend as earlier municipalities as the unemployment rate increased during the years 2007-2009. The effect here is stronger than in the municipalities of Kiruna, Gällivare and Luleå.

Figure 2 illustrates an overall positive trend in the data set with one exceptions where total earnings in the municipality of Övertorneå has not increased. The year where total earnings decrease in Övertorneå is 2013.

Figure 3 illustrates a downward sloping trend as the number of individuals in the workforce in Övertorneå has been shrinking during the 17 years in the data set.

2.1.5 The municipality of Arvidsjaur

Figure 8 illustrates the labor market in the municipal of Arvidsjaur. In Arvidsjaur there is a more diversified labor market than in the mining municipalities. Although the two largest industries are health and social care industry (Q) and the public administration and defense (O). This suggests that the labor market in Arvidsjaur is not as dependent on one or two sectors as Kiruna and Gällivare, but it is significantly smaller in total number of employees.
Figure 8. Employees by industry, Arvidsjaur municipality 2016.

Figure 1 illustrates the same movement for Arvidsjaur during the years 2007-2009 as for other municipalities as the unemployment rate increases during these years. In the rest of the data set Arvidsjaur had a decreasing trend.

Figure 2 illustrates a continuously increasing trend for Arvidsjaur where total earnings never decreased during the time period.

Figure 3 illustrates that Arvidsjaur is not unlike any of the other small municipalities in Norrbotten as all municipalities except Luleå has a downward sloping trend which combined with data on unemployment rates suggests that some municipalities are growing yet becoming more efficient on the labor market.

2.2 The Swedish mining industry
The Swedish mining industry is a diversified industry with mines that produce iron ore, copper, zinc, lead and gold. Sweden is a large exporting country in the European Union where Sweden contributes to 91% of the iron ore, 39% of the lead, 37% of the zinc and 24% of the gold production in the European Union. The mining industry combined with the steel production industry contributes with about 10% of the Swedish gross exports (SweMin, 2018).

2.2.1 Luossavaara-Kiirunavaara Aktiebolag
The history of Luossavaara-Kiirunavaara AB (LKAB) goes far back through history and the development of the company has been far from straight forward. The following part will conclude the history of Luossavaara-Kiirunavaara AB. It is important to understand
the mines role in the small municipalities of Gällivare and Kiruna in order for their importance to be noticed.

The upbringing of the mine in Malmberget in the municipal of Gällivare started year 1888 and the same year the railway that had been built between Malmberget and Luleå was used to transport one thousand tons of iron ore. Luossavaara-Kiirunavaara Aktiebolag was founded 1890 with three million Swedish crowns in capital. During the year of 1891 Aktiebolaget Gellivare Malmfält (AGM) was founded and acquired the mining operations in Malmberget after a legal twist with the English owners. 1893 AGM acquires a majority of the shares in LKAB, AGM was however, later acquired by Trafikaktiebolaget Grängesberg-Oxelösund (TGO) and therefore TGO also took control of LKAB. During year 1907 the Swedish Government becomes a minority owner in LKAB, this later lead to the Swedish government taking over 97% of the mining firm. Almost 70 years later year 1974 the mine has a record-breaking year where the amount of produced Iron Ore reached 30 million tons. The company keeps growing throughout the years and during 2010 LKAB opened the opencast mine in Svappavaara, Kiruna. The history of LKAB and the size of the company has made an impact on the local communities and still has an impact with the current relocations of both the city in Kiruna and Malmberget (LKAB, 2018). In 2016 LKAB employed 4 224 people, this made the company the second biggest employer in the municipalities of Kiruna and Gällivare where they employ 2 175 people or 17% of the total workforce in Kiruna and 1 175 people or 13% of the total workforce in Gällivare (Statistics Sweden, 2018a). Apart from an important role in the local communities the company has an important role in the European Union as LKAB stands for 90% of the total production of iron ore in the European Union (LKAB, 2018).

2.3 Swedish trade unions

Sweden is one of the countries that have the highest level of memberships in trade unions in the world even if the level of memberships has gone down since 1980. Today the level is at 70% which shows that the Swedish trade unions have significant power in the negotiation of wages in several industries. Statistics shows that 90% of all employed
people between the ages of 16 to 64 have a collective bargaining agreement made by the trade unions (Kjellberg, 2016).

2.3.1 IF Metall
IF Metall is a large union that operates within a lot of metal industries in Sweden. The union has approximately 313 000 members, are divided into 36 different divisions and has 40 different collective agreements (IF Metall, 2018a). One of the divisions are IF Metall, “Mamfällen”. The division covers the area of the northern parts of Norrbotten County where they have 7 250 members at 236 different workplaces (IF Metall, 2018b). IF Metall has a collective agreement with the mining employers covering mining, mineral and metal production operations (IF Metall, 2018c).

2.4 Previous research
The boom and bust cycles effects on labor markets has been brought up in several studies. Marchand (2012) investigates the differential growth in earnings and employment during the time of the boom-bust-boom in the energy industry in Western Canada. Marchand presents evidence of positive impacts on employment and total earnings during boom periods and negative impacts during bust periods. The results also show that there is an indirect impact on sectors outside of the energy sector and that booms had a positive impact on total earnings and employment and busts had a negative impact on earnings per worker. However, the non-energy sectors show growth in some variables even during bust periods in the energy industry.

Basso (2016) investigates the effects on the economics of different regions during price swings in the oil industry. By using historical data on oil price throughout the years of 1970s-1980s Basso provides proof that price shocks have both short and long run effects on local labor markets. Basso also suggests that booms and busts in the oil industry can impact the local labor market up to twenty years after the occurrence of either a boom or a bust. Basso also believes that governments spend too much money through investments in the oil industry during booms which can lead to negative impacts on local communities.

Moritz et al. (2017) investigates the local employment impact of mining in Norrbotten County and Västerbotten County during the boom in the iron ore market that occurred between 2003 and 2013. Moritz et al. conclude that the job multiplier in mining
municipalities is higher than in all municipalities in both counties overall, indicating that one job in the mining sector result in more jobs in the mining municipalities than in the municipalities overall. Moritz et al. also concludes that the mining industry in Norrbotten County have a larger impact on the numbers as the mining industry in Norrbotten accounted for 82% of all the employments in the mining industry sector in the counties of Norrbotten and Västerbotten. The results suggest that the mining industry in Norrbotten County is more important for the county than mining industries in other counties are for their respective county.

Ejdemo and Söderholm (2008) investigates the impacts of two new iron ore mines in the municipality of Pajala. Ejdemo and Söderholm concludes that direct employment in the mining operations might reach 326 and that indirect employments generated might be 331. The job multiplier calculated by Ejdemo and Söderholm is 2.47 which would lead to an average of 1,575 jobs in the municipality of Pajala during full production in the mining operations. Ejdemo and Söderholm also conclude that the municipal income would increase with mining operations. This indicates that the mining operations would have several positive effects for the municipality of Pajala.
3.1 Nature of boom and bust cycles

The economy tends to experience a circular flow over time where the economy is either good or bad, these periods in time are called booms and recessions. A boom is a point in time where economy is greater than its normal capacity and creating extra income. The point where the boom reaches its highest level is called a peak. A recession is a point where potential income is higher than the actual income meaning that the actual income is declining. The bottom level of the recession is called a trough (Gärtner, 2016).

Boom and bust cycles in commodity and product markets are identified as strong fluctuations in the price for the commodity or the product. Booms are upwards trends and busts are downward trends in the market. Boom and busts in the commodity market is mostly a result of macroeconomic demand shocks where the last boom in the iron ore market was identified to be the cause of an iron ore demand shock originating from Chinas developing industries. Demand in China increased on iron ore-based commodities which led to an increasing price on iron ore (Radetzki and Wårell, 2017).

Booms in the iron ore market creates incentives for firms to expand and extract more iron ore due to increased profitability. For a profit maximizing firm to increase the output the production factors must increase as the production function is dependent on labor, capital and material (Lundmark, 2014).

A boom in the iron ore market would increase the demand for labor. This is illustrated in Figure 9. The Figure describes the isoquant of capital and labor which displays how firms exchange the two input variables to reach a certain type of production level. A shift to the right in the isoquant displays an increase in the production which explain the reasoning that an increase in production lead to an increase in labor demand. (Lundmark, 2014)
3.2 Mineral markets

To understand the mineral markets the supply both in the short run and long run but also the mineral demand will be described based on economic theory to give a better understanding of the circumstances in the market.

3.2.1 Mineral supply in the long and short run

The mining industry is a capital-intensive industry. The mines are very large operations that needs a lot of machinery to obtain minerals from their extraction sites. Therefore, a big operation like a mining firm needs a lot of time to be able to change and adapt to short run changes (Tilton, 1992). This implies that it is complicated for mining firms to change their output in the short run and that the price elasticity of the supply normally is insensitive (Radetzki and Wårell, 2017). The mining supply of the individual commodities is dependent on input costs, such costs are for example inputs in the machinery which could be oil, diesel and gas prices also known as the cost of capital usage. Another input cost is the cost of labor which means that labor costs and social costs are input costs (Tilton, 1992).

A mine can change and adjust the production in the long run making it possible to follow price changes that are lasting for longer periods of time. This is mainly because they are not constrained by the capacity constraint in the long run. A vital aspect in the mining industry is that even if there are large deviations in the price and the price falls below average cost, mines will in most cases not shut down their operations. Mines will shut
down in the short run if the price is below average cost and the mine need investments to keep the operation running (Tilton, 1992).

There are different types of costs that must be taken into consideration for production decisions. Normally costs are separated into fixed and variable costs where fixed costs are types of costs that cannot be changed in the short run. Variable costs are costs that can change alongside with the production level. The problem that arises with variable costs is that the time lapse is what constitutes whether the costs is a variable or fixed cost. The problem that arise is whether labor should be a variable or fixed cost. Labor is mostly considered to be a variable cost at the annual budgeting (Runge, 2009). Lundmark (2014) do believe that there are some fixed costs connected to labor but that most of labor costs should be variable costs.

3.2.2 Mineral demand

During the last couple of years, the iron market has experienced some of the largest commodity booms since world war two (Radetzki and Wårell, 2016). There are many uses for different types of minerals and the basic use for a firm purchasing mineral from a mine is to refine the mineral and sell the refined product. Therefore, the mineral iron ore is considered an intermediate mineral (Martinovich, 2010). There are certain types of factors that affects the demand for iron ore which are income, own price, price of substitutes and complements, technological change, consumer preferences and government activities (Tilton, 1992). It is important to have knowledge about the mineral market and how it works to understand the possible effects of booms and busts on local labor markets in Norrbotten County.

3.3 Labor market

To characterize and understand the labor market it is important to understand the basic dynamics of a general labor market. This is done by describing the partial production function (PPF). The partial production function is a concept which relies on the assumption that there is a fixed stock of capital and a fixed technology level. (Gärtner, 2016). From the production function the firms labor demand can be derived as the function for firms contain the labor costs.
Figure 10 demonstrates how profits of a firm will change as the amount of labor change. Assuming that firms are profit maximizers, a firm will hire labor until it maximizes profits at the top of the profit line where the firm will stop hiring labor due to decreasing returns on labor (Gärtner, 2016).

![Partial production function](image)

**Figure 10. Partial production function.**
Source: Gärtner, 2016.

To understand labor supply in the model it is important to understand the basic reasoning that labor supply consist only of the population that is considered to have the possibility to work. Therefore, labor supply is often said to include individuals that are not pensioners or children (Gärtner, 2016). This is a simplified model with several assumptions. However, the model can be used to understand how a profit maximizing firm as Luossavaara-Kirunavaara AB will act and possibly affect local labor markets.

### 3.3.1 Unemployment

There are different types of unemployment which is included in the general term of unemployment. These types will be presented below to support readers in understanding what types of effects that result in changes in the aggregated unemployment rate.
3.3.2 Cyclical unemployment

Cyclical unemployment is created through recessions and upswings in the market. A recession tends to create a rise in the unemployment as labor demand and the number of vacancies decrease. With an upswing in the market labor demand and vacancies increase which tend to decrease the unemployment rate (Gärtner, 2016).

![Beveridge curve](image)

**Figure 11. Beveridge curve.**

Source: Gärtner (2016).

The Beveridge curve in Figure 11 displays the correlation between vacancies and unemployment rates. A conclusion from the Beveridge curve together with economic theory is that a situation with low unemployment and high amount of vacancies lead to higher wages as labor supply is low and labor demand is high (Gärtner, 2016). Low wages are a factor that will drive up the unemployment, this would result in a movement along the Beveridge curve and create a cyclical factor to changes in unemployment (Diamond, 2013).

3.3.3 Trade Unions

Trade unions are unions set out to protect and care for workers and their conditions on the labor market. Trade unions often negotiate with the employers in an industry to secure fair salaries and good conditions for the employees. The minimum wage that a trade union demand can be problematic as this can create a higher unemployment rate than without minimum wages set by trade unions. When trade unions set minimum wages, it results in a new curve named “trade union labor supply” which is shown in Figure 12. The Figure
also indicates that with strong trade unions there might be a higher unemployment rate as the individual labor supply would lead to lower real wages and higher amounts of labor (Gärtner, 2016).

![Diagram showing labor supply curves](image)

**Figure 12. Trade union labor supply curves.**
Source: Gärtner (2016).

Montgomery (1986) found that areas with strong trade unions tend to have higher wages and less people employed than areas with weaker trade unions. He also found that trade unions tend to prolong the average working hours per week for the workers that were still employed where trade unions were strong.

### 3.3.4 Free time

Most individuals have different preferences to the ratio between free time and work. The time that is available for an individual is the same as the number of hours a day. For an individual to reach a desired utility level there is a need for an income that can help the individual to reach the desired utility level (Lundmark, 2014). An individual is constrained by the number of hours available each day which results in that the model for an individual and the chosen number of work hours is a fixed hour constrained model. These models generally state that if the amount of labor hours is equal to the amount of labor hours demanded the individual will enter the workforce. If not, the individual will remain unemployed (Feather and Shaw, 2000).
Voluntary unemployment is related to free time as it is affected by an individual’s willingness to work. Because voluntary unemployment is affected by income levels it implies that voluntary unemployment will increase with lower wages (Gärtner, 2016) which is a result of individuals preferring free time over work hours. With higher wages the voluntary unemployment would decrease (Lundmark, 2014) which leads to the expectation that a boom period will lead to higher wages.

3.3.5 Tax wedge

Gärtner (2016) discusses a tax wedge possible effects on the unemployment rate. Gärtner concludes that a tax wedge creates a difference in the gross salaries and net salaries. The basis of the tax wedge theory is that an increased tax rate decreases willingness to work at the given wage rate. In the labor market model illustrated in Figure 13, the addition of a payroll tax results in a shift to the left in the labor supply which results in a higher real wage and lower amount of labor or a higher unemployment rate. Tax might also result in higher costs due to higher real wages because of a lower labor supply (Gärtner, 2016).

![Figure 13. Tax wedge illustration.](source)

Dolenc and Laporšek (2010) confirmed this theory within the European Union. Dolenc and Laporšek suggested that the countries within the European Union should continue to decrease the tax wedge and that it would increase the employment growth.
3.3.6 Labor demand shocks

Labor demand shocks is an effect that is a result of an increased or decreased commodity supply. As commodity prices increases the commodity supply will increase which results in higher labor demand amongst firms in the industry. Due to the mining industry being a slow-moving industry, a positive labor demand shock could lead to long lasting effects on local labor markets. This has previously been shown by Basso (2016).

Figure 14. Labor supply shocks.
Source: Gärtner, 2016.

In Figure 14 it is concluded that during a positive supply shock labor demand shifts to the right which leads to higher amounts of labor and higher wages. A negative supply shock has the opposite effect with lower amounts of labor used and lower wages. Both effects are expected to be seen in the local labor markets in the municipalities of Kiruna and Gällivare during both booms and busts in the iron ore market. There is also a reason to believe that these effects will be large due to the importance of the mining industry in the municipalities labor markets.
4.1 General method

The method in the thesis is a quasi-experimental method that uses quantitative data collected from different sources. The data is used together with computed econometric models. A quantitative method is chosen as previous research on booms in other commodity market used quantitative methods. Previous research is also hard to use in a qualitative study in this case as booms effects on local labor markets in other countries is not applicable on the Swedish as labor markets as labor markets differ across countries.

A quasi-experimental method is used to show the differences in effects between two different groups. In this thesis the method will show the differences between mining municipalities and non-mining municipalities.

4.1.1 Method criticism

The method in the thesis has both strengths and weaknesses. The strength is that it is possible to gather secondary data that can be used to build expected econometric models and reach conclusions that are specific for the chosen geographical area. However, this method does not get the same broad spectrum as a literature study. A literature study does however make it hard to show specific results. The quasi-experimental method is useful when conducting comparisons between groups with differences that is easily observed. The method has also been used in earlier research on similar subjects. However, the method might be somewhat dependent on the groups formed by the authors, if groups have large differences between the formed groups it might be difficult to demonstrate specific effects.

4.2 Econometrics issues

The models built with the variables listed below are used in a panel data regression. A panel data regression is used when the data set contains cross-sectional data that are spread over two or more periods, this will form a panel data set (Dougherty, 2016). With
the usage of panel data set a couple of benefits are gained compared to the usage of other models. Baltagi (2005) explains the benefits of using panel data. According to him some of the main benefits are that it is controlling for individual heterogeneity, which is not done for cross-section and time-series which could lead to biased results. A second benefit of panel data is that it according to Baltagi give a more reliable and informative data while having less collinearity, a higher degree of freedom and a higher grade of efficiency.

The data in this thesis have the same amount of observations over the municipalities which makes the data set balanced and the panel data is long due to the amount of time periods being bigger than the number of municipalities.

4.2.1 Least Squares Dummy Variable Fixed Effects Model

Least squares dummy variable fixed effects (LSDVFE) is a variant of the fixed effect model. In the LSDVFE model the effect that cannot be observed is lifted into the econometric model. This is made by setting a dummy variable for the variable that is of interest when investigating the unobserved effects. In the models for this thesis the boom dummy is included in the model and the unobserved effect are the coefficient of the time specific boom dummy variable. Since the purpose is to investigate whether the booms influence the different dependent variables there is no risk for a dummy variable trap as there is no need for more than one dummy variable in the model. In addition to the data a stratified sample is created through the mining municipalities dummy to divide the mining municipalities and non-mining municipalities into two different subgroups (Dougherty, 2016).

4.3 Econometrics specification

For this thesis three different regression models have been estimated. The first estimated regression model is set out to explain boom years effects on mining and non-mining municipalities unemployment rates. The dependent variable in the model is therefore the unemployment rate. The independent variables are average yearly earnings, income tax level, foreign born people in the workforce, different forms of government grants together with property taxes and the boom dummy variable.
Unemployment = \alpha_i + \beta_Boom + \beta_{AYI} + \beta_{Tax} + \beta_{Foreign\ Born} + \beta_{GDP} + \epsilon_{it} (1)

The second estimated regression model is set out to explain boom years effects on total earnings in both mining and non-mining municipalities. The dependent variable in this model is total earnings. The independent variables are unemployment rate, income tax level, inflation rate and the boom dummy variable.

Total earnings = \alpha_i + \beta_Boom + \beta_{Unemployment} + \beta_{Tax} + \beta_{Inflation} + \epsilon_{it} (2)

The third estimated regression model is set out to investigate boom years effects on earnings per worker in both mining and non-mining municipalities. The dependent variable is earnings per worker. The independent variables are unemployment rate, income tax level, inflation rate and the boom dummy variable.

Earnings per worker = \alpha_i + \beta_Boom + \beta_{Unemployment} + \beta_{Tax} + \beta_{Inflation} + \epsilon_{it} (3)

4.4 Data
With the choice of an econometric approach there is a need for time series data. Most of the statistical data is gathered from Statistics Sweden. However, some data is collected from other sources. Iron ore prices are gathered from the World Bank which in turn has collected data on iron ore prices from the Singapore commodity exchange. Data on the number of unemployed individuals is collected from the Swedish Public Employment Service.

4.4.1 Correlation matrices
To determine how variables correlate with each other several correlation matrices are computed, these can be found in the appendix. The correlation matrices did in some cases register high correlations between some variables. The variables with the highest correlations that could possibly show the same effects have therefore been omitted from the regression models. Some of the highly correlated variables had to be kept in the models due to their importance according to economic theory. Correlation matrices is
computed from the whole data set and presented low correlations. Correlation matrices for each municipality is created due to high $R$-square values in the regression results. These matrices present higher correlations which led to adjustments in the regression models.

When analyzing the correlation matrix for the whole data, total earnings have a high correlation with unemployment, this is not unexpected as economic theory suggest that lower unemployment lead to higher total earnings. However, these variables are not used together in any models.

4.4.2 Omitted variables

There are a couple of variables that have been omitted from the regression models due to different causes. The Gross Domestic Product (GDP) in current prices have been omitted from the regression models due to a high correlation between the GDP and several other variables in all the models. The variable for share of people with a three year or longer education past high school had a high correlation with all three dependent variables resulting in it being omitted. There are also variables such as the net replacement rate that could be a variable affecting total earnings and earnings per worker. Data on the net replacement rate is hard to find. Therefore, it is omitted due to the time constraint of the thesis.

4.5 Data and variable description

The following variables are chosen with support from theory and research. The variables are chosen to investigate the effects of these independent variables on the three dependent variables. In addition to the independent variables one dummy variable are created for the econometric model. The dummy is created for the identification of boom years. There is also a stratification variable that separates the municipalities to enable an estimation of fixed effects

4.5.1 Unemployment

Data for the unemployment rate is calculated with data on the amount of inscribed people at the Swedish Public Employment Service and data on the number of inhabitants in each
of the municipalities from Statistics Sweden. Data regarding inscribed people at the Swedish Public Employment Service includes the openly unemployed but also people that are part of any labor market political program which is set out to give support and temporary employments (Swedish Public Employment Service, 2018). Data for both inscribed people and the number of inhabitants is restricted to people with ages in the range of 16 to 64 due to the retirement age of 65 and the compulsory school attendance which restricts young people from leaving school at an early age. (Swedish Pension Agency, 2017; Swedish National Agency for Education, 2018).

The unemployment rate is calculated with the following model:

\[
\text{Unemployment rate} = \frac{\text{Inscribed people}}{\text{Amount of inhabitants aged 16 to 64}}
\]  

(4)

4.5.2 Total earnings

Data on total earnings is collected from Statistic Sweden. Total earnings are the collected income of employment for all inhabitants aged 16 to 64 in each of the municipalities and is presented in million Swedish crowns (Statistics Sweden, 2018b). Changes in the labor market are expected to affect the earnings in the market and therefore total earnings are of interest when investigating the effects of booms and busts in the iron ore market.

4.5.3 Earnings per worker

Earnings per worker is a calculated variable where total earnings have been divided by the amount of people that are identified as workers in each of the municipalities. Individuals identified as workers are those that are between 16 and 64 of age and are not inscribed at the Swedish Public Employment Service. This is done to account for the possibilities of both emigration and immigration in the municipalities. This is important given that some of the municipalities in the data set had a decreasing population while others have been growing. Earnings per worker should be affected in the same way as total earnings and is therefore also of interest for this thesis.
4.5.4 Average yearly earnings
Average yearly earnings are collected from Statistics Sweden. Average yearly earnings are the sum of the inhabitant’s income from employment and is given in thousand Swedish crowns (Statistics Sweden, 2018b). Higher average yearly earnings would suggest higher salaries which in economic theory would give individuals an incentive to spend their time at work instead of spending their time on hobbies or other things that is not work related. The theory builds on the idea of individuals preferences and the utility maximization of the individuals constraint which in this case is the 24 hours that is available each day (Nicholson and Snyder, 2012).

4.5.5 Income tax level
The income tax level is the level of tax an individual must pay from their earnings from employment to the state. According to Gärtner (2016) increasing taxation on earnings causes shifts in the labor supply and the amount of voluntary unemployment will grow. Hansson (2006) discusses the possible effects of different taxes on labor and how the economy has changed since the earlier research suggested that taxes did not have any effects on unemployment in the long run. The conclusions drawn by her is that taxes could influence the unemployment rate due to higher price sensitivity on both labor demand and labor supply in modern times.

4.5.6 Foreign born
The variable foreign born is explaining the share of foreign born in the labor market for each of the municipalities, this is restricted to ages 16 to 64. Stadin and Videnord (2017) concludes that foreign born individuals have a higher ratio of unemployment compared to individuals born in Sweden. Stadin and Videnord also concludes that this ratio is present between individuals with higher levels of education even if the differences between the two groups are slightly smaller than groups with only basic education. This suggests that municipalities with a higher ratio of foreign born individuals in the population might have a higher unemployment ratio.
4.5.7 Equalization and government grants and property taxes

Government grants from the equalization system have been a subject for discussion during several years. Papers by Ivarsson and Johansson (2003) and the Stockholm Chamber of Commerce (2009) suggests that the structural contributions from the equalization system might lead to lower incitements for the municipalities to lower the unemployment rate since the structural contributions are based on the rate of unemployment. Both Ivarsson and Johansson as well as Stockholm Chamber of Commerce believes that investments in growth for the municipalities might not be as interesting when the municipalities will lose grants from the equalization system. Ivarsson and Johansson also suggests that even if such investments would be successful it could lead to a lower income for the municipality due to lost grants. Included in the variable is the property taxes which also is a source of income for the municipalities. Income in all form of taxes and grants should be seen as money that could possibly be used to invest in the local markets.

4.5.8 Inflation rate

Data for the inflation rate is collected from Statistics Sweden and is data presented on a yearly basis. The inflation is according to economic theory and research affects the real wages, if inflation increases it leads to lower real wages until new wages are negotiated resulting in higher wages (Gärtner, 2016). Even if this is a variable that is not changing over municipalities it is used to account for inflation-based changes in total earnings and earnings per worker.

4.5.9 Boom dummy

This variable is created for the econometric models to test the specific effects of the identified boom years during the years of 2003 to 2013. The dummy is set up with the value one for each of the years during the given time period and for the rest of the years the value is zero. This made it possible to reach conclusions on whether the iron market boom has had any effects on the dependent variables in the regressions.
4.6 Descriptive statistics

Descriptive statistics shows all the relevant information about the variables in their original form and are therefore not presented in logarithmic form. The information presented in the descriptive statistics Table are the mean value and the standard error for all the observations of each variable. The descriptive statistics is presented in the appendix.

The information in the Table leads to a couple of conclusions. The maximum and minimum for some of the variables are large. Through an assessment of the unemployment rate it is possible to see that the maximum and minimum values are far apart, this is a result of high unemployment during a short period in the municipality of Övertorneå. Övertorneå is also the municipality that has the highest rate of foreign born people in the workforce.

4.6.1 Descriptive statistics for each municipality

The descriptive statistics for each municipal presents the relevant information about both independent and dependent variables. What can be concluded from the information from total earnings across the municipalities is that the standard deviation is almost the same for each of the municipalities except for Luleå which has a higher standard deviation of 1 737 compared to Övertorneå which has a standard deviation of 41. It can also be concluded that the standard deviation is significantly bigger in earnings per worker in Gällivare and Kiruna where Gällivare has a standard deviation of 49 956 and Kiruna a standard deviation of 44 066 compared to 24 372 in Övertorneå. The contribution variable is notably larger in Övertorneå with a mean of 24 562 compared to the mean in Luleå which is 5 687.

By analyzing the correlation matrices in the appendix, it is found that there is no significant correlation problem when assessing the unemployment and the independent variables for the regression model, some values is quite high but nothing that is suspected to interfere with the models. Regarding the regression on total earnings there are two variables that tend to have a somewhat high correlation with the dependent variable, these two variables are the unemployment rate and tax rate. These variables do however vary across the different municipals and are major variables in the model for total earnings which resulted in them being kept in the model. The same variables that seemed to have
a higher correlation in total earnings did also have high correlation in the model for earnings per worker. This might be a result of the earnings per worker variable being calculated with the use of total earnings.
CHAPTER 5
RESULTS

5.1 Regression results
Both the non-mining municipalities group and the mining municipalities group were run in two different regressions and therefore the results from the two different runs will be presented separately.

5.1.1 Regression results – Mining municipalities
Table 1 presents the regression results with the natural logarithmic value of the unemployment rate as the dependent variable. The significance for the independent variable indicates that three of the independent variables are significant at the 1% level, these are the boom dummy variable, average yearly income and share of foreign born in the workforce. The variable tax rate is significant at the 10% level and the government contributions and property taxes is significant at the 5% level. This suggests that the independent variables are better estimates than randomness at their respective significance level.

The coefficients for each of the independent variables indicates that the unemployment should raise at a 0.21% faster rate during the boom years, ceteris paribus. For the average yearly income, the coefficient suggests that a 1% increase in average yearly income leads to a 3.42% decrease in the unemployment rate, ceteris paribus. The coefficients suggest that a 1% increase in the tax rate leads to a 4.37% increase in the unemployment rate, ceteris paribus. A 1% increase in the share of foreign born in the workforce would according to the coefficient lead to a 1.15% increase in the unemployment rate, ceteris paribus. The independent variable government contributions and property taxes has a coefficient that suggest that a 1% increase in the government contributions and property taxes results in a 0.37% decrease in the unemployment rate, ceteris paribus.
Table 1. Regression results of Natural logarithmic of unemployment.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Standard error</th>
<th>T-value</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom dummy</td>
<td>0.21</td>
<td>0.08</td>
<td>2.82</td>
<td>1%</td>
</tr>
<tr>
<td>LN Average income</td>
<td>-3.42</td>
<td>0.38</td>
<td>0.38</td>
<td>1%</td>
</tr>
<tr>
<td>LN Tax rate</td>
<td>4.37</td>
<td>2.31</td>
<td>2.31</td>
<td>10%</td>
</tr>
<tr>
<td>% Foreign born</td>
<td>1.15</td>
<td>0.28</td>
<td>0.28</td>
<td>1%</td>
</tr>
<tr>
<td>LN GG &amp; PT</td>
<td>-0.37</td>
<td>0.18</td>
<td>0.18</td>
<td>5%</td>
</tr>
<tr>
<td>Kiruna FE</td>
<td>5.89</td>
<td>7.21</td>
<td>0.82</td>
<td>Not significant</td>
</tr>
<tr>
<td>Gällivare FE</td>
<td>6.48</td>
<td>7.20</td>
<td>0.9</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

Table 2 presents the regression result from the model with the natural logarithmic value of total earnings as the dependent variable. Two of the independent variables are significant at the 1% level, these two are the unemployment rate and the tax rate. The inflation rate is significant at the 10% level while the boom dummy is not significant at all. This suggests that the independent variables are better estimates than randomness at their respective significance level.

The possible interpretations from the coefficients in the regression results is that a 1% increase in the unemployment rate leads to a 0.29% decrease in total earnings, ceteris paribus. A 1% increase in the tax rate variable leads to a 3.45% increase in total earnings. The last variable that is significant is the inflation rate variable which has a coefficient that suggests that a 1% increase in the inflation rate lead to a 0.03% decrease in total earnings, ceteris paribus.

Table 2. Regression results of Natural logarithmic total earnings.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Standard error</th>
<th>T-value</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom dummy</td>
<td>0.01</td>
<td>0.02</td>
<td>0.53</td>
<td>Not significant</td>
</tr>
<tr>
<td>LN Unemployment</td>
<td>-0.29</td>
<td>0.04</td>
<td>-7.24</td>
<td>1%</td>
</tr>
<tr>
<td>LN Tax rate</td>
<td>3.45</td>
<td>0.72</td>
<td>4.77</td>
<td>1%</td>
</tr>
<tr>
<td>LN Inflation</td>
<td>-0.03</td>
<td>0.02</td>
<td>-1.72</td>
<td>10%</td>
</tr>
<tr>
<td>Kiruna FE</td>
<td>-3.28</td>
<td>2.58</td>
<td>-1.27</td>
<td>Not significant</td>
</tr>
<tr>
<td>Gällivare FE</td>
<td>-3.43</td>
<td>2.57</td>
<td>-1.33</td>
<td>Not significant</td>
</tr>
</tbody>
</table>

Table 3 presents the regressions results with the natural logarithmic value of earnings per worker as the dependent variable. The results suggest that two of the independent variables are significant. Both the unemployment rate and the tax rate are significant at
the 1% level while both the boom dummy and the inflation rate lack significance. This suggests that the independent variables are better estimates than randomness at their respective significance level.

The coefficients in the regression results suggest that a 1% increase in the unemployment rate results in a 0.23% decrease in earnings per worker ceteris paribus while a 1% increase in the tax rate leads to a 4.52% increase in earnings per worker, ceteris paribus.

Table 3. Regression results of Natural logarithmic earnings per worker.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Standard error</th>
<th>T-value</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom dummy</td>
<td>0.02</td>
<td>0.02</td>
<td>0.62</td>
<td>Not significant</td>
</tr>
<tr>
<td>LN Unemployment</td>
<td>-0.23</td>
<td>0.05</td>
<td>-4.77</td>
<td>1%</td>
</tr>
<tr>
<td>LN Tax rate</td>
<td>4.52</td>
<td>0.88</td>
<td>5.14</td>
<td>Not significant</td>
</tr>
<tr>
<td>LN Inflation</td>
<td>-0.04</td>
<td>0.02</td>
<td>-1.61</td>
<td>1%</td>
</tr>
<tr>
<td>Kiruna FE</td>
<td>-2.81</td>
<td>3.13</td>
<td>-2.81</td>
<td>1%</td>
</tr>
<tr>
<td>Gällivare FE</td>
<td>-2.71</td>
<td>3.12</td>
<td>-2.71</td>
<td>5%</td>
</tr>
</tbody>
</table>

5.1.2 Regressions results – Non-mining municipalities

Table 4 presents the regressions results with the natural logarithmic value of the unemployment rate as the dependent variable. The regression shows that two of the independent variables are significant, these are the average yearly income and the tax rate. Both average yearly income and the tax rate are significant at the 1% level. This suggests that the independent variables are better estimates than randomness at their respective significance level. Three of the independent variables are however insignificant, these are the boom dummy, the share of foreign born in the workforce and government grants and property taxes.

The coefficients in the first Table suggests that a 1% increase in the average yearly income leads to a 2.38% decrease in the unemployment rate, ceteris paribus. For the tax rate the regression result coefficients suggest that a 1% increase in the variable leads to a 7.89% increase in the unemployment rate, ceteris paribus.
Table 4. Regression results of Natural logarithmic of unemployment.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Standard error</th>
<th>T-value</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom dummy</td>
<td>0.08</td>
<td>0.05</td>
<td>1.48</td>
<td>Not significant</td>
</tr>
<tr>
<td>LN Average income</td>
<td>-2.38</td>
<td>0.37</td>
<td>-6.44</td>
<td>1%</td>
</tr>
<tr>
<td>LN Tax rate</td>
<td>7.89</td>
<td>2.05</td>
<td>3.85</td>
<td>1%</td>
</tr>
<tr>
<td>% Foreign born</td>
<td>0.02</td>
<td>0.12</td>
<td>0.16</td>
<td>Not significant</td>
</tr>
<tr>
<td>LN GG &amp; PT</td>
<td>0.16</td>
<td>0.23</td>
<td>0.72</td>
<td>Not significant</td>
</tr>
<tr>
<td>Luleå FE</td>
<td>-14.01</td>
<td>5.75</td>
<td>-2.44</td>
<td>5%</td>
</tr>
<tr>
<td>Övertorneå FE</td>
<td>-14.04</td>
<td>5.68</td>
<td>-2.47</td>
<td>5%</td>
</tr>
<tr>
<td>Arvidsjaur FE</td>
<td>-14.30</td>
<td>5.82</td>
<td>-2.46</td>
<td>5%</td>
</tr>
</tbody>
</table>

Table 5 presents the results from the regression with the natural logarithmic value of total earnings as the dependent variable. The regression results indicate that both the unemployment rate and the tax rate are significant at the 1% level, this also implies that these independent variables are better estimates than randomness at the 1% level. The inflation rate lacks significance in this model according to the regression results.

The coefficients from the regression results indicates that a 1% increase in unemployment rate would result in a 0.16% decrease in total earnings, ceteris paribus. A 1% increase in the tax rate lead to a 3.21% increase in total earnings, ceteris paribus. The coefficient for the boom dummy however, suggests that total earnings are growing at a 0.04% faster rate during the boom years than during the comparison years, ceteris paribus.

Table 5. Regression results of Natural logarithmic of total earnings.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Standard error</th>
<th>T-value</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom dummy</td>
<td>0.04</td>
<td>0.02</td>
<td>2.35</td>
<td>5%</td>
</tr>
<tr>
<td>LN Unemployment</td>
<td>-0.16</td>
<td>0.04</td>
<td>-4.49</td>
<td>1%</td>
</tr>
<tr>
<td>LN Tax rate</td>
<td>3.21</td>
<td>0.36</td>
<td>8.83</td>
<td>1%</td>
</tr>
<tr>
<td>LN Inflation</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.91</td>
<td>Not significant</td>
</tr>
<tr>
<td>Luleå FE</td>
<td>-1.50</td>
<td>1.30</td>
<td>-1.16</td>
<td>Not significant</td>
</tr>
<tr>
<td>Övertorneå FE</td>
<td>-4.34</td>
<td>1.30</td>
<td>-3.34</td>
<td>1%</td>
</tr>
<tr>
<td>Arvidsjaur FE</td>
<td>-4.06</td>
<td>1.31</td>
<td>-3.11</td>
<td>1%</td>
</tr>
</tbody>
</table>

Table 6 presents the regression results with the natural logarithmic value of earnings per worker as the dependent variable. Three out of four independent variables are significant according to the results. Both the unemployment rate and the tax rate are significant at
the 1% level while the boom dummy variable is significant at the 5% level. The inflation rate is however insignificant. The significance levels suggest that the independent variables that are significant are better estimates than randomness at their specific significance level.

The coefficients in the regression results indicates that a 1% increase in the unemployment rate leads to a 0.12% decrease in earnings per worker while a 1% increase in the tax rate leads to a 4.07% increase in earnings per worker, ceteris paribus. The boom dummy coefficient suggests that earnings per worker are growing at a 0.03% faster rate during the boom years than during the comparison years, ceteris paribus.

Table 6. Regression results of Natural logarithmic of earnings per worker.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>Standard error</th>
<th>T-value</th>
<th>Significance level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom dummy</td>
<td>0.03</td>
<td>0.01</td>
<td>2.34</td>
<td>5%</td>
</tr>
<tr>
<td>LN Unemployment</td>
<td>-0.12</td>
<td>0.03</td>
<td>-3.48</td>
<td>1%</td>
</tr>
<tr>
<td>LN Tax rate</td>
<td>4.07</td>
<td>0.34</td>
<td>12.1</td>
<td>1%</td>
</tr>
<tr>
<td>LN Inflation</td>
<td>-0.02</td>
<td>0.01</td>
<td>-1.3</td>
<td>Not significant</td>
</tr>
<tr>
<td>Luleå FE</td>
<td>-1.48</td>
<td>1.20</td>
<td>-1.23</td>
<td>Not significant</td>
</tr>
<tr>
<td>Övertorneå FE</td>
<td>-1.43</td>
<td>1.20</td>
<td>-1.19</td>
<td>Not significant</td>
</tr>
<tr>
<td>Arvidsjaur FE</td>
<td>-1.52</td>
<td>1.21</td>
<td>-1.26</td>
<td>Not significant</td>
</tr>
</tbody>
</table>
6.1 Discussion

In this chapter the regression results will be analyzed and discussed in a wider perspective and connected to economic theory.

6.1.1 Boom dummy

The results in Tables 1 and 4 demonstrate a positive correlation between the boom dummy and the unemployment rate in mining municipalities. For the unemployment rate in non-mining municipalities the boom dummy lacked significance. The positive correlation between the boom dummy and the unemployment rate in mining municipalities is surprising as it contradicts earlier research on the effects of booms on local labor markets. Several papers on the subject of booms in different industries concluded that boom years should result in lower unemployment in the local areas that are somewhat dependent on the industry, this has been shown by Moritz et al. (2017), Marchand (2012) and Black et al. (2005). The lack of significance for the boom dummy is interesting as it does not generate any significance. Due to it being non-significant it is not possible to say that it is a variable that possibly could affect the unemployment rates in non-mining municipalities. This also suggest that spill-over effects from the mining industry is not large enough to affect unemployment rates in the other municipalities in the data set.

Tables 2, 3, 5 and 6 presents a positive correlation between both the boom dummy variable and total earnings but also between the boom dummy and earnings per worker for non-mining municipalities. For the mining-municipalities however the boom dummy variable is insignificant in both total earnings and earnings per worker. These results are a bit unexpected since earlier theory and research suggests that total earnings and earnings per worker should be affected during boom years in mining municipalities which is not the case in this study (Marchand, 2012). The interesting aspect of the results presented in the Tables is that the boom dummy variable is significant at the 5% level in non-mining municipalities but not at all for mining municipalities. The positive correlation is however
expected of the boom dummy as a booming iron ore market could lead to spillover effects, this was shown by Moritz et al. (2017) in their study on job multipliers.

The lack of significance for the boom dummy in mining municipalities could be explained by several other factors, for example the financial crisis in the boom period could have a large impact on a couple of years in the data set. If the data set would have been bigger in both amount of years but also number of municipalities it would have been possible to test for time-specific effects by separating the boom-years data into two different time series or test two different boom cycles against each other, which was done by Moritz et al. (2017). Unfortunately, the data set is not big enough to implement these types of tests which led to the results given in the tables.

Another possible reason for the non-significance in the boom dummies effect on total earnings and earnings per worker are that the labor has not yet fully changed and adjusted to the amount of labor that Luossavaara-Kirunavaara AB demanded since trade unions might be protecting the employees that are members of the union IF Metal. This union has a special deal to protect the employees from being replaced by cheaper workforce from staffing agencies and entrepreneurs as special rules applies for firing and rehiring employees (IF Metall, 2016). During positive labor demand shocks trade unions will negotiate higher wages for their employees to maximize their members utility (Gärtner, 2016). This combined with the financial crisis might be a reason to why the unemployment rates have not experienced a decline during the boom years.

6.1.2 Unemployment

According to Tables 2 and 3 there is a negative correlation between unemployment and total earnings but also between unemployment and earnings per worker in mining municipalities. The same correlation is seen in Tables 5 and 6 for non-mining municipalities. The effect is estimated to be larger in mining municipalities than in non-mining municipals. Due to the behavior of the wage and labor market the effect of unemployment could have two different effects depending on the type of unemployment. If the unemployment would be voluntary unemployment it would suggest that tax rates might be too high resulting in people leaving their jobs which lead to higher wages. However, if the unemployment would be involuntary unemployment caused by a lower demand for labor, the effect could be the opposite as in this case where increasing
unemployment seem to result in lower wages in both mining and non-mining municipalities (Gärtner, 2016).

Many of the municipalities in Norrbotten have a declining number of inhabitants (Statistics Sweden, 2018b) which could be a factor that is affecting the correlation seen between unemployment, total earnings and earnings per worker in each of the municipalities except Luleå. A declining trend in inhabitants could suggest that the low unemployment rate in the municipalities is a result of unemployed individuals leaving the municipality for work in other locations. If the unemployment however would raise it could be a result of people moving to the municipality leading to excess labor supply which would drive wages down (Gärtner, 2016). Thus, the reason for a larger effect in the mining municipals could be due to people moving to other areas for work.

6.1.3 Tax rate
In Tables 1, 2, 3, 4, 5 and 6 a positive correlation between the tax rate, total earnings, earnings per worker and the unemployment rate is demonstrated. The positive correlation with total earnings and earnings per worker are surprising as theory suggests that higher tax rates would decrease the incentive to work resulting in higher unemployment which also should lead to lower wages and therefore lower earnings (Gärtner, 2016). The positive coefficient between tax rate and total earnings could be a result of the unemployment falling due to external factors such as a general positive trend in the economy. The positive coefficient between the tax rate and earnings per worker could be a result of the same factors as the total earnings as earning per worker are calculated from total earnings. The positive correlation could also be explained by investments from the municipal in the public sector that could lead to higher wages.

There are no major differences between the regression results when analyzing the results from the mining municipalities and non-mining municipalities except for a lower significance on the unemployment rate in mining municipalities. A second difference is the quite high coefficient value of 7.89 on the unemployment rate in non-mining municipalities, a value which is significantly higher than the value for mining municipalities. The high coefficient in non-mining municipalities are also significant at the 1% level.
6.1.4 Inflation rate

Tables 2, 3, 5 and 6 suggest a negative coefficient between the inflation rate, total earnings and earnings per worker. However, these coefficients are insignificant for all but one of the dependent variables making it hard to analyze their meaning or importance for each of the dependent variables. The only significant level that is computed is a significance level of 10% for the inflation rate on total earnings in mining municipalities. However, economic theory suggests that inflation should be affecting unemployment and wages as the real wage will decrease with higher inflation rates (Gärtner, 2016).

There are no major differences between the regression results as the inflation rate is almost insignificant in all regressions except one. This makes analyzes hard to perform which also lead to higher interest for the other variables.

6.1.5 Share of foreign born in the workforce

Tables 1 and 4 illustrates a positive correlation between the share of foreign born in the workforce and the unemployment rate. This was expected and is shown by Stadin and Videnord (2017) as they conclude that foreign born people have a higher ratio of unemployment compared to individuals born in Sweden.

The main difference between the results are that the share of foreign born in the workforce is significant in the regression on mining municipalities but not on non-mining municipalities. This could however be a result of the labor market characteristics in the municipalities where the mining municipalities have a less diversified labor market while Luleå has a more diversified one. A good system for the integration in the municipality could make this variable less significant.

6.1.6 Government grants and property taxes

In Tables 1 and 4 there is a positive correlation between government grants and property taxes and the unemployment rate. The variable is significant in mining municipalities and insignificant in non-mining municipalities. The correlation between government grants and property taxes and the unemployment rate is a bit unclear in theory as research suggests that the equalization system included in the variable could be destroying incitements for municipalities to decrease their unemployment rate since this would result
in lower grants. At the same time successful investments done with the government grants could lead to a lower unemployment rate but also possibly lower income for the municipality due to the tax income not being equal to the amount of grants lost (Ivarsson, S and J, Johansson, 2003).

6.1.7 Average yearly income

In Tables 1 and 4 the regression results demonstrate a negative coefficient between average yearly income and the unemployment rate. This is also supported in economic theory as the theory suggest that higher wages will result in a higher incentive for individuals to choose work over free time which lead to lower unemployment rates (Gärtner, 2016).

Comparing the results between non-mining and mining municipalities it is possible to conclude that the effect of a 1% raise in the average yearly income has a higher effect in mining municipalities as in non-mining municipalities. This could be a result of the higher mean in average yearly income in mining municipalities which would suggest that a 1% increase in the average yearly income would have a larger effect on the variable in the mining municipalities and therefore also a higher effect on the unemployment rate.

6.1.8 Fixed effects

The fixed effects coefficients in the model are hard to analyze since the numbers estimated do not provide any data for analyzation as they are to be seen as individual specific constants and are a separate constant term for each group (Greene, 2012). Therefore, it is not the same as if the model would just have one constant as the case in the ordinary least square models. What can be concluded with the fixed effects coefficients is that there are differences between the municipals as they do not have the exact same estimated fixed effects coefficients. Some of the fixed effects are significant and suggests that there are differences in the fixed effects between the municipals. The insignificant fixed effects suggest that there is no significant difference between the fixed effects for the municipalities.
6.2 General thoughts

The regression results from non-mining municipalities with total earnings as the dependent variable presented an unreasonably high $R$-square value as it is approximately 0.99. Such a high value suggests that there is an error in the regression. The correlation matrix does not show any correlations that could lead to such a high $R$-square value. However, this could be a result of data mining and chance correlation which is a reasonable thought. It could also be a result of the fact that the data is time series data which results in trends that easily results in high $R$-square values. The last possible reason for this might be that there are significant trends in the panel data that results in this unreasonably high $R$-squared value. This could possibly be tested by running the panel data in a time series analysis but due to the low number of observations for each municipality, this would not generate any useful results.

6.2.1 Derived effects of the results

There are different levels on society to which the results in this thesis could be applied. The results in non-mining municipalities shows that the boom dummy is significant at the 5% level. This suggests that a booming iron ore market lead to higher total earnings and earnings per worker in the municipalities without mines. This could be a result of external factors or spillover effects to the municipal of Luleå which is one of the biggest municipalities in the county and the municipal where Luossavaara-Kiirunavaara AB has their offices and one of their two ports. Another major firm located in Luleå is SSAB which is an iron beam producer that could possibly be benefiting from the potentially increased production from Luossavaara-Kiirunavaara AB during the boom years.

The knowledge that booms in the iron ore market could influence non-mining municipalities could be of interest for both the municipalities themselves but also for Norrbotten county. The knowledge can be used by the county and municipalities in the future work with policies and planning. An increase in total earnings leads to higher incomes for both the county and the municipalities through taxes which they could use in their planning of investments and regulations through policies.

The regressions results in mining municipalities suggest that boom years should lead to increasing unemployment which is unexpected. This could be a result of strong trade unions which in some instances have the power to push wages up during positive
economic trends which in the long run keep the unemployment at a higher rate than normal (Gärtner, 2016). It could also be a result of the share of foreign born in the workforce which have been increasing due to the high number of newcomers. Foreign born individuals do often have a long acclimation time before they are ready to enter the workforce, this is expected to be even harder within the mining sector where certain skills are required. The knowledge about these negative employment trends even during boom years could be used by the municipalities and the county when deciding where and how to invest in the development of the local economy.

There is also a possibility that the boom years did not reach the expected results due to changes in preferences for free time. If a boom would increase earnings per worker, it could also lead to increased household income. This in turn might lead to a point where households can cut down on their work hours and maintain the same household income as before due to the increase in earnings per worker. It could also indicate that an increase in voluntary unemployment due to increased demand for free time could create a cyclical unemployment.

By assessing Figure 1 it is possible to conclude that mining municipalities was more resilient than non-mining municipalities during the financial crisis. The unemployment rates in the mining municipalities did not increase as much as in the non-mining municipalities which could be a result of the mining industry having a boom and a slow-moving industry. This suggests that the boom could have dampened the effects of the financial crisis in a positive way. The financial crisis could also be one of the reasons behind a positive coefficient for the boom years dummy on unemployment rates in mining municipalities as the financial crisis affected the unemployment rate.

The results for the boom years indicates that the mining industry might not be as important for the labor markets in the local communities, which was unexpected. Mainly because the boom years demonstrates an increasing unemployment rate even if the mining industry experienced a boom for approximately a decade. This in combination with technology development in the mining industry suggests that the mining industries role as a direct employer will decline with time.

Another factor that could explain the labor changes is the technological development. If jobs are replaced by machinery it could affect the unemployment level. It is also possible that the technological development leads to movement of employees between industries
which could negate the negative effects on the labor market. It could be of importance for policymakers and firms to understand that technological development might be a big part of future mining operations.
CHAPTER 7
CONCLUSIONS AND FURTHER RESEARCH

7.1 Conclusions
The purpose of the thesis is to investigate whether the iron ore market booms had any effect on local labor markets and if there are any difference between the effects on mining and non-mining municipalities. After the work with the thesis the following conclusions are reached.

The thesis does not succeed in finding any significance for the boom years on total earnings and earnings per worker in the mining municipalities. The thesis does however find a significance for the boom years dummy on the unemployment rate in the mining municipalities and that the boom years have led to an increase in the unemployment rate. Increasing unemployment rates during the boom years were unexpected and are the contrary to what earlier research of booms and busts suggest.

It is also concluded that the boom years seem to increase total earnings and earnings per worker in non-mining municipalities. The results for boom years on non-mining municipalities are unexpected as the expectations is that boom years would be significant in mining municipalities and that the effects would be concentrated to mining municipalities.

The main conclusion is that even if the mining industry is a big part of mining municipalities labor markets it is important for policymakers and firms within the area to not base all their actions around the mining industry and its markets.

The results might be of interest for municipalities and the county as it could help in future work with policies and grants for the stabilization of both the county and separate municipalities. Whether or not the municipalities will make use of the results in this thesis it is important for them to understand the possible effects that a boom in the iron ore market might have on their respective local economy, which is addressed throughout the thesis.

How these results can be used in future research is unclear due to the unknown level of spillover effects from the mining industries to other municipalities in Norrbotten county. It is also of importance to understand that the results on total earnings and earnings per
worker in the non-mining municipalities as well as the unemployment rate in the mining municipalities could have been affected by external factors.

7.2 Suggestions for further research

The thesis has resulted in a couple of suggestions for further research in the same or similar subjects. Future research should aim to include a longer time period to be able to test for time-specific effects except for the boom years. It could also be of interest to use a longer time period to investigate the effects of different booms and busts over time, this could however result in some difficulties as municipality borders and geographical areas has been changed over time. There is also a possibility for further research to investigate the spillover effects of the iron ore market booms on nearby municipalities. A last area of interest would be to include all the municipalities in Norrbotten county to make more than two different municipality groups. This could lead to interesting results if these groups would be composed by similar municipals. For all further research on the subject of local labor markets we suggest the use of a more complex model than the one used in this thesis.
LIST OF REFERENCES


Basso, G. (2016). *Local Labor Market Adjustments to Oil Booms and Busts*. Paper, University of California, Davis, California, USA.


APPENDIX

Description of Table variables

A: Agriculture, forestry and fishery
B: Manufacturing and extraction
D: Energy supply for environmental activities
F: Construction
G: Trade
H: Transport and warehousing
I: Hotel and restaurant activities
J: Information and communication
K: Financial and insurance activities
L: Property activities
M: Business services
O: Public administration and defense
P: Education
Q: Health and social care; social services
R: Cultural and personal services, etc
X: Unknown business

Correlation matrices

<table>
<thead>
<tr>
<th>Variables</th>
<th>Average Income</th>
<th>% EDI (J)</th>
<th>Unemployment rate</th>
<th>Tax rate</th>
<th>% Foreign Born</th>
<th>Boom Dummy</th>
<th>Total earnings</th>
<th>Earnings per worker</th>
<th>Inflation</th>
<th>GDP</th>
<th>GO &amp; PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Income</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% EDI (J)</td>
<td></td>
<td>0.978549399</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment rate</td>
<td></td>
<td>-0.025314679</td>
<td>0.955205281</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax rate</td>
<td></td>
<td>0.851380729</td>
<td>0.85318341</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% Foreign Born</td>
<td></td>
<td>0.658410096</td>
<td>0.647328159</td>
<td>-0.07174892</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boom Dummy</td>
<td></td>
<td>-0.105751159</td>
<td>0.15931316</td>
<td>-0.12641888</td>
<td>-0.04871</td>
<td>-0.44597448</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total earnings</td>
<td></td>
<td>0.997757231</td>
<td>0.95337718</td>
<td>-0.19429401</td>
<td>0.850292</td>
<td>0.8009057</td>
<td>-0.05480056</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earnings per worker</td>
<td></td>
<td>0.977777922</td>
<td>0.90417699</td>
<td>-0.00721260</td>
<td>0.062411</td>
<td>0.70910008</td>
<td>-0.05480056</td>
<td>0.99649414</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td></td>
<td>-0.003944102</td>
<td>0.75250408</td>
<td>0.15591833</td>
<td>0.41823</td>
<td>-0.43775647</td>
<td>0.10552020</td>
<td>-0.3771848</td>
<td>-0.40873111</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td></td>
<td>0.928421625</td>
<td>0.96485597</td>
<td>-0.92108448</td>
<td>0.877893</td>
<td>0.73830218</td>
<td>0.05529884</td>
<td>0.73721291</td>
<td>0.75751868</td>
<td>0.7231</td>
<td></td>
</tr>
<tr>
<td>GO &amp; PT</td>
<td></td>
<td>-0.249986469</td>
<td>0.56930182</td>
<td>0.28217978</td>
<td>-0.44017</td>
<td>-0.26346168</td>
<td>0.82750241</td>
<td>-0.25703124</td>
<td>-0.65792072</td>
<td>0.0992</td>
<td>-0.4609</td>
</tr>
<tr>
<td>Label</td>
<td>Variables</td>
<td>Average Income</td>
<td>% EDU 3+</td>
<td>Unemployment rate</td>
<td>Tax rate</td>
<td>Foreign Born</td>
<td>Boom Dummy</td>
<td>Total earnings</td>
<td>Earnings per worker</td>
<td>Inflation</td>
<td>GDP</td>
</tr>
<tr>
<td>-------</td>
<td>----------------</td>
<td>----------------</td>
<td>----------</td>
<td>------------------</td>
<td>---------</td>
<td>--------------</td>
<td>------------</td>
<td>----------------</td>
<td>-------------------</td>
<td>-----------</td>
<td>------</td>
</tr>
<tr>
<td>Average Income</td>
<td>0.98385</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% EDU 3+</td>
<td>-0.81730</td>
<td>-0.08204</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.97378</td>
<td>0.01388</td>
<td>-0.56984</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax rate</td>
<td>0.92896</td>
<td>-0.98153</td>
<td>0.37757</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign Born</td>
<td>0.92158</td>
<td>0.00739</td>
<td>0.97887</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boom Dummy</td>
<td>0.99243</td>
<td>0.00274</td>
<td>-0.14805</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total earnings</td>
<td>0.99361</td>
<td>0.00136</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earnings per worker</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GGR/PT</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Income</td>
<td>0.98612</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% EDU 3+</td>
<td>-0.72381</td>
<td>-0.72381</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.99396</td>
<td>0.07391</td>
<td>-0.73597</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax rate</td>
<td>0.97221</td>
<td>-0.96153</td>
<td>0.96989</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign Born</td>
<td>0.92158</td>
<td>0.00739</td>
<td>0.97887</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boom Dummy</td>
<td>0.99243</td>
<td>0.00274</td>
<td>-0.14805</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total earnings</td>
<td>0.99361</td>
<td>0.00136</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earnings per worker</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GGR/PT</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Income</td>
<td>0.98816</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% EDU 3+</td>
<td>-0.60123</td>
<td>-0.60123</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.98999</td>
<td>0.00563</td>
<td>-0.66815</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax rate</td>
<td>0.98709</td>
<td>0.00517</td>
<td>0.98543</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign Born</td>
<td>0.92158</td>
<td>0.00739</td>
<td>0.97887</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boom Dummy</td>
<td>0.99243</td>
<td>0.00274</td>
<td>-0.14805</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total earnings</td>
<td>0.99361</td>
<td>0.00136</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earnings per worker</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GGR/PT</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total:

<table>
<thead>
<tr>
<th>Label</th>
<th>Variables</th>
<th>Average Income</th>
<th>% EDU 3+</th>
<th>Unemployment rate</th>
<th>Tax rate</th>
<th>Foreign Born</th>
<th>Boom Dummy</th>
<th>Total earnings</th>
<th>Earnings per worker</th>
<th>Inflation</th>
<th>GDP</th>
<th>GGR/PT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Income</td>
<td>0.98145</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>% EDU 3+</td>
<td>-0.77954</td>
<td>-0.77954</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.98175</td>
<td>0.02323</td>
<td>-0.36812</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax rate</td>
<td>0.97450</td>
<td>0.01118</td>
<td>0.97272</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign Born</td>
<td>0.92158</td>
<td>0.00739</td>
<td>0.97887</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boom Dummy</td>
<td>0.99243</td>
<td>0.00274</td>
<td>-0.14805</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total earnings</td>
<td>0.99361</td>
<td>0.00136</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earnings per worker</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inflation</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GGR/PT</td>
<td>0.99376</td>
<td>0.00137</td>
<td>-0.00000</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Descriptive statistics

### Kenya

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVERAGE YEARLY INCOME</td>
<td>254.67</td>
<td>42.79</td>
<td>181.80</td>
<td>304.70</td>
<td>17</td>
</tr>
<tr>
<td>PERCENTAGE OF WORKFORCE WITH EDUC 3+</td>
<td>13.83</td>
<td>1.92</td>
<td>9.49</td>
<td>14.06</td>
<td>17</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>6.98</td>
<td>2.81</td>
<td>3.78</td>
<td>11.83</td>
<td>17</td>
</tr>
<tr>
<td>TAX LEVEL</td>
<td>32.79</td>
<td>0.65</td>
<td>22.05</td>
<td>24.29</td>
<td>17</td>
</tr>
<tr>
<td>PERCENTAGE OF FOREIGN BORN IN THE WORKFORCE</td>
<td>9.41</td>
<td>1.17</td>
<td>8.39</td>
<td>12.30</td>
<td>17</td>
</tr>
<tr>
<td>BOOM DUMMY</td>
<td>0.65</td>
<td>0.49</td>
<td>0.00</td>
<td>1.00</td>
<td>17</td>
</tr>
<tr>
<td>TOTAL EARNINGS</td>
<td>3815.80</td>
<td>665.69</td>
<td>2985.60</td>
<td>4606.00</td>
<td>17</td>
</tr>
<tr>
<td>EARNINGS PER WORKER</td>
<td>278130.90</td>
<td>44066.60</td>
<td>218277.53</td>
<td>341613.96</td>
<td>17</td>
</tr>
<tr>
<td>INFLATION</td>
<td>1.22</td>
<td>1.09</td>
<td>-0.30</td>
<td>3.40</td>
<td>17</td>
</tr>
<tr>
<td>GDP</td>
<td>3297841.24</td>
<td>650570.20</td>
<td>2380358.00</td>
<td>4494802.00</td>
<td>17</td>
</tr>
<tr>
<td>CONTRIBUTION</td>
<td>7242.87</td>
<td>3811.82</td>
<td>4043</td>
<td>9955</td>
<td>17</td>
</tr>
</tbody>
</table>

### Ghana

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVERAGE YEARLY INCOME</td>
<td>236.45</td>
<td>42.80</td>
<td>175.80</td>
<td>303.8</td>
<td>17</td>
</tr>
<tr>
<td>PERCENTAGE OF WORKFORCE WITH EDUC 3+</td>
<td>10.11</td>
<td>1.75</td>
<td>7.20</td>
<td>12.55</td>
<td>17</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>5.47</td>
<td>1.45</td>
<td>4.80</td>
<td>9.32</td>
<td>17</td>
</tr>
<tr>
<td>TAX LEVEL</td>
<td>33.68</td>
<td>0.64</td>
<td>31.75</td>
<td>33.89</td>
<td>17</td>
</tr>
<tr>
<td>PERCENTAGE OF FOREIGN BORN IN THE WORKFORCE</td>
<td>6.83</td>
<td>1.73</td>
<td>4.54</td>
<td>10.15</td>
<td>17</td>
</tr>
<tr>
<td>BOOM DUMMY</td>
<td>0.65</td>
<td>0.49</td>
<td>0.00</td>
<td>1.00</td>
<td>17</td>
</tr>
<tr>
<td>TOTAL EARNINGS</td>
<td>2073.78</td>
<td>461.64</td>
<td>2362.10</td>
<td>3627.20</td>
<td>17</td>
</tr>
<tr>
<td>EARNINGS PER WORKER</td>
<td>2756727.63</td>
<td>490564.48</td>
<td>207110.95</td>
<td>352043.55</td>
<td>17</td>
</tr>
<tr>
<td>INFLATION</td>
<td>1.22</td>
<td>1.09</td>
<td>-0.10</td>
<td>3.40</td>
<td>17</td>
</tr>
<tr>
<td>GDP</td>
<td>3297981.34</td>
<td>605671.09</td>
<td>238036.00</td>
<td>4404802.00</td>
<td>17</td>
</tr>
<tr>
<td>CONTRIBUTION</td>
<td>9022.80</td>
<td>2054.65</td>
<td>5564</td>
<td>11820</td>
<td>17</td>
</tr>
</tbody>
</table>

### Leed

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVERAGE YEARLY INCOME</td>
<td>225.37</td>
<td>53.50</td>
<td>175.80</td>
<td>293</td>
<td>17</td>
</tr>
<tr>
<td>PERCENTAGE OF WORKFORCE WITH EDUC 3+</td>
<td>19.55</td>
<td>2.77</td>
<td>14.64</td>
<td>23.66</td>
<td>17</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>7.29</td>
<td>1.23</td>
<td>5.29</td>
<td>8.87</td>
<td>17</td>
</tr>
<tr>
<td>TAX LEVEL</td>
<td>32.13</td>
<td>0.77</td>
<td>31.20</td>
<td>33.84</td>
<td>17</td>
</tr>
<tr>
<td>PERCENTAGE OF FOREIGN BORN IN THE WORKFORCE</td>
<td>10.02</td>
<td>1.19</td>
<td>8.29</td>
<td>12.22</td>
<td>17</td>
</tr>
<tr>
<td>BOOM DUMMY</td>
<td>0.65</td>
<td>0.46</td>
<td>0.00</td>
<td>1.00</td>
<td>17</td>
</tr>
<tr>
<td>TOTAL EARNINGS</td>
<td>11320.29</td>
<td>1737.65</td>
<td>8766.70</td>
<td>14341.40</td>
<td>17</td>
</tr>
<tr>
<td>EARNINGS PER WORKER</td>
<td>285698.43</td>
<td>35384.05</td>
<td>199868.38</td>
<td>217128.00</td>
<td>17</td>
</tr>
<tr>
<td>INFLATION</td>
<td>1.25</td>
<td>1.09</td>
<td>-0.09</td>
<td>3.40</td>
<td>17</td>
</tr>
<tr>
<td>GDP</td>
<td>3297841.24</td>
<td>605671.09</td>
<td>238036.00</td>
<td>4404802.00</td>
<td>17</td>
</tr>
<tr>
<td>CONTRIBUTION</td>
<td>5687.61</td>
<td>1257.27</td>
<td>2729</td>
<td>7871</td>
<td>17</td>
</tr>
</tbody>
</table>

### Overseasia

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVERAGE YEARLY INCOME</td>
<td>183.39</td>
<td>77.29</td>
<td>141.70</td>
<td>224.30</td>
<td>17</td>
</tr>
<tr>
<td>PERCENTAGE OF WORKFORCE WITH EDUC 3+</td>
<td>9.50</td>
<td>1.76</td>
<td>6.72</td>
<td>11.10</td>
<td>17</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>12.68</td>
<td>2.69</td>
<td>7.54</td>
<td>18.78</td>
<td>17</td>
</tr>
<tr>
<td>TAX LEVEL</td>
<td>31.48</td>
<td>0.64</td>
<td>20.95</td>
<td>33.09</td>
<td>17</td>
</tr>
<tr>
<td>PERCENTAGE OF FOREIGN BORN IN THE WORKFORCE</td>
<td>25.04</td>
<td>1.88</td>
<td>22.38</td>
<td>26.67</td>
<td>17</td>
</tr>
<tr>
<td>BOOM DUMMY</td>
<td>0.65</td>
<td>0.49</td>
<td>0.00</td>
<td>1.00</td>
<td>17</td>
</tr>
<tr>
<td>TOTAL EARNINGS</td>
<td>567.40</td>
<td>41.10</td>
<td>493.20</td>
<td>621.00</td>
<td>17</td>
</tr>
<tr>
<td>EARNINGS PER WORKER</td>
<td>227276.24</td>
<td>24374.50</td>
<td>185727.00</td>
<td>264845.07</td>
<td>17</td>
</tr>
<tr>
<td>INFLATION</td>
<td>1.32</td>
<td>1.09</td>
<td>-0.30</td>
<td>3.40</td>
<td>17</td>
</tr>
<tr>
<td>GDP</td>
<td>3297841.24</td>
<td>605671.09</td>
<td>238036.00</td>
<td>4404802.00</td>
<td>17</td>
</tr>
<tr>
<td>CONTRIBUTION</td>
<td>24562.76</td>
<td>2852.68</td>
<td>18713</td>
<td>29334</td>
<td>17</td>
</tr>
</tbody>
</table>

### Arvidsjaur

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVERAGE YEARLY INCOME</td>
<td>206.64</td>
<td>31.00</td>
<td>154.30</td>
<td>257.90</td>
<td>17</td>
</tr>
<tr>
<td>PERCENTAGE OF WORKFORCE WITH EDUC 3+</td>
<td>10.04</td>
<td>1.38</td>
<td>8.13</td>
<td>12.66</td>
<td>17</td>
</tr>
<tr>
<td>UNEMPLOYMENT RATE</td>
<td>8.82</td>
<td>1.66</td>
<td>5.75</td>
<td>12.23</td>
<td>17</td>
</tr>
<tr>
<td>TAX LEVEL</td>
<td>33.83</td>
<td>1.03</td>
<td>31.70</td>
<td>34.84</td>
<td>17</td>
</tr>
<tr>
<td>PERCENTAGE OF FOREIGN BORN IN THE WORKFORCE</td>
<td>6.60</td>
<td>3.07</td>
<td>2.80</td>
<td>11.98</td>
<td>17</td>
</tr>
<tr>
<td>BOOM DUMMY</td>
<td>0.65</td>
<td>0.49</td>
<td>0.00</td>
<td>1.00</td>
<td>17</td>
</tr>
<tr>
<td>TOTAL EARNINGS</td>
<td>889.16</td>
<td>92.79</td>
<td>732.00</td>
<td>1045.60</td>
<td>17</td>
</tr>
<tr>
<td>EARNINGS PER WORKER</td>
<td>247461.46</td>
<td>33586.76</td>
<td>197920.60</td>
<td>302142.44</td>
<td>17</td>
</tr>
<tr>
<td>INFLATION</td>
<td>1.22</td>
<td>1.09</td>
<td>-0.30</td>
<td>3.40</td>
<td>17</td>
</tr>
<tr>
<td>GDP</td>
<td>3297841.24</td>
<td>605671.09</td>
<td>238036.00</td>
<td>4404802.00</td>
<td>17</td>
</tr>
<tr>
<td>CONTRIBUTION</td>
<td>16868.41</td>
<td>1997.97</td>
<td>12588</td>
<td>20310</td>
<td>17</td>
</tr>
</tbody>
</table>