Abstract: A central debate within the field of Economic History and Growth studies is the effect trade liberalization has on the long-term growth of an economy. One radical switch in the foundation of an economy is from Import Substitution Industrialization (ISI) to Trade Liberalization. Mexico is one of the economies that have undergone this transformation since the early 1980s. This paper makes an attempt to identify possible effects of trade liberalization within the aspect of skill and knowledge accumulation as a potential for innovativeness in the domestic economy. Cohesively the findings in this thesis indicate that the industrialization process of the Mexican economy has, due to the effects of trade liberalization, to a greater extent the character of a concealed economic process. However, several indicators point at possible policy improvements that can yield to a greater extent a process of unrestrained forms of development.

Key words: Mexico, Import Substitution, skills, knowledge, automotive industry, Dependency, Structural Change
Contents

1. Aim and justification .................................................................................................................. 3

2. Previous research ..................................................................................................................... 4

  2.1 Underinvestment in human capital ...................................................................................... 4

3. Theoretical framework ............................................................................................................. 5

  3.1 Advances on Krugman – reformulating Ricardian theory .................................................. 5

  3.2 The Education Paradox ....................................................................................................... 5

  3.3 Dependency in Latin America and particular characteristics concerning Mexico ............... 6

  3.4 Industrial Development: Structural Change and Dependency ........................................... 7

4. Contribution of this study ......................................................................................................... 8

  4.1 Hypothesis ........................................................................................................................... 8

  4.2 Focus of the study ................................................................................................................ 8

  4.3 Approach .............................................................................................................................. 8

5. Scope and limitations .............................................................................................................. 9

6. Methodology ........................................................................................................................... 9

7. Data and sample selection ...................................................................................................... 10

8. Analysis .................................................................................................................................. 11

  8.1 The experience of the automotive industry ...................................................................... 11

    8.1.1 Background: facts and prognoses on the automotive industry in Mexico .................. 11

    8.1.2 Classifications, input (employment) and output (value of sales) ................................. 12

    8.1.3 Wages .......................................................................................................................... 17

    8.1.4 Trade and Competitiveness ......................................................................................... 19

  8.2 The Education Paradox ...................................................................................................... 24

    8.2.1 Education ..................................................................................................................... 24

    8.2.2 Education in relation to the automotive industry and MFE ....................................... 28

    8.2.3 Education, trade and competitiveness ....................................................................... 32

  8.3 Dependency and Structural Change .................................................................................... 35

    8.3.1 Dependency .................................................................................................................. 35

    8.3.2 Potential for innovation ............................................................................................... 39

    8.3.3 The process of Structural Change .............................................................................. 41

9. Ethical considerations .............................................................................................................. 45

10. Concluding remarks ............................................................................................................. 45

  10.1 Summary ............................................................................................................................ 45

  10.2 Conclusions ....................................................................................................................... 47

References ................................................................................................................................... 49

Definitions .................................................................................................................................... 51

Appendix ...................................................................................................................................... 52
1. Aim and justification

The research question:
To what extent has the automotive industry in Mexico since 1982 contributed to the creation of skill accumulation, intensified cross-sectorial dynamics or dependency forms of economic development over time and space?

Latin American economies have shown an overall diverging trend in growth rates from the 1970s when compared with the world economy. A converging trend can however be seen within the continent. The differences amongst countries are becoming less important, making them more homogenous. It can be argued that divergence from the rest of the world economy is policy driven, causing a very deep structural heterogeneity (Bertola 2003). A high volatility in growth rates can be related to the production structure. A concentrated production, with few domestic products, makes Latin-America different from the developed world. Importing technologies is limiting stable growth. Dependency on few products and markets creates volatility, negatively affecting per capita income and growth. Therefore it can be argued that diversifying and intensifying production and integrating Latin-American markets is essential for achieving stable growth.

Mexico has always had a strong dependency on the United States, and it can be argued that the country therefore has a unique position on the American continent both geographically and as a link between north and south. The North American Free Trade Agreement is one example that links the economy with the United States, but the country is historically a part of Latin-America. Therefore different growth patterns might be expected in Mexico than in other Latin-American countries. At the same time domestic industries have started to develop over time. The maquiladoras industry traditionally consisted of assembly that served as a source for cheap labor under large foreign industries, specifically the United States. The question remains if this can still be said today, especially since the automotive industry in Mexico has started to experience rapid growth since trade liberalization has gradually started to replace import substitution since 1986 (Reid 2007).

Macroeconomic policies, borrowing heavily from foreign banks with loans in dollars against future oil revenues, of the 1970s left the Mexican economy vulnerable to external conditions. Therefore it is arguably desirable to obtain, in an increasing amount, an internal position of power and innovativeness. To determine if this has been the case an analysis of the competitive position of the industry and structural change and/or transformation patterns will be made, wherein indicators related to human capital accumulation in the domestic economy are leading. Hereby the automotive industry, being one of the drivers of the economy with an expected Compound Annual Growth Rate (CAGR) just shy of 9% between 2014 and 2020 (Ornelas 2015), will serve as a case example to illustrate whether a possible knowledge accumulation process since the lost decades has been taking place domestically or if there has been the creation of a production structure that steers to a lesser extent towards sustainable economic development in the future. The implications of these factors can indicate the extent to which dependency in economic development in Mexico is still present, what pattern of structural change can be derived from employment development and whether certain policy recommendations can help to stabilize economic development.
2. Previous research

Arguably Mexico, amongst many other economies in Latin-America, seems to a certain extent have missed what Kuznets (1973) described as the ideal model of structural transformation in an economy. Investigating on the developments described above can create a better understanding of this process on the long-term, through a case study of the automotive industry, by assessing recent human capital development since a radical economic change has taken place.

The automotive industry can possibly allow for making an empirical observation on how far one can go into making the internal processes that are created and can be useful in relation to dependency or comparative advantages. Understanding institutional reform can hereby be a key factor in creating understanding about the type of economic situation that can be found in Mexico, and perhaps on a broader scale in Latin America. Concerning New Trade Theory (Krugman 1995, Krugman & Elizondo 1995, Shiozawa 2007 and Shiozawa & Fujimoto 2011;2012) a certain trend in this theoretical framework might be the moving away from the assumption of constant returns to scale, towards the use of protectionist measures to build up an industrial base in certain industries allowing those sectors to dominate the world market.

An example that has often been referred to in the literature (MacEwan 1999) is that of the Japanese automotive industry after trade liberalization in the 1950s. Where quotas and regulations had prevented import competition initially, Japanese companies were encouraged to import foreign technology but required to produce 90 per cent of all parts domestically. This led to suffering domestic consumption at first but on the long term to a local industry that could outperform international competition. This allows for a case study of Japan (Smitka 2002) to serve as a point of reference in helping to assess the case of Mexico, theoretically approximately 30 years behind trade liberalization when compared to Japan.

2.1 Underinvestment in human capital

This study will attempt to expand on the collective body of research by investigating on the aspect of the input variable human capital investment and the output variable skill accumulation. Here the question comes to mind whether, and if so, what the process of structural transformation has been in the case of Mexico. Has there been enough space for human capital development since 1982 and has this created a certain internal learning process, not solely aimed at ‘extraction’ of capital and investment in production and obtaining of market share. In this manner one can seek the way that a system dynamically evolves, relying on variation and the passage of time (Boulton 2010).
3. Theoretical framework

Moving on to this study, a case specific example will attempt to show if this hypothesis holds. If there is in fact evidence that an internal learning process is taking place this could indicate that the economy is in fact finding to a greater extent its own path of development. On the other hand, if we can expect a further stagnation of this process on the long-term one might find support in saying that this is not the case (Benett & Sharpe 2001). This study will look at what the conditions have been – something happened, but sometimes it is considered something inevitable. Dependency theory in an evolutionary framework arguably states that the capitalistic system in the world forced Mexico, amongst other ‘periphery’ economies, to become dependent on the developed, ‘core’ first world economies.

The more recent kind of economic activity in the periphery supposedly is industry. However, this is usually carried out by foreigners, although at times in collaboration with the local economy. The surplus from this production mostly goes to back to the foreign shareholders, where the rest is spent on consumption in a similar manner by the well to do. Baran (1957) thought that political revolution was a necessity to break this pattern (Vernengo 2004).

3.1 Advances on Krugman – reformulating Ricardian theory

Krugman (1995) arguably finds that each firm in the industry is homogenous worldwide and that consumer preferences are identical. The heterogeneity of all of the companies is not considered. Ricardian theory does not explain the variance of labor input coefficients for each industry and country. Therefore this project attempts to look at the “survival of the fittest” since trade liberalization on an industry and firm level and between factories. And under the logic of Ricardian theory of how labor input is decisive in the industry. Veblen (1898) refers to human knowledge, skill and predilection as the representation of true capital. He thereby emphasizes the essence of workmanship and arguably addresses an essential evolutionary component in his theory. Hence employment can serve as a useful initial indicator.

Thereby the assumption of constant returns to scale is relaxed, and some argue that using protectionist measures to build up a huge industrial base in certain industries will then allow those sectors to dominate the world market. A comparison and challenge of this project might be to look at the development of the Japanese automotive industry since trade liberalization in the 1950s. In that case it might be worth to empirically analyze the theoretical assumption described above, if such a development has in fact taken place in the Japanese automotive industry, and if in turn a comparison can be drawn between the Mexican automotive industry since the 1980s.

3.2 The Education Paradox

Mexico can to a greater extent be viewed as an industrial economy, at the same time being generally less reliant on natural resources than other Latin-American economies. Hausmann et al. (2013), arguably a scholar that specializes on the production side of an economy, finds in his economic complexity index that Mexico is high in the rankings. A complex economy to him would indicate that it is more advanced and should therefore have a more competitive position. The same could be said when observing figure 1, where Mexico appears to be on a level of economic complexity of the developed world.

On the other hand, Mexico has low levels, similar to for example Mongolia, of formal education while the economic complexity is dramatically higher (Hausmann et al. 2013).
Therefore education can be one of the core variables in an analysis on the Mexican economy. A helpful variable for comparison can in addition be wages (Romero 2011). Dependency can be related to new economic geography and the dynamics behind the spatial distribution of factor mobility and potential for innovativeness since trade liberalization. In that light a further analysis of the development of trade and competitiveness (Rodríguez-Pose & Sánchez-Reaza 2003) in a regional perspective strikes as an adequate addition.

![Figure 1](Note: Image not provided, should be replaced with actual figure)

Figure 1 Mexico in the Economic Complexity Rating highlighted with blue, and simultaneously compared to Mongolia highlighted in blue (edited and from Hausmann et al. (2013) The Atlas of Economic Complexity, Mapping Paths to Prosperity, p. 22)

3.3 Dependency in Latin America and particular characteristics concerning Mexico

Gunder Frank (1969) and Cardoso (1979) describe dependent development in Latin-America as a long-term process, limiting these economies from sustained growth. Until trade liberalization the impetus for industrialization was arguably maintained by a relationship between nationalism and populism in Latin-America (Cardoso 1979). The Mexican economy differs to this extent from other Latin-American economies, such as Argentina and Brazil, in the internationalization process of the market in terms of political and military crises. The machinery for the integration of trade unions had been modernized and this perhaps created a more participatory worker movement (Cardoso 1979). The earlier established bourgeoisie and investor state that therefore not come to a confrontation, arguably prevented through an absence of populism and creating development and stability.

Gunder Frank (1969) suggests that the history of the Mexican economy fell into five phases: the four centuries from the conquest until 1910 (1); the subsequent fifteen years of violent
revolutions towards independence from the colonizers (2); the again following fifteen years of
reform characterized by the enclave-economy model until the 1930s (3); the fifteen years after
1940 with novice industrialization and growth of bourgeois power and the import substitution
industrialization (ISI) model from the 1930s (4) and the consolidation of the Mexican system
under bourgeois leadership until the 1970s (5). A system of borrowing heavily from foreign
banks with loans in dollars against future oil revenues collapsed when the oil prices plunged
and interest rates rose when approaching the 1980s. The import substitution model collapsed
in the 1980s (Rodríguez-Pose & Sánchez-Reaza 2003).

The PNI (Partido Nacional Revolucionario), though by many argued with violence and
electoral frauds (Jackson 2012), was the single party leader of Mexico from 1929 to 1982. The
Mexican economy went bankrupt in 1982, simultaneously symbolizing the end of the long
reign of the PNI, forcing the government to devaluate the peso and nationalize the banking
system (Crandall 2004). Arguably this development made the government decide to move
from import substitutions to neoliberal reforms. Large multinational corporations were invited
to come to Mexico as domestic production could be opened to foreign capital (Cardoso 1979).
Many industries were privatized, starting by Presidents Miguel de la Madrid in 1982 and
subsided by president Carlos Salinas in 1988.

3.4 Industrial Development: Structural Change and Dependency
A problem mentioned by authors is that the transformation in Latin-America came to a halt
after WOI. The economies came to be to a greater extent based on isolation through policies
aimed at import substitution. Therefore a way to possibly break free from the dependency
would be to find an ideal model for spontaneous and self-generating growth. If the industries
can be depicted in different sectors of this dependency model an economic historical
perspective can indicate the sectors moving at relative strength, where some are gaining and
some are declining. Special attention will to this extent be given to production being utilized
for benefits and value added in the domestic economy.
4. Contribution of this study

4.1 Hypothesis
As mentioned a certain trend might be that moving away from the assumption of constant returns to scale, towards the use of protectionist measures builds up an industrial base in certain industries allowing those sectors to dominate the world market (Krugman 1995, Krugman & Venables 1997). According to Rodríguez-Pose and Sánchez-Reaza (2003) factors that impinge on trade can evolve around dynamic trade models emphasizing the importance of spillovers. At the same time they argue that there is a discussion about the spatial distribution of the benefits of trade and economic integration. Some authors (Wood 1994) have argued that factor mobility may also yield a reduction in territorial disparities.

4.2 Focus of the study
Special attention will be given to the question if incentives for more sustained forms of economic growth can be derived from an analysis of human capital development in the domestic automotive industry. Hereby a move from human capital and knowledge creation to the aspect of reallocations is made. Correlations and regressions will be drawn through several variables in the analysis regarding the aspect of knowledge creation and potential for innovation in a spatial/reallocation perspective within the automotive industry. Thereby the maquiladora for export industry will serve as a helpful additional variable for determining comparative advantages or disadvantages. These comparisons can give an indication of the innovativeness of the industry, attempted to approach over time and space. On a macro level a better understanding of the dynamics of the industrial process can give an indication of the potential for growth of the economy in a dependency development perspective. In addition conclusively an analysis will be made of the extent to which indications in the analysis can be attributed to the development process of structural change.

4.3 Approach
This project assumes two possible outcomes or conclusions, where findings can indicate a certain degree towards pointing the industrialization process in one direction or the other. On the one hand there is the possibility that the Mexican economy and its domestic development over time consists of a mainly concealed assembly industry, foreign investors simply taking accumulated capital back to their home base and an absence of added value or an internal knowledge creation process in the economy. On the other hand an increasing complexity, unrestrained forms of development and domestic skill creation could have taken place, likely indicating a more sustained growth process for the domestic economy.

The automotive industry, as being a more advanced industry and arguably often seen as the core of industrial development of an economy, can be helpful in creating an understanding of these two possibilities. Therefore the development of the industry since 1982 will be analyzed through making clear what defines the industry, what it consists of and what the competitive position of the sector is. The main focus in this investigation will be on human capital development. Skill accumulation is by numerous scholars and theories viewed as a key characteristic in the catching up process of a developing economy (Abramovich et al. 2010). Cross-sectorial dynamics to that extent can be viewed as a key factor in determining a competitive position or comparative advantage of an industry or economy.
5. Scope and limitations
The Mexican industrial sector, and in particular the automotive sector - also in relation to related sectors as maquiladoras assembly industries - will be studied. An attempt will be made to track its development since 1982 through a longitudinal case study, and these observations will lead to confirmation or rejection to several hypotheses regarding economic development of Mexico in the world economy. Dependency development can range from Latin-American to country specific characteristics regarding political/policy development in an economic historical framework, economic effects and economic change. Industry specific relatedness will in this light look at human capital development, technological development, and indicators for economic development such as employment, wages, potential of industry specific segments and the economy as a whole. An ideal model of structural change or structural variables will have a bridging function from the industry case study towards the theory, where certain characteristics could possibly identify the nature of the industry.

There will be no specific studies on economic development due to the USA trading relationship. The study is aimed at identifying internal dynamics in the Mexican economy since 1982, and when possible an analysis of whether there has been increasing economic integration with the neighboring Latin-American economics to the south. At the same time there will not be investigations on the extent to which the Mexican economy is still dependent on oil, other natural resources or land inequality. This part of dependency theory will not be studied nor be part of the case study. However, assumptions will be based on the theoretical idea that land inequality played a vital role in long-term development of the economy. In this light the part of the theory related to contemporary dynamics and innovativeness in an economy will be addressed.

6. Methodology
Here specific indicators of the automotive industry will be assessed, aimed at the assessment of the extent to which the automotive industry is creating certain processes that are beneficial for the Mexican economy on the long-term through certain core qualities according to theoretical hypotheses. Simultaneously an attempt will be made to make exploratory comparisons, such as geographical/regional economic development and domestic innovative prospects on both a national and regional industry and macro level.

Several relevant indications might be derived from the following information since 1982:

- Employment, background and nature of the automotive industry
- Wages in the automotive industry compared to the industrial sector
- Education overall in relation to maquiladora for export and automotive industry technology
- Education, trade and competitiveness in relation geographic location of the industry
- Extending the spatial analysis: geographic number of employed in the maquiladora for export industry per state, labor dispersion per state in a dependency theory framework
- Structural transformation: structural change in the economy and the employed and potential for innovation per state
7. Data and sample selection

Data is obtained through field research done in Mexico in collaboration with and/or under coordination of UN/ECLAC and The World Bank México. Measurements can be done through the use of several databases such as *World Development Indicators (World Bank)*, Encuesta de Maquiladoras, Encuesta Industrial Anual, The Comtrade database, INEGI (Mexican Bureau of Statistics) and OECD Main Science and Technology Indicators.

The United Nations has assisted in this project with the collection of data on the industry and economy. Universities might be expected to do individual research, and therefore desirably seen as objective. On the other hand, the quality of doing research differs per university and this has been taken into account. In general it can arguably be useful to individually analyze raw data from banks and compare it with data from The World Bank or the United Nations.

On the count of the above an attempt has simultaneously been made to interview several important stakeholders in the automotive industry at a firm level. Perhaps here divergent data can be discovered that can lead to counterfactuals, a comparison or at least differing views in the actual assumptions or generalizations that will be made during this study. Because there is a particular importance to the documentation of the dynamics behind the processes of change regarding the case study and economic change in addition to private companies a specific number of interviews must be held for orientation regarding what crucial information must be obtained in to depict this, simultaneously interpreted as objectively as possible.
8. Analysis

With regards to the data that has been collected for interpretation and analysis, it is important to clearly distinguish at all times the economic crises that supposedly impacted sales, manufacturing and employment in 1994 and 2008. An attempt is made to illustrate these crises with the data over time and space. When possible or necessary, two or more data sets are combined. Within the assessment of the variables the Japanese automotive industry, as mentioned earlier, will serve as a point of reference in the variables that have been chosen to assess.

Whilst keeping Trade Liberalization in Japan since the 1950s and in Mexico since the 1980s in mind several variables have been compared in chapter 8.1 to the Japanese experience in the automotive industry. In chapter 8.2 specific attention is given to the Education Paradox, where an attempt is made to view the automotive and maquiladora for export industry in the light of educational levels. In chapter 8.3 dependency and structural change are touched upon, simultaneously in the light of chapters 8.1 and 8.2. The New Trade and dependency theory framework and hypothesis weaves through the analysis and conclusion as a red thread.

8.1 The experience of the automotive industry

8.1.1 Background: facts and prognoses on the automotive industry in Mexico

Between 2004 and 2014 the CAGR in the industry was 7.1% and, as mentioned before, is expected to increase to 9% between 2014 and 2020. In 2014 Mexico supplied 11.5 of every 100 new automobiles sold in the USA. Ornelas (2015) finds that when by 2020 the production output of 5 million units with 70% exports is achieved to the 17 million then projected U.S. market, 20% of all new cars sold in the USA will come from Mexico. The predicted increase in light vehicle sales in the USA until 2020 and the 71% of light vehicles produced in Mexico bought by USA consumers in 2014 can be viewed as an important indication for Mexico and its automotive industry (Ornelas 2015). The record peak of 17.4 out of 100 light vehicles sold in 2000 is expected to re-occur in 2017. Between 2014 and 2020 an increase in light vehicles output is expected from 3.2 to 5.1 million units (Ornelas 2015).

Traditional foreign car brands, from this point referred to as Original Equipment Manufacturers, from this point referred to as OEMs, have supposedly experienced this potential for growth within the industry and investments are being made on a large scale. New investments throughout Mexico of nearly US$20 billion have been made or announced between 2010 and 2014. A challenge for the domestic economy is however to decrease the extent to which the assembly industry is aimed at export to global markets. The market is adjusted to the needs of foreign markets and not those of the Mexican consumers. The domestic market is supplied with global cars. About half of the units sold domestically are actually made in Mexico. A more desirable situation would be to have domestic sales being supplied by local OEMs.

The domestic market, although sales grew by 6.8% over 2013, is not living up to its much larger potential. Where 9.5 units per 1000 inhabitants were sold in 2014, Brazil and Argentina with similar economies sold approximately 17 units per 1000 inhabitants. This difference can perhaps be attributed, and simultaneously related back to the import substitution era, to the amount of used cars that are imported into the country. There has however been a vast decrease in these numbers, for instance down to 450,000 in 2014 from 700,000 a few years
The forecast is that 1.2 million units in 2015 and, with a CAGR of 3.5% between 2016 and 2020, 1.4 million units will be sold in 2020 (Ornelas 2015).

Within the fundamental root of the problem of the domestic market a reference has to be made to the informal economy. The OECD estimates (Ornelas 2015) that 60% or more of the working-age population is in the informal economy and therefore do not pay taxes or social security. Under the absence of having the possibility to acquire bank credit this may force this part of the population to repair old cars or import less costly used cars paid in cash. This in turn causes the market to not live up to its domestic potential as long as the government continues to allow the informal economy.

8.1.2 Classifications, input (employment) and output (value of sales)

When attempting to look at the distinction of skills and learning processes several indicators can be distinguished from the data that INEGI provides. Monthly data are used in this analysis, starting with data sets that run from 1994-2008. This data refers to the automobile industry under the subcategorized 3841 code and comes from a section in the database that is not updated anymore but nevertheless representative. Several comparisons here can be made with regards to maquiladoras for exports (assembly industry destined for export – referred to
as MFE in the remainder of the analysis) in relation to export data and the automotive industry. This analysis takes dynamics over time in employment and value of sales as a starting point, where the former serves as input and the latter as output variable.

Contemporary data from 2007 collected by INEGI on the automotive industry is categorized under code 336, falling under the SCIAN (Sistema de Clasificación Industrial de América del Norte – or Industrial Classification System for North America). Again comparisons can be drawn with the MFE industry as data is available on the amount of income for the automotive industry from maquiladora production. The relationship between development in the automotive and maquiladora industry input and output in this analysis can give an indication of skill development in the automotive industry. In the appendix both classifications can be found in paragraph 8.2.

Employment and Value of Sales
When moving from the monthly INEGI data set for the 3841 to the 336 category for the automotive industry it becomes clear that there is no coherence between the two categories in terms of the number of employees in the sector. Presumably an explanation for this can be that employees that used to be classified under maquiladora for export or other industries have now been classified, if not partially, under the 336 category for domestic employment. This may be explained by the fact that a large share of the 336 employment category can be attributed to the assembly of motor parts for automobiles (see graph 4). Because the 3841 classification provides a longer timeframe and more data on the MFE (1990-2006) industry it will be leading in the analysis. When more relevant data is available in the 336 classification for a particular analysis this will be used. If so, this will be specifically mentioned and motivated.

The same assumption might be derived when looking at the relationship between the total number of employees in the MFE sector and automotive sector over time between 1990 and 2008 (see graph 1 and 2). It shows a possible relationship between employment in the two sectors.
Graph 1

Total employees per sub-sector 3841

Graph 2 (purple and light-blue on secondary axis)

Composition employees MFE & 3841
The results in Graph 2 could be an indication that the assembly industry is moving from MFE to being incorporated in the domestic industry itself. When looking at employment in the Japanese automotive industry since 1985 (graph 3) assembly could be an indicator for MFE employment. This is however a broad assumption that requires further research. A clear, generally constant decrease in employment in this sector can be noted. 1985 in Japan, within the theoretical framework comparison, might be viewed as 2015 in Mexico due to the 30 year time-lag since Trade Liberalization. When approaching the years or prognosis for Mexico in that manner, an increase might be expected in other, non-assembly sub-sectors, until 2020. Hereafter an intensifying decrease would appear to be at hand. Another striking observation that can be made between graph 2 and 3 is the overall similarity in growth pattern in industry employment over the period of approximately 15 years.
When looking at growth of sales, 2008 in Mexico appears to depict a record high. 2008 in Mexico might be aligned with Japan in 1972, in graph 5, as a point of reference. This would mean that exports would start decreasing around 2030 and sales would start increasing at around the same time, supposedly in the domestic economy.
8.1.3 Wages

Ruiz (2008) subdivides the different industrial sectors in Mexico into 4 categories. Figure 1.2 shows these four categories, and simultaneously shows the automotive industry in the medium-high technology classification. When moving up the ladder of technological development, a link can arguably be made between the automotive and aerospace industry as both specialize in manufacturing of transportation equipment. The newest classification by INEGI (336, see above) perhaps confirms this to a certain extent as aerospace manufacturing is in the same category as automotive manufacturing when compared to the old classification of the automotive industry (3841, see above).

![Table: CLASIFICACIÓN DE LA INDUSTRIA POR INTENSIDAD TECNOLÓGICA](image)


Wages in relation to the industry

The classifications that are used in this case are based on 336 data, as a clear distinction on Ruiz’s industrial classification on the basis of the OECD industrial classification can be made from this data. This affects the representativeness of the results. As 336 data is used here, wages will only be done in this paragraph and not in the remainder of the analysis. In the appendix the INEGI industry classifications, and under which industry classification these have been, attributed can be found. Primarily an attempt has been made to look at average wages in the type of industry classification in Graph 7, and subsequently to relate these to wage levels in the automotive industry between 2007 and 2015.
What stands out Figure 6 is the wage development of the automotive industry and classification category 2 and 3. Since the 2008 crisis there appears to have been a diverging trend, where wages in category 2 and 3 have increased more rapidly than in 336. Wages being lower in category 4 than in 2 and 3 can indicate that high technology industries have yet to catch up in wage levels. Here a scatter plot can yield the possibility to determine the correlation between the 5 month moving averages of wages in the different industry classifications in relation to the automotive industry. In Japan, see graph 7, wages started increasing vastly in the industry around 1994, what could be 2024 in Mexico.
The fact that the highest correlation in wage development over time can be found between 336 and 3 might be expected as the automotive industry is classified here. On the other hand, the wages levels in category 3 are the highest, though much lower in 336 whilst showing a diverging trend from 2 over time. What might be considered the most striking about the measurements above is that there appears to be a closest correlation over time between 336 and 1. It must however be mentioned that the $r^2$ fits the model slightly more accurate in the 336 and 1 comparison. The findings above could indicate that more research and knowledge creation would be required in the domestic automotive industry as wages appear to be correlated towards a low level for the OECD industrial classification of the automotive industry. The rest of the scatters can be found in the appendix under 8.1.3.

### 8.1.4 Trade and Competitiveness

This paper approaches economic integration and dependency within an evolutionary framework. According to Rodríguez-Pose and Sánchez-Reaza (2003) factors that impinge on trade can evolve around dynamic trade models emphasizing the importance of spillovers. This paper attempts to approach these dynamics. At the same time they argue that there is a discussion about the spatial distribution of the benefits of trade and economic integration. Some authors (Wood 1994) have argued that factor mobility may also yield a reduction in territorial disparities.

In this paragraph dynamics of trade over time will be assessed, using trade data per state. In paragraph 8.5 an attempt will be made to assess factor (labor) mobility over space. Therefore the total degrees awarded in states with and without industry will be compared with average added value of exportation covered by maquila for export service per state (real, thousands of pesos at current prices) and manufacturing production per state (base 1993=100). In this manner the maquila for export will serve as an indicator for determining if knowledge flows out of the country and the manufacturing production to determine if there is internal knowledge creation.
In this analysis it must primarily be mentioned that data of only a number of states was available, some with and some without the automotive industry. Therefore averages have been calculated. In the appendix is indicated which states are included in the analysis. The states with automotive industry have experienced a more rapid growth in output rates. The above moving averages have been chosen to be able to depict in a clearer manner the cyclical movement of the two geographic areas. When looking at the 24 month moving average of the annual variation in the average manufacturing production output in both geographic areas it appears that output in states with the automotive industry is more volatile. This can make one want to assess if it is advisable to perhaps invest in education to for a better stabilization of this volatility.

The vast decrease in output in Japan since 1992 is clearer than the near simultaneous decrease in exports and sales from that year. Judging by manufacturing output in Mexico one could compare 1973 in Japan with 2003 in Mexico. When assessing the five years from 2003 in Mexico it might be assumed that Japan experienced a vaster increase in output from 1973 to 1978 although both industries experienced higher rates of growth. With this in mind it could be the case that the automotive industry in Mexico will start experiencing a vast decrease in output from 2022. The graphs below show the two time period between the industries compared.
Figure 7 (from Smitka 2002)

Graph 6
Average added value of exportation covered by maquila for export service (real in thousands of pesos at current prices) per state

Legend

TBAPGPT = total degrees awarded
AVGAVEXPMFEWI = Average added value of exportation covered by maquila for export service
WI = states with industry
WOI = states without industry

Again, data of only a number of states was available, some with and some without the automotive industry. Therefore again averages have been computed. In the appendix is indicated which states are included in the analysis. When comparing the total added value of exports by maquila services again a faster increase can be noted in the states with the automotive industry. The 24 month moving average of the annual variation does not show a clear cyclical behavior as is the case when it comes to the output production of manufacturing. Again, there is a greater volatility. However, the most drastic divergence can be noted between 1996 and 2002. This might be an indication that maquila for export services cause to a greater extent economic instability than the domestic manufacturing process in states with the automotive industry.

Graph 7
Faster growth in the capital-output assembler than parts variable in Japan between 1985 and 2000 could be an indication that there has been knowledge creation as more capital is accumulated in what can be assumed to a greater extent a refined aspect of the automotive industry. As a clear increase can simultaneously be noted in the states with the automotive industry in Mexico between 1990 and 2006 the question remains if this will also be the case between 2015 and 2030, what would be the same period if compared to each other in terms of change in economic foundation from ISI to Trade Liberalization. Chapter 8.2 will elaborate further on the prospects for education and the education paradox in Mexico.
8.2 The Education Paradox

8.2.1 Education
In this analysis the types of degrees awarded three major fields of education are assessed over time and on a regional (states of the country with and without automotive industry, see also 8.1) level. Hereby only higher education degrees are used in the analysis and therefore high school technical industrial degrees awarded are left out. The reason for this is the closer relation these three variables have in the amount of degrees awarded and the annual variations. From the above it appears evident that the amount of professional degrees awarded is expected to grow faster in the part of the country without industry while population growth has slowed down in that part of the country. Notable at the same time is that there was a drop in both regions amount of degrees awarded. This may be related to the decline in population growth in the part of the country without automotive industry.

It must however be mentioned at all times that the years in which certain OEMs were established are not related to the above analysis. This could perhaps in a more intensified manner have created an effect on skill accumulation as more OEMs have been established over time, however this is complicated to illustrate due to a lack of relevant data before 1990.
Bachelor
From the results in the above graphs can be derived that states with industry seem to be more stable in both growth of population and the amount of degrees awarded (five year variation/moving average and over time). In addition, where the amount of Bachelor degrees awarded remained stable until 2010 when comparing the two groups, the population growth in the states without OEMs slowed down in comparison to the states with OEMs. This makes the total population in both groups more or less equal (55.96 million in states with and 56.37 million in states without automotive industry in 2010).

Postgraduate
The amount of Postgraduate degrees awarded could indicate a lag in investment or competitiveness of the industry in relation to education as divergence is forecasted, where in states without industry the amount of degrees awarded is expected to grow faster in the future. However, the higher volatility in the moving average of the states without industry could indicate that this prognosis is more vulnerable.

Professional Technical
When looking at Professional Technical education the first most striking remark that can immediately be made is the sharp fall in degrees awarded between 2010 and 2015. Presumably the prognosis for the future has been adjusted to this development. At the same time it has to be noted that the amount of technical degrees awarded in states with industry greatly exceeds the amount of degrees awarded in the states without industry, while before 1990 there were still more degrees awarded in the states without industry. This could be attributed to the establishment of the industry in those states, and at the same time this could indicate that the automotive industry has contributed to domestic knowledge or skill accumulation.
Bachelor (public)
When comparing Bachelor degrees awarded in public education to the overall picture it can be noted that relatively more public degrees have been awarded and are expected to be awarded in states without the industry. This could be an indication that public education needs to a greater extent a boost in the states with the industry if a more equal spatial distribution of bachelor education is to take place.

Postgraduate (public)
The amount of Postgraduate degrees awarded in public education can leave one to think that there will be less increase in states with industry. This could indicate more investment is needed in public education in the states with industry to accommodate to a greater extent the knowledge requirements in the industry.
Professional Technical (public)
The most dramatic drop has taken place and has been forecasted in Professional Technical degrees awarded in public educational institutions. Specifically in states with the industry investments would be advisable to sustain contributions to domestic skill accumulation through the industry.

Bachelor (particular)
As might be expected the amount of privately educated Bachelors awarded is, as opposed to public Bachelor’s awarded, expected to increase more in states with the industry. However, the 5 year moving average of the annual variation for the states without industry was severe in recent years. Again it might be advisable to invest in public education in the states without industry to attempt finding a more balanced knowledge/skill accumulation spread.

Postgraduate (particular)
Judging by the Postgraduate degrees awarded in particular education, perhaps there should be investment in reducing particular education in states without the industry to stimulate equal knowledge distribution. Especially in the Postgraduate, as opposed to the amount of Bachelor degrees awarded, the prognosis shows a more radical divergence. Much more Postgraduate public degrees are expected to be awarded in the states without the industry. When looking at private degrees this is expected to remain similar in the future.

Professional Technical (particular)
As the decline in Professional Technical degrees awarded is the least within particular education it may be advisable to invest in more opportunities within public education for obtaining a PT degree. One could argue that especially when the goal would be to obtain domestic knowledge accumulation through the automotive, Professional Technical degrees would appear a sound basis for such processes to be taking place. On the other hand, as mentioned earlier, the fact that more degrees have and are expected to be awarded in the states with the industry could again indicate that the automotive industry is an incentive for knowledge accumulation.

![Graph 13]
8.2.2 Education in relation to the automotive industry and MFE

When considering skills in the Mexican labor force, Romero (2011) finds that entrepreneurs in Mexico cannot find the necessary skills under the Mexican skilled labor force, mainly engineers, in the automotive industry. Supposedly there is a mismatch in the origin of the industry, namely the export market focus of the industry. Where the knowledge level in Mexico of these skilled laborers would yield a certain wage abroad, this skill-wage ratio would be lower in Mexico. The main issue to this extent appears to be that foreign companies are looking for very specific skills and simultaneously don’t want to pay the value of that knowledge that it would have in their domestic economy.

With regards to education specified annual data is available at SNIEE per state, per field of study, national level and annual, including prognosis. Annual export and import data is once again available at INEGI on a national level. Therefore an attempt is made to look at an indication of the relationship between types of education and the extent to which this is related to MFE in 3841 and technology transfers and royalties in 3841 between 1994 and 2004.

![Annual Variations Degrees Awarded](image)

**Graph 14**

*Income from transfers of technology and royalties (thousands of pesos at current prices)*

In the light of the impact of education on growth within the industry as a whole it could perhaps be useful to look at two variables and the way these relate to education, one relating to income from the automotive and one to income from the maquiladora for export industry. When it comes to data collected on income from transfers of technology and royalties all four the fields of education seem to be quite closely correlated to the 3841 (total) category. Scatter 2 below depicts the closest correlation between Technical Professional degrees awarded and income of technology and royalties.
However, the most absent relationship within the subcategories of 3841 can be found in 384122 “parts for car and truck motors”. The fact that this field is highlighted in the results could be an indication that there is a certain absence of knowledge accumulation taking place through education in the industry. This observation appears to be striking when compared to Graph 4 in paragraph 8.2 where a large amount of the income from sales is attributed to category 384122, and at the same time the amount of employees is falling more rapidly between 1994 and 2008 than in the other two major employment categories (384110 and 384126) as can be seen in Graph 1. This raises the question if revenues are not to an increasing extent gained from unskilled labor. The lowest correlation can be found between Bachelor degrees awarded (scatter 3).
Education is correlated to income from maquila services for the same period in the industry to a greater extent in general. This is an interesting observation as one might expect that the maquila industry usually demands a lower education than is demanded from technology transfer. In the case of income from maquila in 3841 there is only annual data available for the 3841 category and not the subcategories. However, it can be noted in any case that the correlations here with education are in any case higher than with the income from transfer of technology.

As the value of sales (see 8.1.2) has gone up the most in 384110 and 384122 between 1994 and 2008, the above results could indicate why this has been the case. When next relating these results to education it appears to be so that education has a strong relationship with the development, although 384110 appears to have been relevant for skill transfer, apparently this has not taken place specifically in the 384122 segment although the value of sales have increased rapidly in both segments. Altogether the results could indicate that value increase primarily comes from unskilled labor, which could create a negative effect on long-term skill development. Coming back to the variable employment it might be advisable to compare workers and other employees in the other industry in these specific segments, as data is available for the same timeframe.
Graph 15 and 16 indicate that the 5 month moving average of the annual variation of total employees occupied has become more stable aligned. This could be an indication that the 384122 segment is stabilizing employment while at the same time increasing the value of sales. When looking at workers the stabilization becomes clearer than with other employees. This could indicate that the most knowledge creation is found within the worker segment, and could also indicate that knowledge creation is lacking in the other employees segment. At the same time the employees segment shows a more volatile development in general, which could also support the latter observation.
When looking at the average manufacturing production output in states with the automotive industry in relation to education (degrees awarded) the highest correlation and r^2 is found in the segment where degrees are awarded in states with automotive industry and in manufacturing production output in states with automotive industry. This could be an indication that in states where the industry is located manufacturing and education positively affect knowledge creation. This can be assumed as manufacturing output is increasing faster in states with the automotive industry.
Here the highest correlation and $r^2$ is found in degrees awarded in states with the automotive industry and in manufacturing production output in states without automotive industry. This could indicate, when looking at the previous correlation that stands out, that the effect of education in the states without industry is more closely related to the production manufacturing output in states without the automotive industry. On the other hand, since the correlation is higher in the states with manufacturing output and the automotive industry this could indicate that states with the automotive industry have a greater effect on education development in general.
The highest correlation and $r^2$ is in states without automotive industry with total higher education degrees awarded and states without automotive industry with average added value of exportation covered by maquila for export service (real). This could indicate that maquila for export industry has a negative effect on education or degrees awarded development. On the other hand this could indicate that the automotive industry is contributing to skill accumulation. In addition, with this correlation being the highest in both the maquila segment and the manufacturing segment, this could indicate that the economic focus is to greatly directed at export industry, where knowledge flows out of the domestic economy. Support for this assumption is given by the fact that the highest correlation in general is found here, while all the correlations that fall slightly below this are all from comparisons where degrees awarded in states with automotive industry where a variable.
8.3 Dependency and Structural Change

8.3.1 Dependency

It can be argued that dependency, although often in the literature refuted, is relevant when it comes to spatial analyses, regional advantages and proximity of labor and to markets. Capital can in the present day economy be expected to flow anywhere in the world without major obstacles (Piketty 2014). When it comes to labor this is however to a much a lesser extent the case. A good example is Mexican laborers that want to enter to the United States for work, but are not allowed into the country. Labor mobility in the domestic economy can therefore, within the light of domestic skill accumulation, be viewed as an essential criterion for successful and sustained economic development over space.

Arguably a more equal spatial distribution of labor can in turn result in a reversal of this activity and simultaneously more balanced economic and industrial process (Pogge 2010). Regarding the impact of trade liberalization and economic integration on regional growth and disparity Rodríguez-Pose and Sánchez-Reaza (2003) argue that the shift from the import substitution system to free trade has caused regional divergence, a reduction of the importance of Mexico City as the main market and the emergence of a system where the endowment of skilled labor becomes more important. Therefore an analysis will be made of labor mobility in this section, where the extent of the number of employed over time and labor mobility over space on two points in time per state can give an indication.

From a geographical/spatial perspective 32 states, from which one (Distrito Federal) is officially not a state but approached in the analysis as being such, can be found within the domestic borders (INEGI 2010). Within this analysis these states have been subdivided in four different spatial areas, encompassing differencing contributions per state to the competitiveness of the economy. The data set that is available for this analysis includes 18 states, also shown in the appendix under 8.4.2.
Number of MFE employed over time per state

Once more the states that have been included in this analysis (on the basis of availability of data) can be found in the appendix under 8.4.2 Average added value of exportation covered by MFE service (real). The measurements are available in 8.5.1 in the appendix. When looking at the northern states the automotive industry can be found in all states that border the USA except the state Tamaulipas. Here the states of Baja California, Sonora, Chihuahua, Coahuila de Zaragoza and Nuevo Leon respectively count two, three, one, six and two OEM establishments. The most notable findings have been highlighted below.

Overall the five Border States with the industry and the one state without the industry have a high total, which indicates that there are relatively similar amounts of people employed in the sector when compared to the states in the center. They are slightly lower in Coahuila, where the most OEM establishments can be found (6). The highest total is in Baja California.

The averages are in general also the highest in the northern states, between 0.6 and 0.7. The totals and averages in Tamaulipas are relatively similar to those in the rest of the northern Border States with the industry.

Furthermore an interesting comparison might be to look at labor mobility in the states that are between the states with the industry in the north and the center of the country such as Baja California Sur, Sinaloa, Durango, Zacatecas and Tamaulipas.

The state of Baja California Sur stays relatively similar to the Border States with the industry; here the totals and averages are slightly lower but staying between 0.6 and 0.7. Durango has a lower total (7.8) and average (0.46) on the other hand. As the state is landlocked by five states there could be a relationship with the fact that there have been less similar amounts of people employed. The total and average in Sinaloa and Zacatecas on the other hand is in a different category. The total is very low and the averages are getting close to zero. This
indicates there is a radical change in the amount of people employed in the sector. In the case of Zacatecas this could be related to the automotive industry as the state connects to Coahuila, Nuevo León, San Luis Potosí, Jalisco and especially Guanajuato and Aguascalientes with 9 and 8 OEM establishments. On the other hand the high difference between Durango and Sinaloa could indicate an effect that has no relationship with the automotive industry.

When next moving toward the south San Luis Potosí, with two establishments, connects the states in the center of the country where the states Aguascalientes, Jalisco and Guanajuato have eight, one and nine OEM establishments.

In general the number of people employed in the sector over time is a lot more similar in the northern states than in the three center states with the industry. The averages fall between 0.2 and 0.51 and this indicates a much lower change in employment. As the highest change can be found in Jalisco with 0.51 with only one OEM establishment this could again indicate a relationship between the amounts of people employed in the MFE and the automotive industry. The lowest average change is however in San Luis Potosí where 0.2 is the average. Aguascalientes with 0.39 and Guanajuato with 0.32 also have a high change in employment which could relate to the industry but with eight and nine OEM establishments versus two in San Luis Potosí there can also be another factor playing a part.

In the states further towards the south-east of Guanajuato the State of Mexico, Morelos and Puebla have six, four and eight OEM establishments. Data on MFE employment is unavailable for the state of Morelos.

When looking at The State of Mexico and Puebla the averages are relatively low when compared to other states. In Puebla it falls just below 0.5 at 0.49, which indicates a change in the number of people employed. The State of Mexico has a one of the lowest averages, indicating a radical change in the amount of people employed. When comparing this with Distrito Federal where there is no automotive industry, an even lower average is measured. As Puebla and The State of Mexico both have a relatively large amount of OEM establishments and higher averages this could be an indication that there are less people in unskilled manufacturing than in more skilled labor in the automotive industry. This is however an assumption, as there could also be more people employed. When relating it however to the results from the states in the north, this would seem presumable.

Yucatan is geographically very far from the rest of the states in this analysis. It can however be noted that the totals and averages are rather similar to those in the northern states. This could in turn indicate the northern states are to a greater extent isolated when it comes to unskilled labor, and that more skills and knowledge are being accumulated in the center states. One thing that has become certain from this analysis is that there are more dynamics in the center and center-south states, overall especially in those with the automotive industry. This could be support for domestic skill accumulation in those areas to a greater extent as opposed to the Border States.
**MFE employment dispersion over space**

For this analysis all the states have been plotted in a linear regression to show the change in the dispersion of MFE employment between 1999 and 2006 in states with and without the automotive industry in a logarithmic scale representing the amount of employees. Baja California Sur is left out of this analysis as there is no data available after 2002. The markers with red filling indicate the states without the automotive industry. The markers for the states with the automotive industry have the amount of OEM establishments indicated in brackets behind the name of the state.

The primary observation that stands out is the cluster with the Border States that all show a positive or stable dispersion of employment in MFE. Another finding is that the states with a lot of OEM establishments towards the center of the country experience a negative dispersion in employment. Especially the State of Mexico with OEM industry and Distrito Federal without OEM industry, two bordering states basically connecting the capital city of the country, show this negative dispersion. This could be an indication that the automotive industry is in fact extracting MFE employees from the center of the country as opposed to the north. The vast positive development in Sinaloa remains unexplainable in this analysis. However, judging by the graph there could be a relationship with MFE employment in Distrito Federal and Sinaloa. It is however not possible to confirm this in this case.

Although a direct relationship cannot be depicted here, the number of OEMs in the center states appears to be related to a decrease in MFE labor. This aligns to a large extent with the observations that were made above. It must however be remembered that the Border States are by origin to a larger extent aimed at the exportation of goods and services. With this in mind, in addition the theoretical framework by Krugman (1995) about the creation of an industrial base in Mexico City under the principles of import substitution appears to be confirmed to some extent in this case. Simultaneously the regional divergence argument posed by Rodríguez-Pose and Sánchez-Reaza (2003) might be derived from this.
8.3.2 Potential for innovation

Ruiz (2008) distributes the different sectors the economy into four categories for the Mexican geographic economy of innovation. The map of Mexico with the different states is indicated below (Figure 4), succeeded by the subdivision of the states for the spatial analysis that will be made (Figure 5):

When it comes to agglomeration effects in urban development some interesting clues have been provided according to Krugman (1995) regarding the nature of spillovers. This can be viewed within the self-organization of economic activity, otherwise formulated as the way in which economic structures emerge from unplanned interactions of economic agents. To that extent dependency arguably plays a part when posing the question whether external economies are truly technological or if they emerge from market size effects. He finds that self-organization applies to technology, growth and geography both over time and space. Krugman and Venables (1996) argue that the location of two industries in two countries benefit from trade, where economic integration induces agglomeration. The possible long run gains from integration after lower trade barriers have been introduced in a country include an adjustment process that can force wages down as relocation occurs. This could in turn influence the job creation in Mexico in relation to skills in the domestic labor force.

It becomes clear through the distinction that Ruiz (2008) makes that the automotive sector is in the medium-high technological classification, in part contributing to 40.4 percentage points of GDP. It can therefore be argued that a challenge for the industry is to move up the technological ladder, creating a better competitive advantage. As mentioned, a link towards another industry in the high technology classification can presumably be found with the aerospace industry. If the automotive industry would be able to intensify this connection perhaps a more competitive position could be apprehended. Ruiz argues that the challenge for transforming the national economy is to move from a cost paradigm to an innovation paradigm.

From the analysis made by Ruiz, the following subdivision has been made per state based on the potential the separate states have for innovation (figure 1.4). Herein he distinguishes three indicators that show this potential:

1. Building productive capacities (CCP): here the variable is considered that reflects performance in the technological profile of capital accumulation per state based on the percentage of added value of medium-high and high technological sectors.

2. State contribution to the advancement of innovative inputs (CEDIN): here higher education institutions, national researchers, disbursements from funds by Conacyt (2002-2008) and patent accumulation (1996-2007) are the considered variables per state.

3. The creation of innovative networks (RI): here the weight of foreign investment in the formation of global value added networks, for which foreign investment flows were classified by type of technology, targeted to areas of high and medium-high technology were selected and weighted by relative strength representing the national scale (2004-2008).
4. At the same time businesses that are registered at Reniecyt and therefore part of the national network of institutions, businesses, scientific research, technological development, innovation and the formation of highly skilled human capital in the country are considered.

<table>
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<tr>
<th>Entidad</th>
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<th>2) Contribución del Estado a la creación de imunnos innovadores</th>
<th>3) Redes innovativas</th>
<th>Índice potencial de innovación en escala estatal</th>
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Figure 10 (from Ruiz 2008)
With the classification of these four different groups an analysis will be made of the spatial development of the different regions in the automotive industry, simultaneously in relation the maquiladora for export figures. The development of the four categories will be depicted by the available data over time and thus space, subdivided in these four categories. From this analysis an attempt can possibly be made to emphasize critical success factors in the future that can help the promotion of innovation in a region and where extra attention is needed in order for sustained economic/industrial development or growth on long term.

8.3.3 The process of Structural Change

In this concluding paragraph of Chapter 8 an attempt is made to make an analysis of the process of structural change that has been taking place between 2000 and 2015 when looking at employment. This period might be relevant to conclude with in order to be able to simultaneously assess recent assess. Therefore data is used regarding the amount of permanent or temporary workers insured by the Mexican Social Security Institute per economic activity. The choice for this data has been made because a clear distinction can be made between the three phases of the industrial process that Kuznets (1973) describes as agriculture, industry and services. The distinction of economic activity sectors can be viewed in 8.3.3 in the appendix. By finally relating this to the geographic number of employed per state and relating that to the potential for innovativeness in 8.3.2 the analysis will be complete. The results can give an indication of the extent to which dependency forms of economic development and structural change have taken place over time and space.
**Structural Change**
When primarily looking at the three graphs, the services employment development is mostly steady increasing as opposed to the agriculture and industry sectors. In graph 17 and 18 clear decreases in employment can be observed in 2004 and 2008. The 2008 decrease might be explained by the economic crisis in that year. However, as can be seen in graph 19 there is only a slight decrease occurring in 2009/2010. This means the service industry was possibly only later affected, only at one point in time and less severely by the crisis. At the same time the stabilization and increase in graph 17 and 18 after 2008 could be an indication that there is no ideal progression of structural transformation taking place and that there is an increasing dependency towards developed economies and at the same time no decrease in environmental degradation (Kuznets 1973). Figure 12 depicts in which manner employment development in the Japanese automotive industry has taken place between 1990 and 2000, what could theoretically be aligned with the Mexican automotive industry between 2020 and 2030. This could be an indication that a sharp decline might expected from 2024 in Mexico. The question remains what this means for the rest of the industrial sector, as the share of agriculture and services.

![Graph 17](image-url)
When comparing employment in the automotive industry in Japan between 1990 and 2001 in figure 12 and the industrial sector as a whole in Mexico between 2000 and 2014 in graph 18, 30 years deducted in Mexico since trade liberalization would result in the same period in Japan between 1970 and 1984. With a six year time lag this could be an indication for industrial employment development in Mexico from 1990 in figure 12 on Japan depicted above. Of course there is a difficulty in the comparison as graph 18 depicts the industrial sector as a whole and figure 12 only depicts the automotive industry.
**Employed and potential for innovation per state**

In this final paragraph a correlation has been drawn between the average permanent or temporary workers insured by the Mexican Social Security Institute in all economic activities between 2000 and 2015 and potential for innovation (Ruiz 2008).

As Distrito Federal and the State of Mexico are both outliers from the trend and both have a high potential for innovation the hypothesis once more points to a lesser extent to a concealed industrialization process. Simultaneously this confirms once more Krugman (1995) about the creation of an industrial base. This partially opposes 8.6.1 where in the light of Kuznets’s
ideal model for structural transformation the economy seems to be pointing more towards a position of dependency. With reference to the automotive industry, all the outlying states from the trend have the automotive industry, with exception of Distrito Federal that is however right beside the State of Mexico. Hereby only the labeled markers have been included in this analysis. This could be an indication that the automotive industry is creating more dynamics in terms of employment in the states where it is active. Therefore, the territorial effect of ISI can supposedly be related to Figure 6 above.

9. Ethical considerations
Anonymity will be pledged to all participants or collaborators when desired during this study. Subjects will be protected in case of any kind of conflicts arising from this study. Subjects can rely on the study being of good quality, and therefore at that it at the same time will not be inconvenient in its outcome when compared to desired efforts from the subjects.

10. Concluding remarks
In this paper an attempt has been made to analyze the quality industrialization process and competitiveness of the Mexican economy over time and space through important variables that all directly or indirectly relate to human capital. Through mainly employment and education data on the automotive, maquiladora for export and domestic industry data an attempt has been made to critically assess the extent to which skill accumulation has been taking place on a national and state level. With relation to the assessment of the industrialization process as a whole on a macro level an attempt has been made to place the automotive industry in a broader perspective and determine whether the Mexican economy is and has been heading to a greater extent towards a position of dependency or a more sustained growth process in the domestic economy.

To elaborate on the results that have been encountered in this paper all the separate points mentioned in Chapter 6 and related findings in Chapter 8 will be addressed through summarizing the most essential findings in the following paragraphs. Subsequently an encompassing and adequate final conclusion will be drawn. As mentioned several relevant indications have been attempted to derive from the following information:

A certain trend might be that moving away from the assumption of constant returns to scale, towards the use of protectionist measures builds up an industrial base in certain industries allowing those sectors to dominate the world market (Krugman 1995, Krugman & Venables 1997). According to Rodríguez-Pose and Sánchez-Reaza (2003) factors that impinge on trade can evolve around dynamic trade models emphasizing the importance of spillovers. At the same time they argue that there is a discussion about the spatial distribution of the benefits of trade and economic integration. Some authors (Wood 1994) have argued that factor mobility may also yield a reduction in territorial disparities.

10.1 Summary
CAGRs in the automotive industry are pointing to a greater extent towards light vehicle production, incentivized by OEM foreign investment. Hereby the market is to a great extent driven by foreign demand. The domestic market is not living up to its greater potential due to most notably the large informal economic circuit and in a decreasing scale the amount of imported vehicles.
When looking at employment findings could indicate that the assembly or MFE industry is moving from assembly to being incorporated in the domestic industry. Whether this is beneficial for domestic skill accumulation remains unclear. When comparing Mexico with Japan a general decrease in employment can be noted from what would be 2020 in Mexico. The fact that a similar growth pattern in employment can be noted for approximately the same period might be support for a cyclical pattern. Within that assumption domestic sales might start increasing from 2030 and exports might start decreasing in 2030.

Wages in the automotive industry in Mexico are relatively low when compared to other industries and the level of sophistication according to the OECD industrial classification. The 2008 crisis seems to have created a diverging trend, causing wages in less sophisticated industries to rise faster. This could be an indication for a decrease in domestic skill accumulation. In Japan wages started increasing vastly in the industry around 1994, what could be 2024 in Mexico. The current wage levels in Mexico could indicate that intensified research and knowledge creation is required in the domestic automotive industry, as wages are correlated towards a low level of the OECD industrial classification.

Manufacturing production per state indicates that output in states with the automotive industry is more volatile. It might be the case that the automotive industry in Mexico might start experiencing a vast decrease in output from 2022 when compared to the Japanese experience. Average added value of exportation by maquila for export service notes a vaster increase in states with the automotive industry what could indicate, as with the manufacturing output per state, could indicate that less skill accumulation is taking place due to the automotive industry and more concealed economic development is taking place. When comparing the Mexican experience to capital-labor ratios in the Japanese experience between 1985 and 2000 as a proxy for skill accumulation on the other hand it might be questioned if the same amount of skill accumulation might be taking place in Mexico between 2015 and 2030, as a great divergence appears to be taking place when it comes down to assembly industry and more refined parts of the industry.

Population growth has been greater in states with the automotive industry, whilst at the same time the prognosis on growth in degrees awarded has been greater in states without the automotive industry. Professional Technical education appears however more intensified in states with the industry. The much greater gap here than between Postgraduate or Bachelor degrees awarded might be an indication that the automotive industry is incentivizing technical education or does not incentivize Bachelor or Postgraduate degrees. Public degrees awarded mainly point at more degrees awarded in states without the automotive industry. The largest gap can be found in the highest degree analyzed, postgraduate. Private education again can note the greatest gap in Professional Technical education, where the states with the industry award more degrees. This could again point at less skill accumulation due to the automotive industry.

Education in relation to the automotive industry indicates a certain absence of skill accumulation through education in the industry. The observation that the most absent relation is found where the highest value of sales is created could be further support for this assumption. Education in relation to income from MFE in the industry could cause one to draw the same conclusion. Skill accumulation appears to have taken place to the least extent in the industry segment where the most sales have been made. This can simultaneously be related to employment under workers and other employees.
Education, manufacturing output in states and MFE where the industry is located manufacturing and education positively affect skill accumulation, as manufacturing output is increasing faster in these states. This conclusion can be drawn due to the closeness of the relationships between the variables. However, when looking at the overall picture the automotive industry might have a positive effect on education development in general, this might not be concluded when looking at more specialized or sophisticated forms of education.

The automotive industry appears to have a connecting role between economic activity in the north, central northern and central southern states of Mexico. More OEMs usually aligns with more economic employment development. On the other hand the central southern states appear to create a more diversified form of sustainable employment development over time. From a geographical perspective, factor mobility appears to be developing more diversified from the center of the country and more concealed when moving further towards the Border States in the north. Employment dispersion dynamics are greater in the central-southern states, which could be indicating a greater potential for innovation and at the same time the regional divergence that Rodríguez-Pose and Sánchez-Reaza (2003) argue for, supposedly created by the industrial base that Krugman (1995) mentions.

As the services industry is only affected slightly by the crisis, and the stabilization and increase of agriculture and industry after 2008 might be an indication that there is no ideal process of structural transformation taking place. This observation could at the same time indicate and increasing dependency towards developed economies and environmental degredation (Kuznets 1973).

When finally looking once more at the Japanese experience in terms of dependency and structural change, a decline in employment in the industry might be expected from 2024 in Mexico. However, when looking at the Japanese comparisons in general, it must be questioned if the Japanese country example will actually be the case for Mexico. After all the export oriented assembly industry poses on the one hand an opportunity for the Mexican economy but on the other hand a threat. Concealing production creates labor and capital, but can degrade economic prosperity when not taking its effects into account.

10.2 Conclusions
The automotive industry in Mexico has in certain cases contributed to the creation of skill accumulation and intensified cross-sectorial dynamics. The Border States in Mexico appear to have a more negative effect on knowledge creation, economic dynamics and diversification than the central states with the automotive industry. Regional divergence appears to be caused by industries that focus on foreign investment aimed at the benefits of less costly labor across borders. On the other hand this divergence could have been caused by the industrial base that has been built up in the era of ISI in the central geographical location of the domestic economy, Mexico City and The State of Mexico. An argument against this hypothesis might however be the findings that have been done in the education paradox. The level of education appears to have a negative effect on sustained domestic growth, due to the overall picture that has been discovered with respects to dependency and structural change. A clear relationship between the northern, mainly assembly oriented industry and dependent forms of economic development over both time and space.
In nearly all cases regional divergence has shown similar patterns in this study. The comparison with Japan and the analysis of the different variables in this paper leaves one to believe that now is the time to invest in education for long-term stability and less volatility in growth rates, although it must of course mentioned that the strong focus on education in this study can give a distorted view and leave other important factors in the background. However, policies aimed at the incorporation of labor and the creation of awareness amongst the labor force pushing more social and equal reforms in opportunities for education amongst the different social layers of the population would be a good start. Long-term growth comes from a long-term economic strategy for the foundation of an economy, which has been oriented to a great extent upon prosperity of that what can be found across borders but neglecting what can be found in the basis of own competency and the ability stop and think what truly is in and can be built with the hands of the people of Mexico.
References


Kuznets, Simon (1966), Modern Economic Growth, New Haven, CT: Yale University Press


**Definitions**

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMIA</td>
<td>Asociació mexicana de la industria automotriz (The Mexican association for the automotive industry)</td>
</tr>
<tr>
<td>CAGR</td>
<td>Compound Annual Growth Rate</td>
</tr>
<tr>
<td>Conacyt</td>
<td>Consejo Nacional de Ciencia y Tecnología (the National Council of Science and Technology)</td>
</tr>
<tr>
<td>INEGI</td>
<td>Instituto Nacional de Estadística y Geografía (National Institute of Statistics and Geography)</td>
</tr>
<tr>
<td>ISI</td>
<td>Import Substitution Industrialization</td>
</tr>
<tr>
<td>Maquiladoras</td>
<td>A manufacturing operation in a free trade zone, where material and equipment are imported for assembly destined for export</td>
</tr>
<tr>
<td>Reniecyt</td>
<td>(National Registry of Institutions and Businesses in Science and Technology)</td>
</tr>
</tbody>
</table>
Appendix

8.1.2

INEGI Classification 3841 Automotive Industry

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>384110</td>
<td>cars and trucks</td>
</tr>
<tr>
<td>384121</td>
<td>bodywork and trailers</td>
</tr>
<tr>
<td>384122</td>
<td>parts for car and truck motors</td>
</tr>
<tr>
<td>384123</td>
<td>parts for car and truck transmission system</td>
</tr>
<tr>
<td>384124</td>
<td>parts for car and truck suspension</td>
</tr>
<tr>
<td>384125</td>
<td>parts and accessories for cars and trucks for the breaking system</td>
</tr>
<tr>
<td>384126</td>
<td>other parts for cars and trucks</td>
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</table>

Table 1

INEGI Classification 336 Transport Equipment

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
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<tr>
<td>336110</td>
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</tr>
<tr>
<td>336120</td>
<td>trucks and tractors</td>
</tr>
<tr>
<td>336210</td>
<td>bodywork and trailers</td>
</tr>
<tr>
<td>336310</td>
<td>gasoline engines and parts for motor vehicles</td>
</tr>
<tr>
<td>336320</td>
<td>electrical and electronic equipment and parts for motor vehicles</td>
</tr>
<tr>
<td>336330</td>
<td>parts of steering and suspension systems for automotive vehicles</td>
</tr>
<tr>
<td>336340</td>
<td>brake systems for automotive vehicles</td>
</tr>
<tr>
<td>336350</td>
<td>transmission systems for motor vehicles</td>
</tr>
<tr>
<td>336360</td>
<td>seats and interior accessories for motor vehicles</td>
</tr>
<tr>
<td>336370</td>
<td>metal stampings for automotive vehicles</td>
</tr>
<tr>
<td>336390</td>
<td>other parts for automotive vehicles</td>
</tr>
<tr>
<td>336410</td>
<td>aerospace equipment</td>
</tr>
</tbody>
</table>

Table 2 *3365 (fabrication of railway equipment) and 3366 (fabrication of boats) are left out in the analysis due to a lack of coherence with the 3841 classification. 336410 (aerospace equipment) is added for further investigation on technologically refinedness and skill relatedness of the industry, however specifically referred to when included in an analysis.
Graph 1 (green line plotted on secondary axis)

Graph 2 (green on secondary axis)
8.1.3

INEGI industry categories and how they have been placed in the OECD industrial classification 1/2/3/4, in Ruiz (2008)

| 1 | 311 Food Industry |
|   | 312 Beverage industry and snuff |
|   | 313 Manufacture of textile inputs and finishing of textiles |
|   | 314 Manufacture of textiles, except apparel |
|   | 315 Manufacture of wearing apparel |
|   | 316 Tanning and dressing of leather and leather products and manufacture of leather and leather substitute materials |
|   | 321 Timber industry |
|   | 322 Paper Industry |
|   | 323 Printing and related industries |
| 2 | 324 Manufacture of products of petroleum and coal |
|   | 326 Industry Plastic and rubber |
|   | 327 Product Manufacturing of nonmetallic minerals |
|   | 331 Basic metal industries |
|   | 332 Fabricated metal products |
|   | 337 Manufacture of furniture, mattresses and blinds |
| 3 | 325 Chemical industry |
|   | 333 Manufacture of machinery and equipment |
|   | 336 Manufacture of transport equipment |
|   | 334 Manufacture of computer, communication, measurement and other equipment, electronic components and accessories |
| 4 | 335 Manufacture of accessories, electrical appliances and equipment electricity generation |

Table 3
Scatter 1, Correlation: 0.698203

Scatter 2, Correlation: 0.876196
8.1.4

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<th>Average Production Manufacturing Output</th>
<th>Average added value of exportation covered by MFE service (real)</th>
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<tbody>
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<td>States without industry</td>
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</tr>
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<td>Baja California</td>
<td>Durango</td>
</tr>
<tr>
<td>Coahuila de Zaragoza</td>
<td>Querétaro</td>
</tr>
<tr>
<td>Jalisco</td>
<td>Tlaxcala</td>
</tr>
<tr>
<td>México</td>
<td>Veracruz de Ignacio de la Llave</td>
</tr>
<tr>
<td>Morelos</td>
<td>Yucatán</td>
</tr>
<tr>
<td>Nuevo León</td>
<td>México</td>
</tr>
<tr>
<td>Puebla</td>
<td>Nuevo León</td>
</tr>
<tr>
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</tr>
<tr>
<td>Sonora</td>
<td>Sonora</td>
</tr>
</tbody>
</table>

Table 4
8.2.1

Degrees Awarded in Mexico

Graph 6 (green line plotted on secondary axis)

BA states with and without automotive industry

Graph 7
Graph 8

PG states with and without automotive industry

Graph 9

BA (public) states with and without automotive industry
Graph 10

PT (public) states with and without automotive industry

Graph 11

BA (particular) states with and without automotive industry
Graph 12

BA and income from transfers of technology and royalties 3841 1994-2004

Scatter 4, Correlation: -0.38769
PG and income from transfers of technology and royalties 3841 1994-2004

Scatter 5, Correlation: -0.37842

PG and income from transfers of technology and royalties 384122 1994-2004

Scatter 6, Correlation: 0.065993
TP and income from transfers of technology and royalties 384122 1994-2004

Scatter 7, Correlation: -0.25382

BA degrees and income maquila by 3841 1994-2004

Scatter 8, Correlation: 0.6224
PG degrees and income maquila by 3841 1994-2004

Scatter 9, Correlation: 0.60571

Total employees 3841 av 5m ma

Graph 13
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<th>Data span</th>
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<th>Jalisco(1)</th>
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<th>México(6)</th>
<th>Nuevo León(2)</th>
<th>Puebla(8)</th>
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**Total**

Data span: 96-07

State: Aguascalientes(8)
Baja California(1)
Baja CaliforniaSur
Coahuila de Zaragoza(6)
Chihuahua(1)
Durango

Average: 0,2636688

**Total**

Data span: 96-07

State: Guanajuato(9)
Jalisco(1)
Distrito Federal
México(6)
Nuevo León(2)
Puebla(8)

Average: 0,2636688
### Table 5

<table>
<thead>
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<th>Tamaulipas</th>
<th>Yucatán</th>
<th>Zacatecas</th>
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<td>Aguascalientes(8)</td>
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### Table 6

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<td>1</td>
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</tr>
<tr>
<td>2</td>
<td>Mining and quarrying</td>
</tr>
<tr>
<td>2</td>
<td>Processing industries</td>
</tr>
<tr>
<td>2</td>
<td>Construction</td>
</tr>
<tr>
<td>2</td>
<td>Power industry and water supply</td>
</tr>
<tr>
<td>3</td>
<td>Trade</td>
</tr>
<tr>
<td>3</td>
<td>Transport and communications</td>
</tr>
<tr>
<td>3</td>
<td>Services for businesses, individuals and homes</td>
</tr>
<tr>
<td>3</td>
<td>Social and community services</td>
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</tbody>
</table>

8.3.3
Graph 14

Graph 15
Services

Graph 18