UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO

Posgrado de Economía

Facultad de Economía

Distribution of the Gross Fixed Investment and the Employment in Mexico

T E S I S

QUE PARA OPTAR POR EL GRADO DE

MAESTRO EN ECONOMÍA

P R E S E N T A

Brenda Murillo Villanueva

TUTOR: D. Pablo Ruiz Nápoles

Facultad de Economía

MÉXICO, D.F., ENERO 2015

To Daniel

ACKNOWLEDGEMENTS

This thesis becomes a reality with the kind support and help of many individuals and institutions. I would like to extend my sincere thanks to all of them.

I would like to express my gratitude towards my **family** for always being by my side and for their encouragement in every day of my life.

I am highly indebted to my tutor **Professor Pablo Ruiz Nápoles** for all his support in the realization of this thesis and to the **Universidad Nacional Autónoma de México** for all the possibilities that it offers to its students.

I would like to express my special gratitude and thanks to **Professor Heinz D. Kurz** and to the **Graz Schumpeter Centre** for their help, assistance, hospitality and kindness provided during my research stay in the University of Graz.

And finally, thanks to **CONACYT** for sponsoring my studies.

CONTENTS

INTRODUCTION

Over the last three decades Mexico has experienced several episodes of economic expansion and contraction; but on the whole, it has showed a declining trend in terms of Gross Domestic Product (GDP) growth. For instance, GDP grew from 1980 to 2013 at an annual average rate of 2.59% (INEGI, 2014). Some of the main explanations to this extremely low rate of growth of GDP refer to the low rates of investment, and particularly of capital investment, to the misleading role of the trade liberalization and the correlation between the US and Mexico's business cycles (see Loría, 2009; Loría et al., 2011 and Ros, 2008). However, we believe that capital investment develops an important role on enabling economic growth; from 1980 to 2013 we observe that the annual average rate of growth of Gross Fixed Investment (GFI) was of 3.19%. (INEGI, 2014).

One of the main and most worrying consequences of the low rates of growth of GFI and GDP is the incapability of the Mexican economy to generate new jobs; the growth rates of GFI and GDP of the last decades are not translated into significant rates of growth of employment, from 1980 to 2011, the level of employment grew at an annual average rate of growth of 1.17% (INEGI, 2014).

It also needs to be considered that the low capital investment and GDP are not the only factors that generate pressures in the labour market, also socio-demographic factors, such as the growth of population and the demographic transition generate additional pressures in the job generation. The very low growth rates of employment can lead to other problems such as the diminution of wages, the loss in the country's competitiveness and the degradation of human capital, that is the reason why the problem of low job generation needs to be studied.

The role of capital investment on job generation is of great importance, capital investment refers to the part of the economy that is related to the productive capacity and to the means of production; the idea is that whenever capital investment increases, the production possibilities increase and thus, to cope with higher levels of production, additional labour would be needed. Nevertheless, differences among industries and production processes, have led to discrepancies in the capacity to generate new jobs. The effect of additional capital investment on employment in a modern industry is not the same as in a traditional industry; and factors such as the gain of skills, labour specialization, the constant competition between labour and machinery, the effect of employment on income and the multiplier effects, act differently among industries, and thus the power of labour absorption and generation tends to be different among industries.

Therefore, the aim of this research is to identify those sectors of the Mexican economy in which additional capital investment leads to significant increases in the level of employment. For this purpose the Input-Output analysis, which allows visualizing the productive structure of the Mexican economy disaggregated in, as many industries as wished, would be utilized. This study seeks to know the impact that GFI has upon the ability of the economy to generate new jobs. In order to identify those sectors that positively contribute to the level of employment, several methods of the Input-Output analysis are applied, and factors like the power of labour absorption, the employment multipliers and the degree of interconnectedness, are key aspects that need to be considered in order to decide if a sector can significantly contribute to the level of employment or not.

This research is divided in three chapters. In the first chapter, both the classical and Keynesian schools of economic thought were revisited in order to understand the theoretical importance that GFI has on employment, it also considers the effects of GFI on employment in the short and long runs and finally we discuss the role of human capital, institutions and the choice of technique in the process of capital accumulation and on employment.

In the second chapter a general overview about the performance in time of our variables of interest, name them GDP, GFI and employment in Mexico, takes place. In this section, the most important events from 1970 to the present days are presented from a historical perspective. Besides, special attention is given to the performance of GFI in Mexico from 1970 to 2013, and of employment from 1970 to 2011. This chapter demonstrates the deterioration of the productive capacity and the declining tendency of the growth rates of GDP, GFI and employment in Mexico.

In the third chapter the Input-Output analysis is studied; the different tools of this approach, such as the subsystem analysis, the employment multipliers and the indices of Rasmussen are addressed and then applied for the case of the Mexican economy. These analyses will help us to identify those sectors that could contribute more to the level of employment. Two sources of statistical information are utilized, the first one, obtained from the Mexican statistical institute (INEGI), consists of an Input-Output matrix of 79 industries with sectorial information about GFI and employment. The second was obtained from the Word Input-Output Database (WIOD) and refers to an Input-Output matrix of 35 industries and GFI and employment data. In this chapter after applying the different methods of the Input-Output analysis, we obtain a number of industries that could significantly contribute to the level of employment when an increase in capital investment occurs. At the end of this chapter, the main results are discussed.

Finally, taking into consideration the main results obtained in chapter three, the final conclusions of this research are disclosed in the last section of this work. The statistical appendix presents the preliminary results obtained after applying the different methods of the Input-Output analysis.

CHAPTER 1
GROSS FIXED INVESTMENT AND EMPLOYMENT

The aim of this chapter is to define the possible effects of gross fixed investment on employment. Considering that the main purpose if this work is to know how to generate employment in Mexico by means of Gross Fixed Investment, in this chapter we will discuss the impact of capital investment on employment from different theoretical perspectives and the possible outcomes in the short and long run that can be addressed in the process of investment and its consequences on the labour market.

In the first part of this chapter we discuss the importance of capital investment on employment generation in Classical economics and in the second part we present the importance of capital investment on employment generation from the Keynesian standpoint. In the third part we address the different possible effects of capital investment on employment in the short and long run and in the last part of this chapter we focus on some of the factors that hinder the generation of employment.

1.1 Capital Investment and Employment in Classical economics

The lack of employment has been one of the main topics of interest in the last decades, the inability of economies to provide with sufficient, productive and well paid jobs has generated other social and economic problems that nowadays are diagnosed in most of the countries all over the world, namely, a rapid expansion of the tertiary sector, informality and difficulty to employ young and just graduated people. Therefore from all the components of final demand, in this work only the effects of investment on the problem of job generation will be considered. First of all because investment and specially gross fixed investment represents the part of the economy that is related to the means of production, and secondly because it can somehow be encouraged.

First of all we need to remember that there is no other variable that accounts for the variations of capital than investment. Investment refers to the variation of capital stock through time, that is, it measures the new capital that will be utilized in the economy above and beyond the already existing. We also need to say that investment can actually take place in different areas, but for the sake of this work we will only be interested in the part of investment that accounts for capital investment. We emphasize this difference because nowadays the term investment no longer refers only to capital accumulation but also to activities in financial markets. With this in mind, in this part we discuss from a classical point of view the effects of capital accumulation on employment.

The effects of the acquisition and utilisation of machinery (fixed capital goods) on the economy are various and of a different nature (see Kurz, 2010 and Kalmbach and Kurz, 1992). The first one has to do with the gain of skills and dexterity of labour due to the division of labour. In this regard we refer to Smith [1776] and the degree of specialisation that comes from the continuous realization of the same task (as in the pin factory). The gain of specialisation at the time allows a better utilisation of plant and equipment and therefore an increase in the level of production. Capital goods foster the increase in labour productivity.

The second effect relates to the replacement of labour by machines, the constant introduction of capital goods apart from increasing the level of production, simplify the production process and thus lead to a lower labour requirement per unit of output. Since labour is getting more productive and machines perform an important part of the process, less and less employees are needed per unit of output. The idea of the replacement of labour by machines is discussed by Smith [1776], Ricardo [1951-1973] and Marx [1959]. For Smith [1776] the continuous introduction of machinery involves a deskilling and degradation of large parts of the working population since not all of them are qualified and have the knowledge of the "how" to utilise the machinery. For Ricardo [1951-1973] the negative effect of machinery on employment is not only the deterioration of the labourer's conditions in terms of skills but also in

terms of wages. Since the labour requirements will diminish, labour supply will seem to increase generating a lower wage rate, that is, "the net revenue of the country may increase but deteriorate the condition of the labourer" (Ricardo 1951-1973, as cited in Kurz, 2010: 1197). In the words of Marx [1959] the introduction of machinery generates a "relative over-population" and a "reserve army of the unemployed" because of the displacement of workers by machines and it also implies a cheapening of commodities since the labour costs will be reduced.

The third effect has to do with the response of the maximum profit rate to the introduction of capital goods. Since for Smith [1776] a greater capital accumulation allows a better division of labour, the maximum wage rate will tend to increase, but for the case of the maximum profit rate the effect may be ambiguous, first because a greater capital accumulation may cause an increase in the capital-to-labour ratio and secondly because a greater capital accumulation may cause an increase in the capital-to-output ratio. For Ricardo [1951-1973] an increase in the capital accumulation leads to a capital-intensive production and with this to an increase in the capital-to-output ratio and thus to a reduction of the maximum profit rate. In the case of Marx [1959] the increase in capital accumulation leads to the increase of the organic composition of capital and thus to a decrease of the maximum profit rate.

Apart from the effects already mentioned it is worth considering the causality between capital accumulation and the rate of profit. On the one hand, for Ricardo as the general rate of profit tends to fall, the process of accumulation will tend to decelerate and eventually stop. That is, capital accumulation depends on the rate of profits; there is no capital accumulation without profits. On the other hand, for Marx the rate of capital accumulation determines the rate of profit (and thus the wage rate), he states [1954] that the rate of accumulation is the independent, not the dependent variable and that the rate of wages (and thus the profit rate) is the dependent variable. But even if it is not clear which causality is "better" or if there is bidirectional causality, it is clear that the relationship between these two variables is strong and that we cannot think of one without thinking in the other.

As modern economic development is characterised by replacement of labour by machinery it is valid to say that in order to employ all or an important part of the working population special effort will be needed. In the frame of the classical economics we would think that due to the fact that machinery and labour are in constant competition, an increase in machinery would lead to a decrease in labour and that the division of labour within that industry will be higher; but besides we can also think that a constant specialisation of labour would also lead to the division of labour among firms and lead to think of a circular economy or a vertical integrated economy. But as the degree of specialisation does not occur at the same time and speed in all industries, the division of labour will lead to a disparity of labour productivity among industries and therefore to an uneven distribution of the means or production. For example, as the capitalist production allows a faster increase in the industry´s productivity than in agriculture's, if there is no competitive pressure, capital accumulation and profit rates will be higher in the industrial production.

It is only through capital accumulation in specific areas that higher levels of employment will be achieved, capital accumulation by itself leads to a process of innovation and technical progress, which can aggravate the problem of unemployment. Nevertheless it is important to keep in mind that the increase of capital accumulation and investment will always have a positive impact on the total level of production, on labour productivity and somehow on the level of employment; while investment may generate a direct reduction of employment it may lead to an indirect increase of employment. In the following section we will continue discussing the impact of capital investment on employment but from another perspective.

1.2 Capital Investment and Employment in Keynesian economics

Before we discuss the relationship between investment and employment in the Keynesian economics we will start by defining investment and understanding the act of investment. Keynes in *The General Theory of Employment, Interest and Money* defines investment as "the addition to capital equipment as a result of productive activities of the period" (Keynes, 1973: 62), and it includes the increment of capital equipment whether it consists of fixed capital, working capital or liquid capital.

The act of investing in the individual firm or industry is the act entrepreneurs face under the motive of seeking to maximise current and future profits, and it involves deciding the volume of finished output (capital goods), the volume of employment and the technique needed in the production activities. For Keynes investment is strongly related to the entrepreneur's expectations, that is, it depends on the prices which they expect to get for their finished output and on what they hope to earn in the shape of future returns of purchasing additional capital equipment. Investment as an aggregate is defined as "that part of the income of the period which has not passed into consumption" (Keynes, 1973: 62); it is the outcome of the collective behaviour of individual entrepreneurs and is necessarily equal to the amount of saving since each of them is equal to the excess of income over consumption. Even though investment and saving must be equal, the decisions to consume and the decisions to investment between them determine income; "saving in fact is a mere residual" (Keynes, 1973:64).

In Keynesian economics, output is determined by aggregate demand and income by the level of employment; this is so that an increment in the level of employment cannot be achievable without an increase in investment. The amount of labour both in each individual firm and industry and in the aggregate, depends on the amount which entrepreneurs expect to receive from the corresponding output, that is, expected spending on consumption and expected new investment.

Therefore it seems that employment and investment are strongly related, any changes in investment and in any factor affecting investment will have repercussions on the level of employment. More precisely, in Keynes, the volume of employment depends on *a)* the aggregate supply function, *b)* the propensity to consume, and *c)* the volume of investment. If there is no change in the propensity to consume, employment cannot increase unless at the same time investment increases as to fill the increasing gap between the aggregate supply price and consumption. This is so because when employment increases, consumption will increase but not so much as the aggregate demand. This is why if the propensity to consume and the rate of investment generate a deficient effective demand, the actual level of employment and thus the level of income will fall.

The importance of *The General Theory* of Keynes resides in the fact that income depends on the volume of employment and the level of employment at the time, depends on consumption and new investment, and in the fact that increments on investment generate increments on employment. That is, if the level of employment in an economy is increased, then the level of income will also be increased. When aggregate income increases, consumption also increases but not in the same proportion, thus in order to keep offering the given amount of employment, there must be an increment in the current investment to absorb the excess of total output over what the community chooses to consume. It follows therefore that the level of employment will depend on the amount of current investment and hence on the stimulus or inducement to investment. If in an economy the inducement to invest is weak, then not only will the level of employment tend to fall, but consequently the level of income and consumption, and thus will lead to entrepreneurial losses, so that the surplus of income over consumption will sufficiently diminish to correspond to the weakness of the inducement to invest.

So far we have only discussed the impact of investment on employment when the propensity to consume is given, now we will proceed to analyse the case in which it is not given. To begin with, we need to define several concepts; if we define the marginal propensity to consume as $\frac{\partial C_w}{\partial Y_w}$ where consumption and income are expressed in wage units, then for $\Delta Y_w = \Delta C_w + \Delta I_w$ we have $\Delta Y_w = k\Delta I_w$ where k is the investment multiplier and tells us that, when there is an increment of investment, income will increase by an amount, which is k times the increment of investment. Besides the importance of the propensity to consume and the investment multiplier, Keynes also refers to Kahn´s employment multiplier as a tool to deal with the case in which the propensity to consume is not given. The employment multiplier designated by $k´$ measures the ratio to the increment of total employment which is associated with a given increment of primary employment in the investment industries, so that if the increment of investment leads to an increment of the primary employment then $\Delta N = k´\Delta N_2$ where N_2 is the primary employment.

Then, bearing in mind that when income increases the level of consumption it does not increase in the same proportion and assuming that the investment and employment multipliers are equal, then "an increase in employment will only be associated with a decline in consumption if there is at the same time a change in the propensity to consume" (Keynes, 1973: 117), and it is only in this event that the increased employment in investment will be associated with an unfavourable repercussion on employment in industries producing for consumption. That is, as $1 - \frac{1}{k} = \frac{\partial C_w}{\partial Y_w}$ and therefore $k = \frac{1}{1-\frac{\partial C_w}{\partial Y_w}}$ only if the marginal propensity to consume falls, the multiplier will fall, because the greater (smaller) the marginal propensity to consume the greater (smaller) the multiplier. Then it is only by a decrease in the propensity to consume, and therefore in the multiplier, that a higher level of employment will lead to a decrease in consumption and indirectly to a decrease in the level of income, but if the propensity to consume remains constant or increases, a higher level of employment will be related to an increase in consumption and in the level of income.

If following this ideas, we analyse the impact of an increment of investment on employment we will see that: *a)* if the propensity to consume and thus the multipliers are large (close to one in the case of the propensity to consume), an increment on investment will first lead to an increase in the level of employment in the investment industries, then to a greater increase in the level of employment of the consumption industries (due to the employment multiplier) and to an increase of the level of income (through the investment multiplier and the propensity to consume), *b)* if the propensity to consume and thus the multipliers are small (near to zero in the case of the propensity to consume), the effect of investment on employment and income will be very small.

If the marginal propensity to consume is close to 1, small fluctuations in investment will lead to significant fluctuations in employment; if the marginal propensity to consume is close to 0, small fluctuations in investment will lead to correspondingly small fluctuations in employment. "In the former case involuntary unemployment would be easily remedied… in the latter case employment may be less variable but liable to settle down…" (Keynes, 1973: 118). Therefore in poor economies in which little is saved and much consumed, small increments of investment will generate important positive effects on employment, but as time passes and more investment is realised, the effect on employment will tend to decrease because the propensity to consume will also tend to decrease. This is why poor or less wealthy countries can take advantage of the greater impact of investment on employment in the beginning. Thereby in the case of a not given propensity to consume, the effect of investment on employment is a matter of magnitudes (the variation of investment) and of propensities (the propensity to consume and the multipliers), and their combinations.

Nevertheless it is important not to forget that there are also other facts that may impede the generation of employment by means of investment. For Keynes, a community is poorer than another one by reason of under-employment, inferior skills, techniques or equipment. That is, in an economy even if an increment on investment may occur, it is possible that its current economic conditions don't allow to take

advantage of the increase on investment, some of this conditions will be further addressed in this chapter. In the following section we refer to the possible effects of investment on employment in the short and long run.

1.3 Effects of Capital Investment on Employment in the short and long run

Having already discussed the importance of capital investment on employment from the Classical and Keynesian economics, we can observe that for the Classics capital investment is relevant because on the one hand it allows a greater labour productivity and gain in specialisation, on the other hand it allows a replacement of labour by machines and a lower labour requirement. That is, the Classics are aware of the possibility of a deterioration of the labourer's conditions as the result of capital investment. For Keynes the role of capital investment as employment generator is higher, the components of aggregate demand are important in defining the level of production and employment, the only way to increase the level of employment is through an increase in aggregate demand. Although the effect of capital investment on employment seems to be different in both economic schools, the importance of investment and specifically of capital for the creation of any new capacity, whether for net expansion or replacement, is by no means negligible. Nevertheless we need to point out that the outcomes on employment of capital investment may be different in time. Since in the short run a higher level of capital investment generates a higher level of employment, in the long run it generates a higher substitution of labour by machines and thus a lower level of employment. Therefore it is important to discuss the effects of capital investment on employment in the short and long run separately.

- Capital investment and employment in the short run

The short run is defined as the period of time in which an increase in the level of production can take place but the expansion of the productive capacity and the introduction of new technologies cannot take place. Properly speaking, in the short run the flow of investment can increase but the stock of capital cannot increase. Therefore in the short run increases in the level of investment will only generate

increases in the level of income which, for example, can be explained through the analysis of the Keynesian investment multiplier. But if we focus on the effect of an increment of capital investment on employment, a higher level of capital investment will generate a higher production in the capital-goods industries and therefore as these industries will demand a higher number of employees, the level of employment may indirectly increase. Besides, in the short run, as an increment in the level of investment in one sector will not expand its productive capacity but instead may increase the degree of utilization of its given productive capacity, then the level of employment could also increase via capacity utilization.

As we can see, to some extent this analysis is based on the idea of the *circular economy* of Leontief (see Leontief 1991) because it is based on the idea of general interdependence in which the whole economy is treated as a single connected system, that is, we refer to the fact that variations or changes in one industry of the system can generate changes in the rest of the economy. In our case, in the short run an increase of investment in one sector may not only generate an increase in its own level of employment but may also generate an increase in the level of employment of other industries. We will refer to the circular economy in the following chapters, but in general "if a part of the surplus value is saved and invested, the system reproduces itself on an upward spiralling level" (Kurz, Dietzenbacher and Lager, 1998: *xxvi*), this because as each sector is interconnected with the rest of the economy positive (negative) effects will affect other sectors, and those sectors, at the time will influence other sectors and so on, that is why the system will reproduce itself.

- Capital investment and employment in the long run

In the long run capital accumulation may have different effects on employment, some may encourage the generation of new jobs and others may dissuade the job generation. The long run is characterised by allowing changes in the choice of technique, by allowing changes in the productive capacity and by encouraging technical progress. Therefore considering these three elements we will base our analysis on the description of two cases. One has to do with the effect of capital

accumulation on employment when the technique does not change and therefore capital accumulation expands the productive capacity. The other one is related to the effect on employment of changing the technique and therefore to the effect of investing in new and modernized capital goods.

In the former case, if investment increases the amount of capital will also increase, this new capital will therefore be utilized for the expansion of the productive capacity or for its replacement. In either case, as we will see, the effect on employment may not be negative because if capital is accumulated with the purpose of expanding the productive capacity, this increment will be utilized to generate a higher level of output and therefore a higher level of employment will be required. If capital is accumulated to replace old capacity, the increment in capital will be utilized to maintain the level of production and therefore the level of employment may not increase but neither may fall.

The accumulation of capital in the long run enables the production possibility frontier to widen, and if we assume that the productive capacity is always fully utilized, a greater productive capacity has to be related to a greater level of output and thus to a higher level of employment. Even though the increment in the amount of capital is the outcome of entrepreneurs choices of the amount of capital and labour required to maximise their profits, it is important to keep in mind that in this case the choice of technique does not change and that the increment of capital accumulation is merely the outcome of the decision to expand the level of production and not of the decision to modernize or innovate the process of production. This is why in this case the increase in the level of capital investment will always be linked to a higher level of employment, of course the magnitude of the effect may vary according to different industries since the requirement of labour per unit of capital is different among them.

In the latter case we consider the possibility in which the entrepreneur decides to change his production technique so that he will be able to choose in what kind of capital to invest among different capital goods. Hence, as capital goods are always

accompanied by innovations and technological changes and as capital goods change in time according to innovation, different kinds of capital goods will be available, i.e. there are methods of production that use intensively labour and others that use intensively capital. In this case labour productivity and the specialization of labour play an important role since the implementation of new and better technologies allow an increase in labour productivity and therefore a replacement of labour by machines.

The successful implementation of innovations either in new products or in new production processes generally requires, in some cases more than in others, the acquisition of new capital goods. These capital goods capture the ideas that are under the growth of productivity and at the same time provide the specific applications that convert new ideas in new products and in more efficient production processes. Nevertheless the introduction of new and better machines displaces workers and leaves them unemployed. When an increment in capital stock leads to an increment in labour productivity, it is possible to have a greater or equal level of production with a lower number of employees. That is, the introduction of new machines simplifies the process of production and in many cases reduces the labour requirements because some of the steps of the production process are no longer realized by human labour but by machines. Then in this case investing in new and modernized capital goods will generate negative effects on the level of employment of that industry. However the net outcome in the aggregated level of employment may not be negative because it may be possible that the introduction of this new machinery indirectly affects the levels of production and employment of other industries.

Properly speaking we are considering the negative and the positive effects on employment of introducing new capital goods. The negative effect is called the displacement effect, it is the outcome of labour substitution by machines and of the discharge of labourers from the production process, that is, it refers to the negative effect on the level of direct[1] employment and thus leads to a lower level of

[1] Employment required in the current production process.

employment in that industry or to what is called technical unemployment. The possible positive effect is called the compensation effect and it refers to the case in which the displacement of labour in one industry can be offset with labour absorption in other industries, that is, it refers to the effect on the level of indirect[2] employment. The compensation effect is based in the following arguments: (See Kalmbach and Kurz, 1992)

i. Technological change brings new goods and markets. Product innovations stimulate final demand and therefore enhance employment.
ii. The application of cost reducing production processes in a competitive economy result in falling commodity prices. With given nominal income, real income rises, leading to an increase the demand for goods and employment.
iii. In a productivity-oriented wage policy the technological change leads to an increase in wages, which increases the demand for consumer goods and the level of employment.
iv. Through process innovations costs and prices are reduced, real wages increase, and as a consequence company profits increase. This stimulates the demand for investment and the entrepreneurial consumption.
v. The use of new capital goods leads to a positive employment effect in the sectors producing these technologies.
vi. Economies with substantial technological change increase their international (price and quality) competitiveness. This results in an expansion of export demand and in a positive employment effect inside the country.

According to some authors (see Freeman, Clark and Soete, 1982) the introduction of technological change via new capital accumulation should automatically compensate the displacement of labour in one industry with the generation of employment in other industries, so that the displacement and compensation effect ought, at least, to be equal. Of course in real life to reach this equality is not an automatic process or an

[2] Employment required in the production of the inputs that are now utilised in the current production process.

easy task, it depends on other factors such as the flexibility of wages and the demand for goods. And even if the equality is not reached, there are other factors that aggravate this economic mismatch between both effects like the disparities of labour qualifications and the lack of economic policies oriented toward that objective.
In the following and last part of this chapter we will discuss some of the factors that hinder the compensation effect and that interfere with the generation of jobs when new techniques are introduced in the processes of production.

1.4 The role of Human Capital, Institutions and the Choice of Technique

As it has been argued in the previous sections, it is possible that the outcome of higher rates of investment would result in negative effects on the level of employment, i.e. it is not quite clear if the higher investment will lead to higher or lower levels of net employment. Therefore in this part we discuss some of the most important factors that prevent the economy from having a strong compensation effect that thus could lead to positive levels of net employment. These factors are the skill level of the workforce, the role of government and institutions and the choice of the appropriate technique.

- The role of the skill level and human capital

The level of skill of the workforce is of great importance to allow that the displacement of labour in one industry can be absorbed in other industries. Skill is defined by Nelson and Winter as "a capability for a smooth sequence of coordinated behaviour that is ordinarily effective relative to its objectives, given the context in which it normally occurs" (1982: 73), that is, it refers to the ability of an individual to realise a task in an appropriate and effective way. Of course the gain of skills, at the time, depends on many other factors such as schooling and practice; these abilities represent the knowledge an organization possesses.

In the modern economic theory, the term human capital refers to these attributes and skills of workers that in some way facilitate the production processes. The importance of human capital on the economic process resides in two main facts: it increases labour productivity and it enables the adoption of new technologies. The first perspective is addressed by Mincer (1974) and it emphasizes the role of human capital in the production process and the incentives to invest in skills, he refers to the advantages that investing in human capital could bring to labour productivity and thus to the aggregate production. More specifically we can observe that qualified labour has the tacit and practical knowledge of the "how to do it" and therefore the outcome of the production process is "better" in quantity and quality when utilizing skilful labour than when not utilizing it.

The second perspective is provided by Nelson and Phelps (1966) and according to them the major role of human capital is not to increase productivity but to enable workers to cope with change, disruptions and new technologies; that is, in order to adopt new technologies, a high level of human capital is needed. It will be of little use to invest in new and technologically better machines if employees are not able and don't know how to use them. Therefore in every industry, the level of human capital will determine the absorption capacity and thus the degree of competitiveness, "the greater is the human capital of the workforce, the higher is the absorption capacity of the economy" (Acemoglu, 2009: 615). Moreover, in less developed countries, it takes time for labour to acquire the skills to operate modern technology, "the use of modern technology is constrained by skill shortages as well as by limitations on physical investment" (Nelson and Winter, 1982: 237). Therefore, when a country has a deficit of skilled labour, this by itself will hinder higher levels of investment and employment, it makes it difficult for any industry to produce in an economy in which the level of human capital is too low. That is the reason why for the purpose of our analysis the gain of skills is important, because in some way it encourages the compensation effect and this offsets the displacement effect.

Then the question would be how to make displaced labour to be ready to be absorbed by other industries? There can be little doubt that the technological education and the training system play a great role in providing the needed level of skills and human capital to allow the adoption and utilization of current and new technologies. For example, as Mazzucato (2013) points out, the rise of Germany as a major economic power in the nineteenth century was the result of State fostered education. Germany´s educational system allowed to have a specialized targeted and diversified workforce, since its Technical Schools, Universities of Applied Sciences and Universities avoid "having too much of this and less of that", besides it facilitates the linkages between employers and future employees. But it also makes sure that the entire workforce is educated depending on their level of knowledge and devotion.

Furthermore, as Rosenberg (2000) mentions, the response of universities to economic needs is crucial, there must be certain degree of congruence between what the university offers and what the market demands. It this case as in the case of Germany, the State´s intervention is an important tool to ensure that the level of human capital faces the utilization of current and new technologies and this, to facilitate the generation of jobs.

- The role of government and institutions

The role of government is not only of great importance in allowing the formation of human capital nor as market fixer, creator of infrastructure or demand generator, it also plays a very important role in developing new technologies, supporting new specific industries and directing public resources for catalysing innovation. As Mazzucato (2013) mentions, the State should be able to generate new technologies that encourage firms to innovate in products or production processes. It should take risks that the individual firms wouldn't take by investing in uncertain and difficult markets, it should take a leading role among the private industries to bow for the country´s common interests.

But besides from this idea of the "Entrepreneurial State" of Mazzucato, we will refer to the Keynesian idea of the State as "the balancing factor", the State should be capable of directing and distributing resources in such a way that it encourages the expansion of those industries that do well in terms of production. In the words of Acemoglu "Economic institutions are important because they influence the structure of economic incentives in society, (…) they ensure the allocation of resources to their most efficient uses and determine who obtains profits and revenues" (2009: 120).

Moreover, the role of institutions in modern times becomes more important because as the growth path of an economy depends on the rhythm of adoption of new technologies, then the resources should be directed to those specific areas that increase a nation´s capacity to innovate. This support for innovation can take the form of investment made in R&D, infrastructure, labour skills, and in direct and indirect support for specific technologies and companies.

For the case of this study, a greater compensation effect could be achieved by means of targeting investment to those sectors that first of all allow the constant modernization of the production and secondly by ensuring that this higher investment will not result in a lower level of net employment. It may be impossible to directly obtain these results from one industry, but may be possible to achieve them indirectly. It is possible that investment in an industry that utilizes modern techniques increases the level of employment of the industries with whom it is linked.

We should not forget that the outcome of a nation´s performance most of the times reflects the degree of participation of government and institutions, and that for the case of industrial and technological development, the intervention of the State plays an important role, "choosing particular sectors in this process is absolutely crucial" (Mazzucato, 2013: 27). It is important to choose the "key" industries because by supporting them, the State indirectly supports the others. However, since there are few economic changes that benefit all agents, the integrity of institutions will define

its possible outcomes. “Different institutions generate different economic allocations, (…) and thus different winners” (Acemoglu 2009: 777). It should be ensured that the economic policies don’t respond to individual preferences.

- The choice of the appropriate technique

The last factor that allows a strong compensation effect refers to how industries choose their techniques, it refers to the fact that while a technique leads to great outcomes in a country, it is very likely that the utilization of the same technique in another country will not lead to the same outcome in terms of quantity or quality. According to Acemoglu (2009) there are two possible reasons of productivity differences across industries and countries. The first one has to do with how production is organized in the different instances, even if all differences in techniques disappear, the degree and nature of the inconsistencies and inefficiencies in production may vary across industries and countries. The second one refers to the suitability of the technique in countries with different characteristics; the latest technologies may be inappropriate to the needs of specific countries. Technologies and skills are complementary bundles, and they vary across countries, so that there is no guarantee that a new technology that works well given the skills and competences in one country will also do in another one.

A good example of this is given by Acemoglu (2009), he refers to the innovation in a firm of a particular type of tractor handled with a single worker that increases the productivity of the worker. Any other firm employing the same tractor with a single worker can use this innovation, but it would be less valuable to firms using less advanced or more advanced tractors. The same applies to the level of skills of the workforce, if a change occurs in a technology that is used with skilful workers, it may benefit the skill-abundant country while may have no effects in countries with scarcity of skilful labour. Technological changes will be well utilized in specific capital-labour ratios, when used with different ratios, the benefits wont be the same, therefore, the choice of the appropriate technique has to do with the different factor intensities, it depends on the amounts of labour (skilful or non-skilful) and physical capital.

Besides, as less developed countries are characterised by being labour-abundant countries, and new technologies operate with a greater amount of capital than labour, new technologies will be suitable for capital-abundant countries, but not for the less developed countries. With this I am not saying that the less developed countries will always be predestined to use old technologies, but that the choice of technique must respond to the country´s needs and capabilities.

It has been observed by Nelson and Winter that "in the more developed countries, new technologies enter the mix (bundles) as invention occurs, while in the less developed countries new technologies enter the mix as the technologies of high income countries are borrowed" (1982: 236), that is, advanced economies utilize the world frontier technologies and the developing economies adopt and copy techniques employed before in advances economies. Then the differences of the level of productivity among industries and merely among countries, is explained by the differences of mixes and combinations of different technologies, physical capital and labour, and this differences, at the time, hinder the utilization and adoption of techniques that could significantly increase the productivity of the less developed countries. That is why choosing the right technique may facilitate the development of the less developed economies, otherwise, it may generate counterproductive effects; every economy must deal with all the phases of economic development. If an economy is dealing with labour abundance, then it would not be the best decision to invest only in labour-saving technologies.

Referring to the compensation effect, the adequate choice of technique will avoid distortions in terms of an indirect lower labour generation instead of a high generation of employment. If industries use the right technique, the effect of an increase in investment, thus will lead to a balances growth, i.e. to increments not only in the level of output but also in the level of employment.

CHAPTER 2
GROSS FIXED INVESTMENT AND EMPLOYMENT IN MEXICO

In this chapter, the evolution of gross fixed investment and employment in Mexico is analysed taking into account the most important facts that have occurred in the Mexican economy. Over time, the Mexican government has developed certain economic policies, plans and reforms in order to increase the gross fixed investment and therefore the economic growth and employment. Consequently, special attention must be paid to the economic backgrounds and history of the events that have taken place in the Mexican economy and that somehow have influenced in the performance of gross fixed investment and employment.

This chapter focuses on explaining how the Mexican economy ended up with such an economic structure as the one analysed in the next chapter. This chapter is divided in three sections, in the first one the economic performance is studied considering the most relevant events occurred in the Mexican economy from 1970 to 2011. The second section relates to the determinants of gross fixed investment in Mexico from 1970-2011. And in the last section of this chapter we address the performance of employment in Mexico for the same period considering the effects that gross fixed investment had on the economic expansion.

2.1 The Mexican Economy from 1970 onwards. A historical perspective[3]

In 1970 the need to address social inequity, led to the reformulation of the strategies of economic growth and development. At the beginning of his administration, Luis Echeverria presented a new strategy of "shared development", with it; he proposed that the benefits of economic growth should be evenly distributed. The goal of "shared development" would be achieved through the reorientation of public investment toward agricultural sector.

[3] This section is based on Moreno-Brid and Ros (2009).

Special attention was also given to the industrial sector; the promotion to the industrial activities was addressed via export promotion, development of capital goods industries and regional decentralization of industrial activities. For instance, the development of capital goods industries- the main bottleneck for economic growth- was supposed to be accomplished with subsidies on imported machinery for the production of new capital goods. Thus the promotion was no longer to import capital goods for industrial activities, instead to import capital goods for the production of capital goods.

However, during 1971 and 1976, foreign debt increased from US$7.5 billion to US$24 billion, and the rate of inflation became a two-digit rate in 1973 and reached higher levels than 20% in 1974. By 1975, the economy's expansion was mainly driven by public spending, which also fuelled the high rates of inflation. Also, by 1974-1975, the industrial policy had failed to generate the incentives needed to produce new capital goods in Mexico. For example, the production of capital goods contributed with less than 8% to the total manufacturing output but represented more than 50% of total imports. The share of imports in the domestic market started to climb as the investment process failed to diversify into new activities. Therefore, the contribution of import substitution to industrial growth declined, which at the time, slowed down the rate of growth of GDP.

As a result, investors anticipated an unavoidable change in policy and took their capital away, generating a worsening of the economic situation. In August of 1976 the situation got out of control and the balance of payments pressures forced the government to devalue the peso by nearly 100%. In the same year, the discovery of oil resources increased the exploitation of oil deposits, and their sales brought a fast and strong recovery from the currency crisis. From 1978 to 1981 economic growth recovered strongly; the increase in oil production and oil exports led to an expansion of GDP at about 9% per year.

From 1978 to 1981 investment reached very high levels (see graph 2.1), it was mainly concentrated in sectors such as the oil industry, and the commerce and service sectors. Public investment was directed to the oil sector, and the private investment to the service sector. Moreover, few investments were directed to the manufacturing export sector. Thus, the oil boom was very far from creating the proper conditions for the development of the industrial sector.

Financially speaking, the oil bonanza turned Mexico into a favourite costumer of international banks; foreign loans were granted in amounts and with conditions more favourable than to other developing economies. Nevertheless, in 1981 the real oil prices reached very high levels and had a strong tendency to grow fast.

This event brought in the first half of 1981 an optimistic outlook and expectations in the government and international banks; banks redoubled their lending to the Mexican economy and the Mexican government started borrowing heavily. However, in the second half of 1981, the private sector started an unprecedented speculative attack on the Mexican peso, causing a massive capital flight. The flight of capital represented the 54% of the increase in Mexico's total foreign debt in 1981 and 1982; Mexico was left heavily indebted.

As a consequence, at the beginning of the 1980s, the Mexican economy went through two important external shocks that had important repercussions on the economic performance, the first one is the debt crisis in 1982 and the second is the shock in oil prices in 1986. Both of them deteriorated the pace of economic expansion and capital accumulation. In the case of the debt crisis, it generated a sharp devaluation, which led to an increase in the price of imported capital goods, and therefore to an important contraction in public and private investment which at the time turned into a depression caused by the fall in aggregate demand. It also led to massive capital flight and to a diminution in the market value of physical assets. Moreover, at the same time the US economy experienced an important increase on its rate of interest causing a decrease in the pace of expansion of the US economy and therefore a fall in demand of

imports, thus having a negative effect on the level of production of the Mexican economy. Meanwhile, the oil price shock deteriorated the terms of trade of the Mexican economy, for a given level of exports the quantity of imports it could buy, diminished, causing the capital goods, which in their majority were imported, to become more expensive.

After the debt crisis the Mexican government adopted several strategies in order to respond to the external shocks, in December of 1982 an orthodox stabilization strategy was adopted with the purpose of cutting the fiscal deficit and restoring the balance of payments stability, also a structural adjustment process was adopted to induce a gradual reallocation of resources toward the production of tradable goods within a stable and growth-oriented macroeconomic framework. Nevertheless these strategies were only successful in terms of improvements in the trade and current deficits, but they failed to stabilize prices, this led to a change in policy in favour of market liberalization reforms and to a stabilization of different approach.

Therefore, in 1984 the reform process initiated with a moderate liberalization of the import regime, in which the direct import controls were relaxed and the number and dispersion of tariffs were decreased. Nevertheless, the low level of nonoil exports in 1985 encouraged the government to accelerate the pace of import liberalization and in July of 1986 the General Agreement on Tariffs and Trade (GATT) was negotiated and signed. With GATT Mexican Government continued the replacement of import controls with tariffs, and with time tariffs should also be reduced. From 1984 to 1993 import license coverage fell from 83.5% in 1984 to 21.5% in 1993 and the maximum tariff fell from 100% to 25% from 1985 to 1993 (Tornell and Esquivel, 1997).

As can be seen, the process of trade liberalization continued from 1984-1985 to 1993, so that in January of 1994 the North American Free Trade Agreement (NAFTA) was signed, in it the three participants (Mexico, The United States and Canada) committed themselves to the elimination of tariff and non-tariff trade barriers and to the loosening of restrictions on foreign investment. The NAFTA´s main initial objectives

were to eliminate the barriers to trade and facilitate the cross-border movement of goods and services between the three territories and increase substantially investment opportunities of the three counterparts.

From the point of view of Moreno-Brid and Ros (2009) NAFTA was an instrument to achieve three main things: *i)* a potential to improve Mexico's trade with US and Canada and increase the foreign investment flows, *ii)* induce local and foreign firms to invest in the production of tradable goods, and *iii)* guarantee the no turning-back in Mexico's economic reform process. Nevertheless the local reorientation of production to sell in foreign markets did not result as expected, the export oriented sectors of production became more dependent on imported inputs, and did not build the sufficient backward and forward linkages to ensure the expansion of the Mexican economy.

In Mexico in the late 1980s and early 1990s the privatization of the majority of public enterprises also took place. The goal of this process of privatization was to strengthen public finances, to improve the efficiency of the public sector by diminishing the size of its structure, and to encourage the economy's productivity delegating the task to the private sector (Sacristán, 2006). Privatizations offered opportunities of relocation of existing economic groups, giving possibilities to consolidate their positions in industries in which they already participated, or diversify in new activities. However, several studies mention that the outcome, was nothing more than market concentration; it allowed existing firms to have greater share of the market and transferred the public enterprises with oligopolistic and monopolistic power to private entities, but had a minor impact on the long-term growth potential of the economy (Hoshino, 1996; Sacristán, 2006; Máttar, 2000; Moreno-Brid and Ros, 2009).

The positive effects that privatization had over these enterprises was the increase in productivity, competitiveness and profitability. Privatized firms tended to catch up with private firms and even surpass them, according to Máttar (2000), events such as

privatization, trade liberalization and other structural reforms have offset the negative effects that market concentration would have on economic performance.

If we also consider the industrial policy of the time we can see that from 1985 to 1995 it was based on horizontal policies taking out the selective promotion of particular sectors (Máttar, 2000). In 1996 a change in industrial policy took place with the Program for Industrial Policy and Foreign Trade (PROPICE), which recognizes the excessive delinking of some productive chains in the Mexican manufacturing sector and the need for selective vertical policies (Máttar and Peres, 1997). PROPICE specifically stated that sector-specific policies were required in order to increase domestic value added and give priority to export industries such as textiles, footwear, automobiles, electronics, appliances, steel, petrochemicals and canned food (Ten Kate and Niels, 1996).

From 2000 to 2006 the Mexican government continued recognizing the importance of a strategy that could strengthen the dynamic of trade liberalization in which Mexico is inserted, therefore it outstands the need for the implementation of sector-specific policies to stimulate investment and economic growth. The goal of the National Development Plan of 2001 was to increase the generation of domestic value added, strengthen the linkages among local productive chains and increase the international competitiveness of certain industries such as automobiles, electronics, software, aeronautical, textiles and garments, agriculture, chemicals, tourism and construction.

Even though it was expected that the process of trade liberalization and privatization would lead to an expansion of the export-led sectors, it actually brought massive increase of imports. The Mexican exports have not served as an engine of growth because the manufacturing sectors became heavily dependent on imports. This because as Fitzgerald et al. (1994) explained, the less developed economies lack of an industry of capital goods that supply internal demand, thus forcing internal producers to import the capital and even intermediate goods needed in their production processes.

2.2 Gross Fixed Investment in Mexico 1970-2013

In order to encourage the role of the private sector in the process of economic expansion, several reforms such as trade liberalization, deregulation of the economy, privatization of public enterprises, financial liberalization and the promotion of foreign investment took place. All of them had repercussions on gross fixed investment and if we aggregate them according to the nature of the effects that they have on gross fixed investment we obtain two main groups. The first group refers to those reforms that altered the competitive matrix of the economic structure; in this group we find reforms like trade liberalization, privatization and the deregulation of foreign investment. The second group refers to the reforms that changed the costs and prices of key products, in this group we have the financial liberalization and reforms to the industrial policy (Máttar, 2000).

However, it needs to be stressed that the short and long run effects of the reform process of the last thirty years have been different. For instance, while trade liberalization may have had positive effects on the export-led sectors, it may have had negative effects on those sectors that produce in non-competitive conditions; financial liberalization also did not register the expected outcome as it contributed to expand consumption rather than investment; and privatization caused an increase in those privatized enterprises' gross fixed investment but due to the delinking of the economic structure it did not cause a ripple effect.

According to several studies, gross fixed investment in Mexico is determined by factors such as *i)* aggregate demand and the complementary effect of public investment (Calderón, 1988; Ramírez, 1991; Musalem, 1989; López, 1994; Guerrero, 1997), *ii)* the availability of financial credits to the private sector in the capital accumulation process (Calderón, 1988; Warman and Thirlwall, 1994, Guerrero, 1997), *iii)* capacity utilization (Levy, 1993; Musalem, 1989) and *iv)* the real exchange rate (López, 1994). For instance, the expansion of aggregate demand and the availability of financial credits lead to an expansion of gross fixed investment and the level of

production. An increase in capacity utilization also encourages the capital accumulation process, as the existing capacity may not be enough to face the requirements of production. And an increase in the real exchange rate (real depreciation) is translated into an increase on foreign good's prices, which could also lead to a fall in the purchases of imported capital goods.

Thus, variations on any of the determinants of gross fixed investment causes changes on capital accumulation and therefore in the production levels and capacity of the economy. For instance, according to Moreno-Brid and Ros (2009) the factor of the slowdown in Mexico's rate of expansion is the weak performance of investment, as we can see from graph 2.1, the performance of gross fixed investment in Mexico in the last four decades shows episodes of expansion, depression and stagnation, causing a very similar behaviour in the rate of growth of the Gross Domestic Product (GDP). Nevertheless, the rate of expansion of GDP was accompanied and explained by a weakening of the rate of growth of gross fixed investment, the trend on the rates of growth of both variables is negative and has shown that at least from 1999 to 2013 they have reached their lowest levels. These events of course have caused the deceleration of modernization and enlargement of the productive capacity, and at the time, have hindered the growth of aggregate demand.

Graph 2.1 shows that the gross fixed investment has followed in a very similar way the path of GDP. From 1970 to 1975, which was the end of a period characterised by growth and stability, the rates of growth of GDP and gross fixed investment showed an outstanding performance. In 1976-1977 a devaluation of the Mexican peso occurred and led to rate of growth of GDP of 4.5% and to a diminution in the growth rate of gross fixed investment of about 7% although it was a followed by an extraordinary recovery from 1978 to 1981. The oil boom and the increase of international rates of interest caused high and positive expectations about the performance of the Mexican economy, the public and private sectors developed great investment projects; and in this period from 1978 to 1981 the average rate of growth of the gross fixed investment reached the 17 percentage points. Nonetheless, the trend towards an

accelerated pace of growth came to an end with another devaluation of the Mexican peso and the crisis of the external debt in 1982-1983, this period was characterised by a fall in gross fixed investment and by a decrease in the rate of growth of the economy.

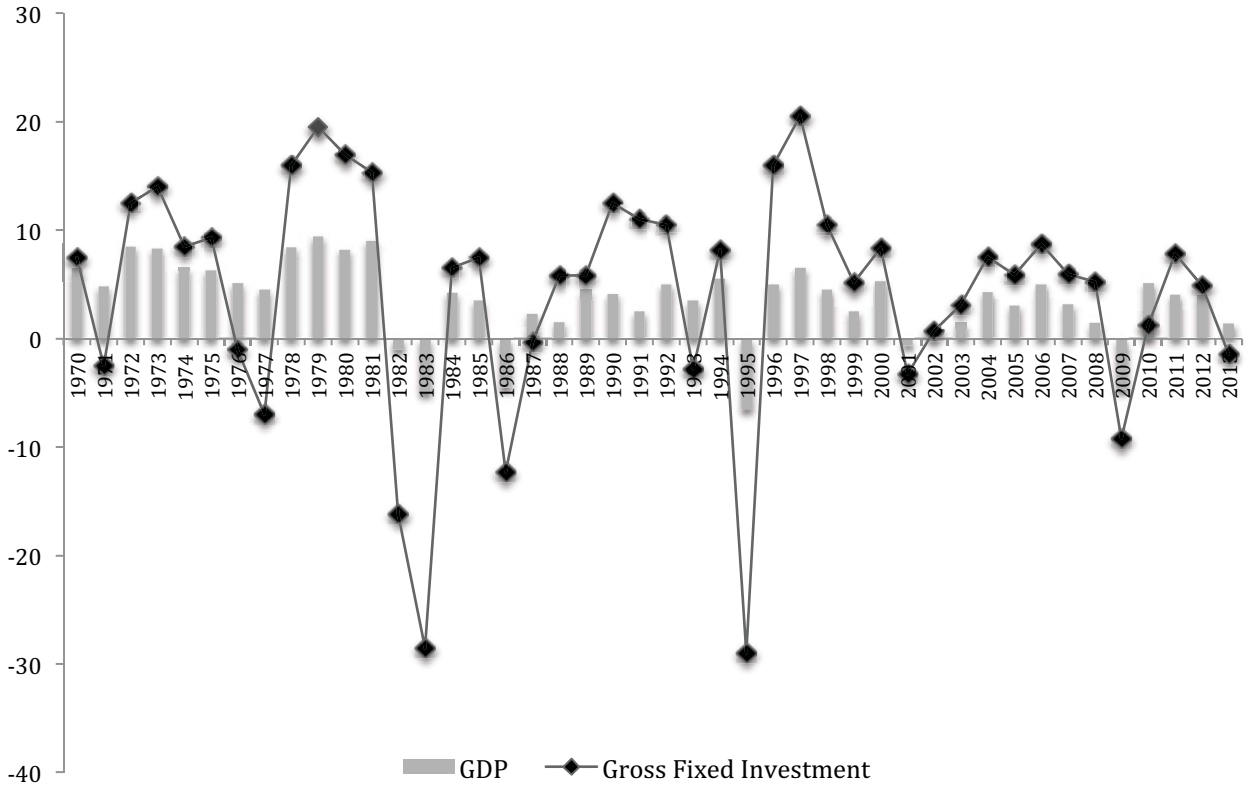
In this stage several programs of adjustment and stabilization to balance public finances took place, but the fiscal discipline generated the contraction of gross fixed investment of the public sector and therefore hindered the ripple effects to the rest of the economy resulting in a worsening of the economic performance.

In 1983-1984 the process of trade liberalization began with moderate measures of trade and commercial liberalization in which the direct import controls were relaxed. The reform process continued until 1987; in this period the Mexican economy entered the GATT and the privatization of small and medium public enterprises also took place. From 1988 to 1994 trade openness reached its deepest level, the reforms on exchange policy caused a system of exchange rates based on currency bands; trade liberalization was translated into the NAFTA agreement; the privatization process showed up in the big public enterprises such as the banks, the steel industry and the telecommunication sector and there was also a great promotion of foreign investment. Therefore, as showed in graph 2.1, all of these reforms generated significant increases in the rates of growth of gross fixed investment and a recovery of the pace of growth of GDP.

In 1995 one of the biggest crisis shook the entire economy, the cause was a strong depreciation of the Mexican peso and the sudden change in expectations from the foreign investors that Mexico received from 1989 to 1994.

Graph 2.1 Gross Domestic Product and Gross Fixed Investment: Mexico, 1970-2013

Rates of Growth



Source: Máttar (2000) and INEGI, Banco de Información Económica.

Before 1995 the process of trade and financial liberalization induced to a very positive international environment given the fact that in industrialized countries the interest rates were very low, which lead to high capital inflows from 1989 to 1994. However, the negative expectations experienced in 1995 caused the capital flight, a growth rate of gross fixed investment of -29 percentage points and thus an unprecedented rate of expansion of the Mexican economy of -6.5%.

After the slump of the Mexican economy of 1995, gross fixed investment recovered its intensity growing at two-digit rates. However, the phenomenal expansion of gross fixed investment only lasted until 2000. The recovery of investment in this period was heterogeneous among sectors; for instance, export-led activities and *maquiladora* industries registered great dynamism, this segment of the economy consisted of a small group of big and medium sized enterprises with transnational origins or linked to big foreign companies with easy access to financial resources. In contrast, the vast majority of the economic structure consisted of small and medium sized industries that faced a weak internal demand and had difficulties obtaining funds for modernization and capital expansion.

From 2000 onwards the performance of gross fixed investment and GDP has been very disappointing. The Mexican economy faces stagnation, the rate of growth of gross fixed investment has shown figures smaller than 10%, and the average rate of growth from 2000 to 2013 is 3.2%. There is no doubt that the mediocre rates of growth of fixed investment were accompanied by a slow rate of growth of GDP, in the same period, the average rate of growth of GDP was 2.4%.

So far we have only addressed the performance of gross fixed investment and GDP in Mexico from 1970 to 2013 and we have found that both variables respond very similarly to external and internal shocks, there is parallel behaviour between the two of them; they are positively correlated. However, it is still not clear what the effects of gross fixed investment on employment are. Though it is valid to think that the rate of expansion of gross fixed investment determines the growth pace of employment. If

capital accumulation expands, it means that the economy is responding to an increase in aggregate demand and thus, a higher amount of employees would be required in order to fulfil a higher aggregate demand.

As we will see in the next section of this chapter, job generation in the last decades has not been enough to employ the increasing supply of labour, therefore the role that the gross fixed investment plays in the process of job generation is of great importance, for instance, Moreno-Brid and Ros (2009) argue that "The failure of capital formation to grow at a fast pace has reduced the expansion of employment" (2009: 238).

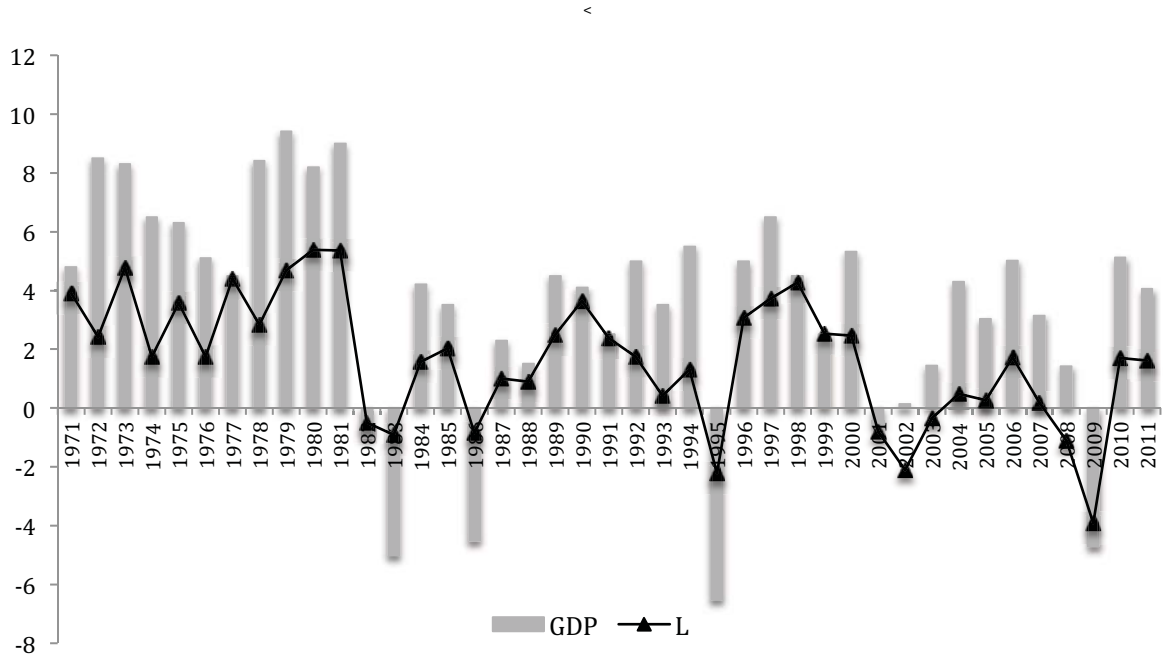
2.3 Employment in Mexico 1970-2011

The rates of expansion of gross domestic product and gross fixed investment in recent years have not been as expected, especially after the debt crisis in 1982. Moreover with the reform process in areas such as trade, finance and State presence in productive sectors, expectations on Mexican economic expansion were very high. However in the last thirty years the Mexican economy has faced a process of slow capital accumulation and expansion of the economic activity, and has had negative repercussions on the level of employment.

Among the most common explanations we find that the slow rate of growth of the economy has not been accompanied by an equivalent increase in employment (Ruiz, 2005), so that from 1982 onwards, the growth of labour has been far below the requirements to generate safe and well-paid jobs (López, 2000). As has already been said, it was expected that the reform process would lead not only to the expansion of capital accumulation and economic activity, it was also expected that the rate of employment would increase. Nevertheless the performance of employment did not even reached the disappointing rates of growth of fixed investment and GDP. The problem of low rates of growth of employment observed since 1982 was not offset by the period of moderate expansion from 1988 to 1994, it actually became worse.

Graph 2.2 Gross Domestic Product and Labour: Mexico, 1971-2011

Rates of Growth



Source: INEGI, Banco de Información Económica.

According to López (2000) the deterioration of the labour market capability to absorb a higher number of employees was caused by three important facts. The first one has to do with the mediocre rate of growth of the Mexican economy, the second refers to the increase in labour productivity experienced in that period and the third consists of the increasing labour supply. This has led to a decrease in real wages, to an increase in informal employment and to a severe mismatch in the labour market; labour supply increases as real wage decreases, that is, it responds inversely to market signals.

In graph 2.2 it can be seen that the relationship between the growth rates of GDP and labour is not as direct and clear as the one between GDP and gross fixed investment, there are periods in which the growth of labour responds positively to the growth of GDP, others in which increases in GDP lead to decreases in labour, and periods in which the growth of labour does not respond at all. However there were periods in which we can see a particular trend. For instance, we see that the average rate of growth of labour from 1971 to 1981 was the greatest one throughout the entire period of study. From 1971 to 1981 employment grew at an average rate of 3.7% while GDP grew at an average rate of 7.2%.

From 1982 onwards it is hard to say if there is a particular pattern or not, the average rate of growth of GDP and labour from 1980 to 2011 was of 2.19% and 0.89% respectively. But what is particularly interesting is that if we divide this period into two, one from 1980 to 1999 and another from 2000 to 2011 we obtain that in the first period the rate of growth of GDP is 2.1% and of labour is 1.48% and in the second it is 2.3% and 0.02% respectively. Clearly the growth of GDP has been mediocre at least in the last three decades, but the rate of growth of employment is even more disappointing, from 2000 to 2011 the level of employment has not grown.

Considering the productive structure of the Mexican economy and the process of economic development, it is also important to identify the structure of labour among the three major sectors of the economy. All the economic reforms and policies applied in the Mexican economy since 1970s were addressed in order to reach a higher level

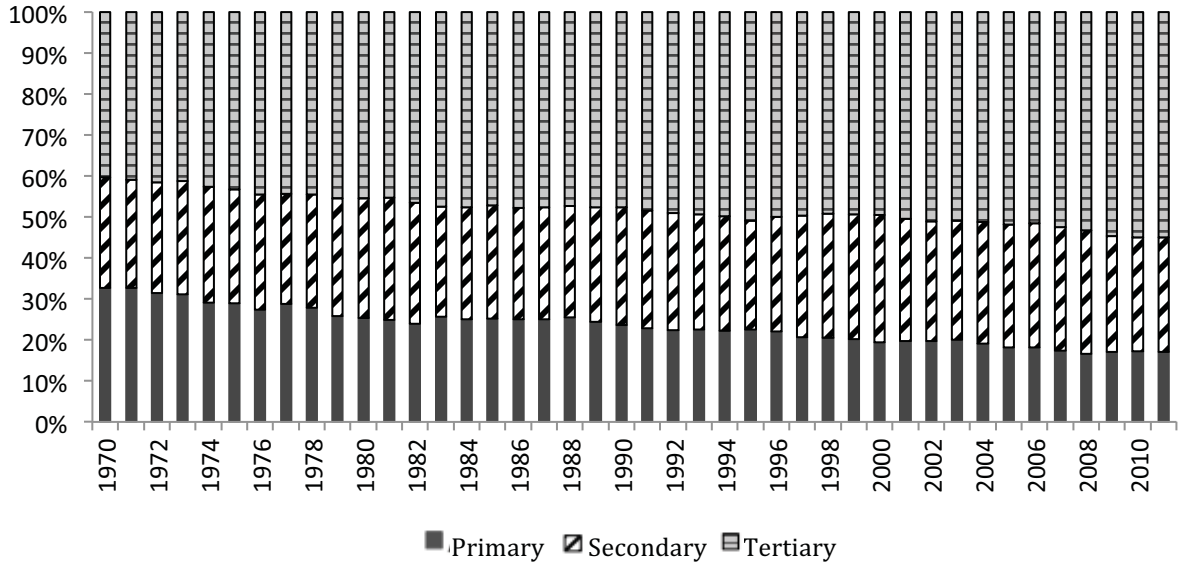
of production, productivity and efficiency in the manufacturing sector. This sector has been considered by several authors (Kaldor, 1966; Lewis, 1954) as the engine of growth of developing economies, thus it was expected that the economic reforms of the time would help the secondary sector to expand and to absorb a greater level of employment.

On this subject, it has been said that a labour transfer process must accompany the economic growth and development. The transfer process occurs from the less productive to the most productive sectors, or as Lewis states, from the traditional to the modern sector; the absorption of labour of the modern sector leads to an increase in global productivity and wages. It consists on expanding the modern productive sectors in order to utilize the unlimited supply of labour that most of the developing countries have (Lewis, 1954).

Graph 2.3 shows the productive structure of the Mexican economy considering the distribution of labour among the three major sectors. Effectively the proportion of total labour employed in the traditional sector, in this case the primary sector, has decreased over the years, the process of expulsion/absorption has taken place not between the primary and secondary sectors but between the primary and the tertiary. Over the years, the proportion of labour that the manufacturing sector has employed has remained stable.

The Mexican economy faces a phenomenon that has affected several economies in the world, and this is an unstoppable growth and development of the tertiary sector. Some studies have recognized that the participation of the tertiary sector in the world economy in production and labour is greater than 50% and therefore the economic structure of the developed and developing countries has changed substantially in favour or the tertiary sector over the last decades (see Garza, 2008; Montiel et al., 2007).

Graph 2.3 Structure of labour (percentage), 1970-2011



Source: INEGI, Banco de Información Económica.

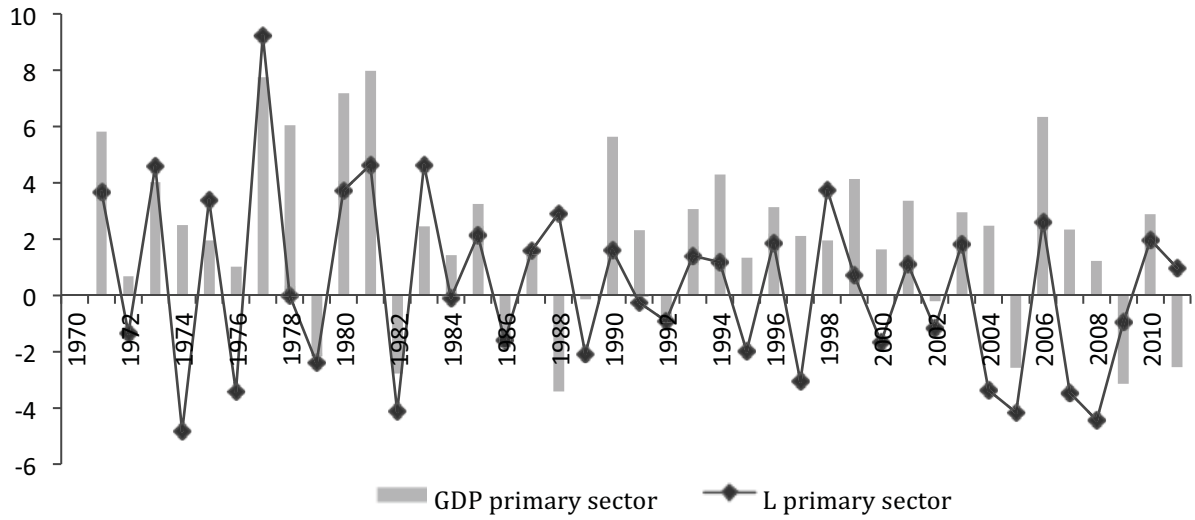
In Mexico over the last years the structure of labour has changed among the three economic sectors. In particular, it outstands the fact that the secondary sector has not been able to absorb the excess of labour supply, even though this is the sector that benefits most from the trade and financial liberalizations; it has not been able to significantly influence in the process of job generation in Mexico (Dussel Peters, 2003). It was also expected that the export-led activities in the secondary sector that in their majority utilize unqualified labour, would somehow increase the level of employment, but the fact that the export-led sectors are highly dependent from imported input's supply, has caused weakness in forward and backward linkages among the different industries of the Mexican economy, and thus has hindered a ripple effect on production and employment (Fujii, 2011).

If we analyse the performance of GDP and employment according to the three main divisions of the Mexican economy, we will realise that there are important facts about production and employment that suggest changes in the productive structure of the economy. For instance, from 1971 to 2011 the average rate of growth of employment

in the primary sector is 0.35%, in the secondary 0.90% and in the tertiary 2.7%. The sector with the greatest power of labour absorption clearly is the tertiary sector, the inefficiency of the productive sector, name it secondary, has led to small rates of employment and thus to the tertiarisation of the economy (see graphs 2.4, 2.5 and 2.6).

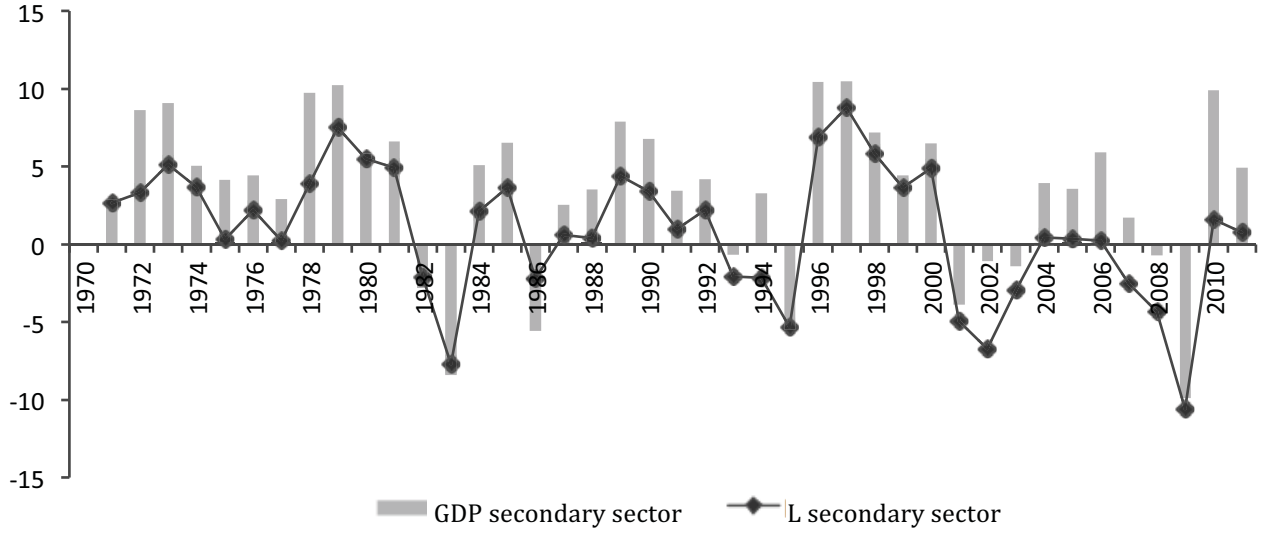
The primary sector has experienced a general decrease in the pace of expansion of GDP especially after the debt crisis; the growth of employment has experienced the process of expulsion discussed before; we can see that it experiences a negative trend and less and less labour is needed in order to accomplish the observed rates of growth of production. The secondary sector registered periods of great rates of expansion but also periods of deep decreases in GDP; in terms of employment, from 1970 to 2000 it more or less obeyed the trend that GDP took, however, from 2000 to 2011 the growth rate of employment substantially decreased and has not been able to recover.

Graph 2.4 Growth of GDP and employment in the primary sector, 1970-2011.



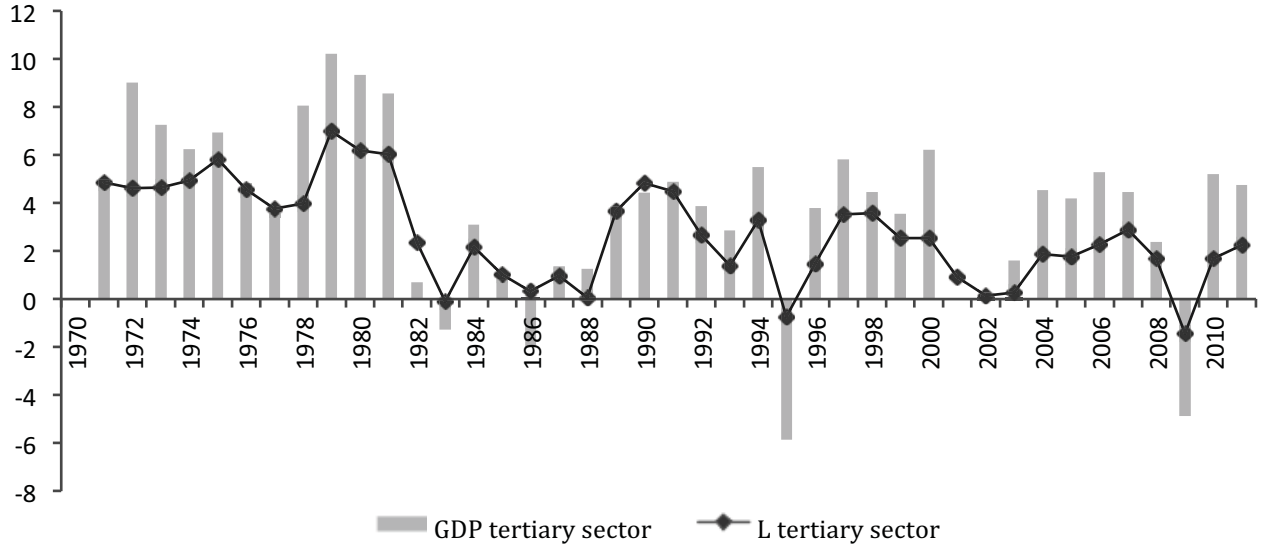
Source: INEGI, Banco de Información Económica.

Graph 2.5 Growth of GDP and employment in the secondary sector, 1970-2011.



Source: INEGI, Banco de Información Económica.

Graph 2.6 Growth of GDP and employment in the tertiary sector, 1970-2011.



Source: INEGI, Banco de Información Económica.

Moreover, even when the GDP tends to expand the rates of employment do not respond to these events. Some authors suggest that this trend could be associated with a relatively high intensity of capital and to modern or productive manufacturing sectors that instead of absorbing labour, they expel it (Dussel Peters and Cárdenas, 2007). The observable negative rates of growth of employment suggest a process of expulsion of labour force from that sector, which was supposed to absorb the increasing labour supply and the less productive labour from the traditional sectors.

The tertiary sector is the sector that records the highest rates of labour absorption; labour positively responds to the expansion of GDP, and its growth rates of GDP are also the highest in comparison with the other sectors. Although the growth of employment does not reach the exceptional rates of expansion of GDP, they are not negligible.

López (2000) states that in order to increase the level of employment in Mexico two roads can be taken, the first has to do with a diminution of labour productivity; that is, changing the relative prices in favour of capital would stimulate enterprises to use labour-intensive methods of production in which labour productivity is relatively low. The second refers to the use of comparative advantages associated with an increment in the production of those sectors in which labour productivity is lower than the average. These competitive advantages are precisely located in the labour-intensive activities.

From my point of view, special attention in the second road can lead to positive effects on the level of employment. The use of comparative advantages can be materialized with the implementation of industrial policies based on the promotion of particular sectors, those that could significantly contribute in the generation of new jobs.

In this context, the actual situation of the labour market in Mexico is particularly worrying because the rates of expansion of GDP and gross fixed investment have not provided the proper environment to generate the sufficient number of jobs. In this

chapter we explained the importance that gross fixed and GDP has on labour, the rates of expansion of gross fixed investment determine the growth rate of labour and it is clear that the disappointing performance of fixed investment over the last years has brought a nil expansion of labour in Mexico from 2000 to 2011.

The main purpose of this research and the next chapter is to identify the effects that fixed investment has on employment considering the productive structure of 2008 and 2009. It is also important to consider the relationship between the productive chains of the Mexican economy so that we could identify those sectors in which additional gross fixed investment could lead to an expansion of employment. In the next chapter a general overview of how this problem will be addressed is presented, and an empirical analysis considering the impact of gross fixed investment on employment of the 79 economic branches is presented.

CHAPTER 3
THE INPUT-OUTPUT MODEL AND THE EFFECTS OF CAPITAL ACCUMULATION ON EMPLOYMENT IN MEXICO

The purpose of this chapter is, first of all, to explain how the Input-Output model is constructed and how it will be utilised for the objectives of this work, and second to realise an empirical analysis for the Mexican economy based on Input-Output analysis. The reason why the Input-Output model was considered for the realisation of this work is because it enables to identify how every single economic entity is linked to the rest of the system, and thus it also allows one to know which of the entities has greater power upon the system and through which external shocks can be transmitted to the entire system. This chapter is divided in two sections; in the first one we present the Input-Output model, the subsystem analysis and also some small notes about how to obtain the employment multipliers and the indices of Rasmussen. In the second section we apply the methods of the Input-Output analysis to the Mexican economy and try to measure the effects of capital accumulation on employment.

3.1 The Input-Output Model

The Input-Output model has its origins in Leontief's conception of the *Economy as a Circular Flow* (1991, original from 1928) and in the Sraffian model of *Production of Commodities by Means of Commodities* (1960). Both Leontief and Sraffa thought of the inter-relations between all the component parts of an economy, i.e. in all the economic relations that occur between different branches and sectors of the economic sector. There are two important concepts to consider in the Input-Output model, the costs which we will later relate to as inputs, and the returns which are associated with the outputs, these two elements are the key elements to describe the relation in a circular production; the production of certain products is realised through the utilization and transformation of other products, and at the time, nearly always, the just-produced elements will be used and consumed in further processes of production.

For the production of almost all products raw materials are needed, there is no production that can be realised without the utilization of other materials. Therefore, one industry will need to acquire cost items to generate its own return items. That is why the concept of the economy as a circular flow developed by Leontief (1991) becomes an important tool, because it allows identifying the degree of interconnectedness and the economic relations between the different industries that constitute an economy. In the words of Leontief "The system of economic interrelationships may be represented as a long path describing a wide circle and ending up again at its starting point" (1991:182). Those paths as Leontief describes them will be of interest for the researchers, but moreover the important paths will be those that contribute the most to the whole circuit. A circular economy can be represented as in the following table:

Table 3.1 The circular economy.

Distribution of the outlays (Costs)	Distribution of Output (Revenues)					
	A	B	C	D	E	Total
A		A_b	A_c	A_d	A_e	$\sum_a^e A_i$
B	B_a		B_c	B_d	B_e	$\sum_a^e B_i$
C	C_a	C_b		C_d	C_e	$\sum_a^e C_i$
D	D_a	D_b	D_c		D_e	$\sum_a^e D_i$
E	E_a	E_b	E_c	E_d		$\sum_a^e E_i$
Total	$\sum_A^E i_a$	$\sum_A^E i_b$	$\sum_A^E i_c$	$\sum_A^E i_d$	$\sum_A^E i_e$	S

Source: Leontief (1936: 106)

The capital letters A, B, C, D and E, indicate economic sectors and household units. The row vectors contain the revenue items of each of the economic sectors, subdivided according to the origin of the revenue and the destination of its products. The lowercase letters represent the amounts that were sold to the rest of the sectors, for example, A_b represents the amount b of output B that was sold to the firm A. The last summation in the output vectors (row vectors) $\sum_a^e A_i$ indicates the total sum of these separate entries and shows the total revenue or production of firm A. And the last summation in the input vectors (column vectors) shows $\sum_A^E i_a$ the total expenditures of firm A and all its entries define the distribution of these expenditures among all the different sources of supply (B, C, D and E).

Therefore, table 3.1 illustrates two important things, first of all it accounts for the distribution of the final products of each sector, and second it helps identifying all the production inputs that each sector requires in its process of production. This is why it represents the circular economy, because it shows that every sector is connected to the rest of the system in such a way that each item and its process of production forms part of other's process of production.

Besides, as can be seen from table 3.1 the cells in the main diagonal are empty, this is because from the accounting principle there cannot be any kind of transactions within the same firm, but it needs to be cleared up that it depends on the aggregation level of each table, in a very disaggregated table that shows every single industry, certainly an industry cannot realise transactions with itself. The grand total S is obtained by adding up the total revenues (row-wise addition) or the total expenditures (column-wise addition) of all the different firms. For obvious reasons the total expenditures must equal the total revenues, an economy cannot spend more than what it earns.

The degree of aggregation can be defined by considering the type of products and production processes, if for example there are industries with more or less similar products, with similar production processes, and similar cost structures then these industries could be aggregated in one grand sector. When the table is aggregated, the cells in the mean diagonal are not necessarily empty, because there are also economic relations between the similar sectors contained in the grand sector.

The table above presented is part of the Input-Output model and it is called the matrix of inter-sectorial relations. This square matrix of dimension industry-by-industry contains current account requirements of each sector. In table 3.2 it can be seen that the grey part of it represents the table of the circular economy. The Input-Output table is a rectangular table that uses double-entry bookkeeping and that tracks all the transactions that have taken place within the economy at a given point of time. For this purpose, all private establishments are classified or aggregated into a specified number of industries, each of which sells its outputs as inputs to the others.

But also each of the industries sell part of their output as final demand to other sectors (column vectors) called the sectors of final delivery or final demand, such as households, government agencies, private investment, and (net) exports. From the other side, each industry's unit price must cover the costs of additional inputs mainly labour, profits, and the use of capital, which comprise the value-added.

Table 3.2 The Input-Output flow table.

		PRODUCERS AS CONSUMERS								FINAL DEMAND			
		Agriculture	Mining	Construction	Manufacturing	Trade	Transportation	Services	Other industries	Personal Consumption Expenditures	Gross Private Domestic Investment	Govt. Purchase of Goods and services	Net exports of goods and services
PRODUCERS	Agriculture												
	Mining												
	Construction												
	Manufaturing												
	Trade												
	Transportation												
	Services												
	Other industry												
VALUE ADDED	Employees	Employee Compensation								Gross Domestic Product			
	Business Owners and Capital	Profit-type income and capital consumption allowances											
	Government	Indirect business taxes											

Source: Miller and Blair (2009:3)

In order to use the Input-Output table as an analytical tool, we need to transform the part of the flow table that represents the circular economy into a coefficient matrix, to do so each entry in a given column of the flow table must be divided by the total output of the column industry (the sum of all the outputs and the value added), and the resulting ratio of input per unit of output is called a technical coefficient. The matrix of technical coefficients can thus be named the A matrix. By transforming the flow matrix into a technical coefficients matrix we are assuming that each column represents a technology or "cooking recipe" for the production of a single unit of the corresponding industry's output and that it does not change, i.e. we are assuming that there is no technical progress.

The A matrix contains the production requirements of each sector, the fundamental Input-Output balance equation can be written in matrix form as:

$$\boldsymbol{x} = \boldsymbol{A}\boldsymbol{x} + \boldsymbol{y} \tag{1}$$

Where $\boldsymbol{x}$ is the vector of total output and $\boldsymbol{y}$ is the vector of final deliveries. This equation means that the output is divided into two parts: the deliveries to all industries to satisfy their production requirements $\boldsymbol{Ax}$ and the deliveries to final consumers $\boldsymbol{y}$.

The equation can be rewritten as:

$$\boldsymbol{x} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\boldsymbol{y} \tag{2}$$

Where $\boldsymbol{I}$ is the identity matrix and $(\boldsymbol{I} - \boldsymbol{A})^{-1}$ is the Leontief inverse matrix, which can also be denoted by $\boldsymbol{L}$, it directly relates final deliveries to the outputs needed to produce them. It is also important to point out that this equation closely resemblances the multiplier equation and in a broad sense, the input output analysis can in fact be considered as an analysis of production multipliers.

The Leontief inverse shows how changes in $\boldsymbol{x}$ are the result of changes in the exogenous final demand $\boldsymbol{y}$; but how do we interpret the meaning of those elements contained in the Leontief matrix? To answer to that question let us begin considering a simple model with two sectors:

$$\begin{pmatrix} \boldsymbol{x_1} \\ \boldsymbol{x_2} \end{pmatrix} = \begin{pmatrix} \boldsymbol{l_{11}} & \boldsymbol{l_{12}} \\ \boldsymbol{l_{21}} & \boldsymbol{l_{22}} \end{pmatrix} \cdot \begin{pmatrix} \boldsymbol{y_1} \\ \boldsymbol{y_2} \end{pmatrix} \tag{3}$$

Where l_{ij} are the elements of the row i and the column j of the Leontief's inverse. If we solve the right side of equation (3) we have:

$$\begin{pmatrix} \boldsymbol{x_1} \\ \boldsymbol{x_2} \end{pmatrix} = \begin{pmatrix} \boldsymbol{l_{11}\, y_1 + l_{12}\, y_2} \\ \boldsymbol{l_{21}\, y_1 + l_{22}\, y_2} \end{pmatrix} \tag{4}$$

The partial derivatives from $\boldsymbol{y_1}$ and $\boldsymbol{y_2}$ lead to the following comparative-static derivations:

$$\begin{aligned} \frac{\partial x_1}{\partial y_1} &= \boldsymbol{l_{11}} \quad \frac{\partial x_1}{\partial y_2} = \boldsymbol{l_{12}} \\ \frac{\partial x_2}{\partial y_1} &= \boldsymbol{l_{21}} \quad \frac{\partial x_2}{\partial y_2} = \boldsymbol{l_{22}} \end{aligned} \tag{5}$$

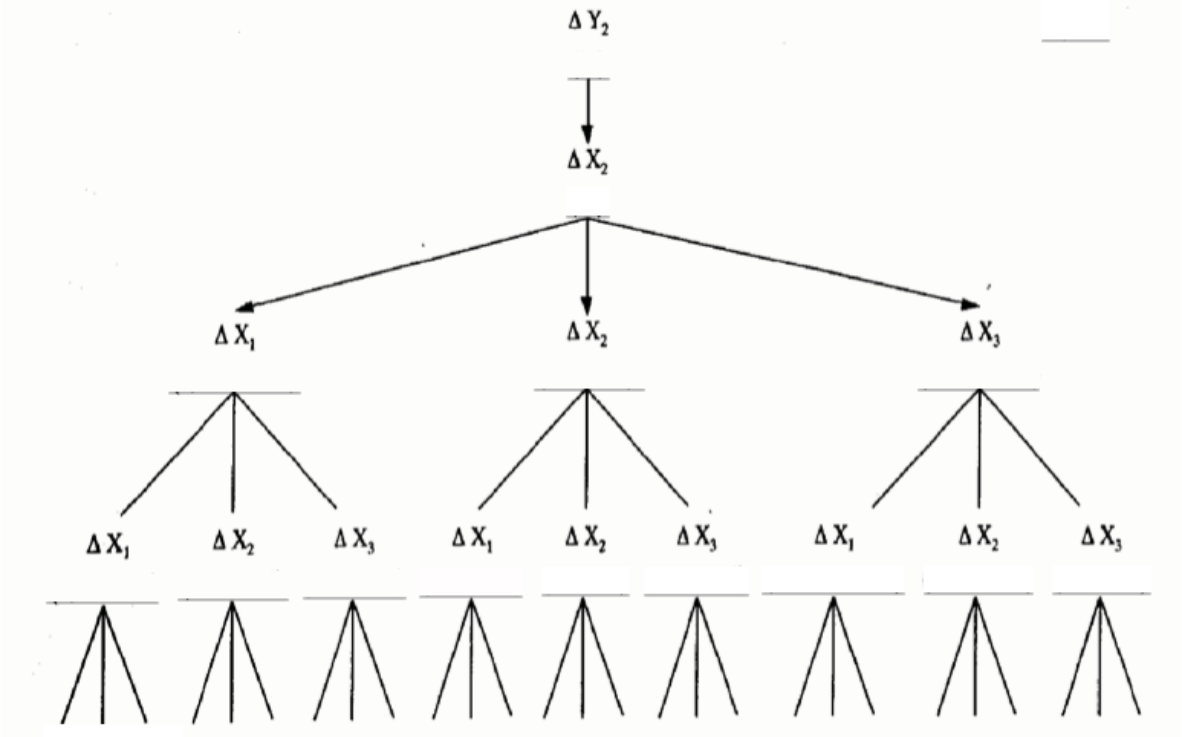
So that: $\frac{\partial x_i}{\partial y_j} = \boldsymbol{l_{ij}}$. Therefore a coefficient $\boldsymbol{l_{ij}}$ in intersection of row *i* and column *j* represents the direct and indirect changes of total production of sector *i* caused by a change on final demand of sector *j*. The $\boldsymbol{l_{ij}}$ elements determine the changes of output from *i* that are directly and indirectly required to produce an additional unit of sector *j* in order to satisfy final demand. Additionally, if we add column wise the coefficients of the inverse matrix $\sum_{i=1}^{n} \boldsymbol{l_{ij}}$ we obtain what all sectors directly and indirectly need to produce so that sector *j* can produce an additional unit for final demand. If we add them row wise $\sum_{j=1}^{n} \boldsymbol{l_{ij}}$ we obtain what sector *i*, by direct and indirect impulses, in total would need to produce so that each sector from 1 to *n* can produce an additional unit of its product for final demand.

Now we need to distinguish between the elements positioned in the main diagonal and the rest of them. The elements in the main diagonal are necessarily greater than or at least equal to one, $\boldsymbol{l_{ij} \geq 1 \; where \; i = j}$, the part of the element $\boldsymbol{l_{ij}}$ that corresponds to the unit represents the direct effect on its production due to an increment on its own final demand, the rest represent the indirect effects. For example, if $\boldsymbol{l_{11} = 1.33}$ and if the increment in final demand of sector one was of 1 million dollars, then $\boldsymbol{1.00}$ million dollars represent what sector one needs of additional output due to the increase in its own final demand and the rest $\boldsymbol{0.33}$ million dollars represent the additional output in sector one that other sectors needed to realise their production activities, i.e. the $\boldsymbol{0.33}$ million dollars represents the output in sector one that was delivered to other sectors, and that was used as input in the production processes of the others.

The elements out of the main diagonal are necessarily smaller than one, $\boldsymbol{l_{ij} < 1 \; where \; i \neq j}$, and they represent the additional production of sector *i* per unit of increment of final demand of sector *j*, that is, what sector *i* will produce and then sell to sector *j*, so that sector *j* uses this purchased quantity of output of sector *i* as input for its own production.

Therefore, the general idea behind the Input- Output model described by equation (2) is to measure the increments in the production of all sectors that were the outcome of the increase in the final demand of another sector(s). An increase in one sector's final demand will lead to a direct increase of the same magnitude in itself, but will also lead to an increase in other sector's production because for the production of the increased final demand additional inputs will be required in all or almost all sectors.

Figure 3.1 Effects of an increment in final demand of sector two.



Source: Holub and Schnabl (1994: 109)

For example, if we consider an economy with three productive sectors, as shown in figure 3.1, we can observe that an increase in the final demand of sector two, will not only affect the level of production of sector two, but that it will also impact the level of production of sector one and three and that at the time they will impact the others and so on. Something similar would happen if final demand of sector one or three increases and of course if we jointly account the effects of an increase in final demand of the three sectors, the picture becomes larger and larger.

Then the simple formulation in equation (2) makes possible numerous experiments. For example, one can:

i. Fix y and determine x for a given A,
ii. Fix x and determine y for a given A,
iii. Change elements of A and repeat the above.

Depending on the interests of the researcher the Input-Output model can be used to study different cases. One can in addition assemble information for a matrix of each industry's labour requirements, by occupation and per unit of output (N matrix) and of each sector's capital stock requirements, by type of capital and per unit of output (K matrix). Then for a given $\boldsymbol{y}$ one can compute not only $\boldsymbol{x}$ but also:

$$\boldsymbol{e} = \boldsymbol{N}\boldsymbol{x}, \ \boldsymbol{k} = \boldsymbol{K}\boldsymbol{x} \qquad (6)$$

Where $\boldsymbol{e}$ is the vector of labour requirements, by occupation, for the economy as a whole and $\boldsymbol{k}$ is the corresponding vector of capital stock requirements. In the event of technological change, one can change the corresponding coefficients in the A matrix and make a new computation. In the case of a technological change, for example in which robots replace welders, one would change coefficients in the $\boldsymbol{K}$ and $\boldsymbol{N}$ matrices. In this case, a problem arises, when capital requirements change, investment patterns will generally also change. While in the above formulation, or model, investment is specified as part of final deliveries, the level and composition of investment goods are in fact generally determined by technological considerations on sectorial growth.

3.1.1 The Subsystem Analysis

The subsystem analysis allows identifying the allocation of other inputs, for example labour, to the production processes of the different goods. This approach is based on the partition of the economic system into as many subsystems m as commodities. This method was developed by Sraffa (1960) in *The Production of Commodities by Means of Commodities* and then by Pasinetti (1980, 1986) in several of his works.

Sraffa defined a subsystem as follows:

> "A system can be subdivided into as may parts as there are commodities in its net product, in such a way that each part forms a smaller self-replacing system, the net product of which consists of only one kind of commodity" (1960: 89).

That is, for example, if the complete systems' net product consists of 35 commodities, then it can be split up in 35 subsystems. Of course the principle behind this idea has a strong economic meaning; it means that the 35 sectors take the intermediate process for granted and bring into relief the final goods and the labour requirements. In other words, this is what Pasinetti (1980, 1986) calls the *vertically integrated sectors* which as he states, can be represented simply by one physical unit of final good i, one physical unit of vertically integrated productive capacity for final good i and one physical quantity of labour for final good i. Pasinetti defines a subsystem as:

> "(…) an analytical construct that represents a self-contained economic system which produces physical quantity Y_i, as net product, and absorbs L_i of labour as net input, while at the same time reproducing all the means of production necessary for this purpose through a self-replacing circular process" (1980: 10).

Technically speaking, this analysis is the result of a change in the allocation of the production system, and is based in the utilization of a synthetic final demand vector $\boldsymbol{y}$ (see Schnabl 2000). The vector $\boldsymbol{y}$ contains only zeros except for one element; this one different element in spot j will be equal to the final demand of j, this vector will now be multiplied by the Leontief inverse matrix so that we get $\boldsymbol{c_{ij}} = (\boldsymbol{I} - \boldsymbol{A})^{-1}\, \boldsymbol{y_j}$.

Each element of the resulting vector $\boldsymbol{c_{ij}}$ indicates how much sector i as a whole must produce to contribute creating a unit of final product j. As we would like to make this observation for all n final sales simultaneously, we would need to use the appropriate multiplication to apply it for n sectors:

$$\boldsymbol{x_{sub}} = (\boldsymbol{I} - \boldsymbol{A})^{-1} \; < \boldsymbol{y} > \tag{7}$$

Where $< \boldsymbol{y} >$ is the diagonalized vector of final demand.

By including the n columns as in equation (7) we can define the square matrix $\boldsymbol{x_{sub}}$ for each j-th subsystem of the production system, that is, the matrix consists of "hanged side by side" subsystems and it shows the production efforts of a single row sector i distributed over the production of all final demand goods. This is of course also a form of imputation that has a special feature because the effect of final demand is distributed, in the context of production, exclusively to the production sectors involved. But as these values are absolute values of the contributions of production of sector i to the rest of industries, we will use equation (8) to obtain the sectorial share values of the contributions of production of sector i to the rest of the system.

$$\boldsymbol{S} = < \boldsymbol{x} >^{-1} (\boldsymbol{I} - \boldsymbol{A})^{-1} \; < \boldsymbol{y} > \tag{8}$$

Where $< \boldsymbol{x} >^{-1}$ is the inverse of the diagonalized vector of production value, or in other words, the diagonalized matrix that registers the $\boldsymbol{1/x_i}$ elements. The $< \boldsymbol{x} >^{-1}$ matrix allows a division of each element by the sectorial production value $\boldsymbol{x_i}$ and therefore allows a "standardization" of the row so that the addition of the elements $\boldsymbol{s_{ij}}$ along row j results 1. If we pre-multiply the $\boldsymbol{S}$ operator given by (8) with a diagonal matrix of size n of, for example, the labour force $< \boldsymbol{e} >$, then we obtain the distribution of the labour force in the n subsystems, those that describe the labour inputs needed for the production of the n sectors final demand.

$$\boldsymbol{x_e} = < \boldsymbol{e} >< \boldsymbol{x} >^{-1} (\boldsymbol{I} - \boldsymbol{A})^{-1} \; < \boldsymbol{y} > \tag{9}$$

The matrix $\boldsymbol{x_e}$ resulting from (9) registers the direct and indirect labour requirements to satisfy final demand. The individual column elements of $\boldsymbol{x_e}$ show how much the

relevant subsystem directly and indirectly needs of labour force for the production of each required quantity of the final demand of the concerned good *j* in order to create the total final demand of the column sector in question. Therefore if we add column-wise the elements of $\boldsymbol{x_e}$ we will obtain the number of employees needed to produce the product(s) of the sector or category *j*. If we add them row-wise we obtain the number of employees embodied in the production of good *i* that sector *i* delivered to the rest of the system.

For the purpose of this study, the subsystem analysis is a very valuable instrument to identify the impact of a given level of final demand on the level of employment, moreover, if instead of considering the whole final demand we just take the part that corresponds to capital investment, we can directly identify the amount of labour needed to satisfy capital investment demand. By utilizing this analysis we will be able to determine three main things, firstly we will recognize the net direct and indirect labour requirements of each sector in order to satisfy investment demand, secondly we will be able to identify those sectors, that in terms of labour, are more connected or depend the most to the rest of the system, and thirdly the degree of connectedness will allow us to identify those sectors that contribute the most to the general level of employment. That is, this analysis helps us identifying the main channels through which the general level of employment can increase.

3.1.2 The multiplier analysis and the indices of Rasmussen

In this subsection it is shown how to obtain first the employment multipliers and second the indices of Rasmussen. The former have been utilized and improved by several authors such as Dietzenbacher and Los and they have been commonly applied not only to analyse the problem of employment but also to describe the level of exports or even to measure the quantity of pollutant emissions. The latter were developed by Rasmussen (1963) in his work *Intersectoral Relations* and are used to highlight and recognize the importance of some sectors that he calls *key sectors*.

On the one hand, by means of the employment multipliers we can recognize the sectors in which an increase in final demand and, specifically, an increase in capital investment, has the greatest effect on the level of employment. On the other hand the indices of Rasmussen help to identify those sectors that in some way are more connected to the rest of the system; they help identifying those sectors in which additional capital investment generates positive effects on the major part of the system so that the largest possible number of industries could benefit from an external shock.

3.1.2.1 The employment multipliers

A multiplier measures the difference between the initial and the total effect of an exogenous change, the total effects can be defined either as direct and indirect effects (open Input-Output model) or as direct, indirect and induced effects (closed Input-Output model). The most common kinds of multipliers are those that estimate the effects of exogenous changes on: *a)* outputs of the different sectors, *b)* income earned by households in each sector because of new outputs, *c)* employment that is expected to be generated in each sector because of new outputs and *d)* the value added that is created by each sector because of new outputs (see Miller and Blair 2009 Chap. 6 and Dietzenbacher and Los 2002). However, in this chapter we will focus on the simple employment multipliers, those that account only for the direct and indirect effects, or in other words those that result from the open Input-Output model.

The simple employment multipliers are given by the following expression:

$$\boldsymbol{m(e)_j = \sum_{i=1}^{n} a_{n+1,j}\, l_{ij}} \qquad (10)$$

Where $[\boldsymbol{a_{n+1,1} \quad \cdots \quad a_{n+1,n}}]$ is the row associated to employment input coefficients that can be measured in terms of monetary or physical units of the number of employees per unit of output, i.e. they result from:

$$\boldsymbol{[a_{n+1,1} \quad \cdots \quad a_{n+1,n}] = h' < x >^{-1}} \qquad (11)$$

Where $\boldsymbol{h}'$ is the row vector that measures in physical or monetary terms the number of employees in each sector in the base period. Then the resulting vector of size *n* of simple employment multipliers $\boldsymbol{m}(\boldsymbol{e})_{\boldsymbol{j}}$ indicates that an additional dollar of final demand for sector *j* would generate the quantity $m(e)_j$ of new jobs when all direct and indirect effects are converted into monetary or physical terms.

These multipliers will determine in which sector an increase in final demand generates more employment; moreover, as capital investment is an element of the final demand, we can say that if the increase in final demand was due to an increase in capital investment, then the employment multipliers will tell us the effects that additional capital investment has on the level of employment.

3.1.2.2 The indices of Rasmussen

The Rasmussen indices are another method to determine whether a sector is important to an economic system or not. The first index can be named as the power of dispersion index; it shows if a sector has a considerable weight in the system. This index describes the relative extension in which an increase in final demand for the products of industry *j* is dispersed through the other industries.

We can calculate the dispersion index as follows (Rasmussen, 1963: 128):

$$\boldsymbol{U}_{\cdot j} = \frac{\frac{\mathbf{1}}{\boldsymbol{n}}\sum_{\boldsymbol{i}=\mathbf{1}}^{\boldsymbol{n}} \boldsymbol{l}_{\boldsymbol{ij}}}{\frac{\mathbf{1}}{\boldsymbol{n}^{\mathbf{2}}}\sum_{\boldsymbol{j}=\mathbf{1}}^{\boldsymbol{n}}\sum_{\boldsymbol{i}=\mathbf{1}}^{\boldsymbol{n}} \boldsymbol{l}_{\boldsymbol{ij}}}; \quad (\boldsymbol{j} = \mathbf{1}, \mathbf{2}, \dots, \boldsymbol{n})$$

$$\boldsymbol{U}_{\boldsymbol{i}\cdot} = \frac{\frac{\mathbf{1}}{\boldsymbol{n}}\sum_{\boldsymbol{j}=\mathbf{1}}^{\boldsymbol{n}} \boldsymbol{l}_{\boldsymbol{ij}}}{\frac{\mathbf{1}}{\boldsymbol{n}^{\mathbf{2}}}\sum_{\boldsymbol{i}=\mathbf{1}}^{\boldsymbol{n}}\sum_{\boldsymbol{j}=\mathbf{1}}^{\boldsymbol{n}} \boldsymbol{l}_{\boldsymbol{ij}}}; \quad (\boldsymbol{i} = \mathbf{1}, \mathbf{2}, \dots, \boldsymbol{n}) \qquad (12)$$

Therefore $\boldsymbol{U}_{\cdot j}$ expresses the extent of an expansion caused in the rest of the industries by an expansion in industry *j* and it is also known for measuring the *backward linkages*. If $\boldsymbol{U}_{\cdot j} > \mathbf{1}$ it means that sector *j* has a considerable weight upon the economic

system compared to the general system of industries. This index describes the relative extension in which an increase in final demand of industry *j* is dispersed through the economic system. Likewise if $\boldsymbol{U_{i\cdot} > 1}$ it means that industry *i* in general will have to increase its production more than other industries to respond to a given increment in final demand, known as a measure of the *forward linkages*. Then when considering jointly the indices of dispersion that measure the backward and the forward linkages we can classify industries as follows:

i. *Key sector:* If $\boldsymbol{U_{\cdot j} > 1}$ and $\boldsymbol{U_{i\cdot} > 1}$

ii. *Backward-oriented sector:* If $\boldsymbol{U_{\cdot j} > 1}$ but $\boldsymbol{U_{i\cdot} < 1}$

iii. *Forward-oriented sector:* If $\boldsymbol{U_{i\cdot} > 1}$ but $\boldsymbol{U_{\cdot j} < 1}$

iv. *Non-key sector:* If $\boldsymbol{U_{\cdot j} < 1}$ and $\boldsymbol{U_{i\cdot} < 1}$

The second index developed also by Rasmussen measures the variance of the dispersion index, this with the intention to know if the effect of an expansion in industry *j* on the rest of the economic sectors is uniform or if it only affects a group of sectors. The variance index can be estimated with the following equations (Rasmussen, 1963: 132):

$$\boldsymbol{V_{\cdot j} = \frac{\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(l_{ij} - \frac{1}{n}\sum_{i=1}^{n} l_{ij}\right)^2}}{\frac{1}{n}\sum_{i=1}^{n} l_{ij}}, (j = 1, 2, \dots, n)}$$

$$\boldsymbol{V_{i\cdot} = \frac{\sqrt{\frac{1}{n-1}\sum_{j=1}^{n}\left(l_{ij} - \frac{1}{n}\sum_{j=1}^{n} l_{ij}\right)^2}}{\frac{1}{n}\sum_{j=1}^{n} l_{ij}}, (j = 1, 2, \dots, n)} \qquad (13)$$

$\boldsymbol{V_{\cdot j}}$ can be interpreted as an index of uniformity of the impact of sector *j* on the rest of the industries, if the value of $\boldsymbol{V_{\cdot j}}$ is low then the expansion affects the majority of the sectors, which is a desirable effect. If the value of $\boldsymbol{V_{\cdot j}}$ is great, then it means that the expansion on sector *j* has a unilateral effect, i.e. it only affects a small number of industries.

Therefore if $\boldsymbol{U}_{\cdot j}$ is relatively large and if $\boldsymbol{V}_{\cdot j}$ is relatively small, then an increase in the final demand in the corresponding sector *j* will lead to a relatively large increase in the final demand of the whole system of industries, thus we can say that the main characteristic of a "key sector" is its great effects on the other industries. If the State would like to increase the final demand in such a way that the economic activity increases in all industries, then it will increase the final demand of those sectors in which the value of $\boldsymbol{U}_{\cdot j}$ is large and the value of $\boldsymbol{V}_{\cdot j}$ is low. An expansion in those economic sectors will lead to a general increase of the economic activity that will comprise all or at least the majority of the sectors.

3.2 The effects of Capital Accumulation on Employment in Mexico

In this section the empirical analysis of the impact of capital accumulation on employment for the case of Mexico is presented. By means of the Input-Output model analysed in the former section and some of its applications that become useful for the objectives of this work, I will try to present those sectors of the Mexican economy in which capital accumulation has the greatest impact on employment.

Those sectors will be identified through the subsystem analysis, the multiplier analysis and the indices of Rasmussen; the first one will enable us to know the labour units (hours or number of employees) that each sector required to satisfy a given level of investment demand, that is, we will be able to identify those sectors that in terms of labour are more connected to the rest of the system; the second one will allow us to identify those sectors in which the impact of additional investment demand on employment is higher; and finally, through the third one we will make sure that investment in those sectors will actually generate the best possible outcome not only for a small number of industries but for the majority of them.

Table 3.3 Classification of the Input-Output Table from WIOD

ISIC	*No.*	*Name of the Sector*
AtB	1	Agriculture, Hunting, Forestry and Fishing
C	2	Mining and Quarrying
15t16	3	Food, Beverages and Tobacco
17t18	4	Textiles and Textile Products
19	5	Leather, Leather and Footwear
20	6	Wood and Products of Wood and Cork
21t22	7	Pulp, Paper, Paper , Printing and Publishing
23	8	Coke, Refined Petroleum and Nuclear Fuel
24	9	Chemicals and Chemical Products
25	10	Rubber and Plastics
26	11	Other Non-Metallic Mineral
27t28	12	Basic Metals and Fabricated Metal
29	13	Machinery, Nec
30t33	14	Electrical and Optical Equipment
34t35	15	Transport Equipment
36t37	16	Manufacturing, Furniture, Nec; Recycling
E	17	Electricity, Gas and Water Supply
F	18	Construction
50	19	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
51	20	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
52	21	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
H	22	Hotels and Restaurants
60	23	Inland Transport
61	24	Water Transport
62	25	Air Transport
63	26	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
64	27	Post and Telecommunications
J	28	Financial Intermediation
70	29	Real Estate Activities
71t74	30	Renting of M&Eq and Other Business Activities
L	31	Public Admin and Defence; Compulsory Social Security
M	32	Education
N	33	Health and Social Work
O	34	Other Community, Social and Personal Services
P	35	Private Households with Employed Persons

Source: WIOD. Timmer (2012).

Table 3.4 Classification of the Input-Output Table from INEGI

NAICS	*No.*	*Name of the Sector*	*NAICS*	*No.*	*Name of the Sector*
111	1	Agriculture	**486**	41	Pipeline Transport
112	2	Breeding and Stocking of Animals	**487**	42	Touristic Transport
113	3	Forestry activities	**488**	43	Services related to Transport
114	4	Hunting, Fishing and Animal Capture	**491**	44	Post
115	5	Services related to Farming and Forestry	**492**	45	Messaging and Packaging
211	6	Oil and Gas Extraction	**493**	46	Storage Services
212	7	Mining and Quarrying except Oil and Gas	**511**	47	Newspaper, Magazines, Books, Software and Publishing
213	8	Services related to Mining	**512**	48	Film, Video and Sound Industry
221	9	Generation and Distribution of Electric Energy	**515**	49	Radio and Television
222	10	Distribution of Gas and Water by pipeline	**517**	50	Other Telecommunications
236	11	Construction	**518**	51	Processing of Information, Accommodation and others
237	12	Civil engineering works	**519**	52	Other Information Services
238	13	Specialized works for construction	**521**	53	Central Bank
311	14	Food	**522**	54	Financial Intermediation
312	15	Beverages and Tobacco	**523**	55	Stock, Exchange and Financial Investment Activities
313	16	Textile inputs	**524**	56	Insurance and bonds
314	17	Textile products except from clothing	**531**	57	Real Estate Activities
315	18	Clothing production	**532**	58	Renting of Machinery and Equipment
316	19	Leather	**533**	59	Renting of Registered Brands, Patents and Franchise.
321	20	Wood	**541**	60	Professional, Scientific and Technical services
322	21	Paper	**551**	61	Corporates
323	22	Printing	**561**	62	Support to businesses
324	23	Products derived from Oil and Coal	**562**	63	Waste and Remediation Activities
325	24	Chemical Industry	**611**	64	Education
326	25	Rubber and Plastics	**621**	65	External Medical assistance
327	26	Other Non-Metallic Mineral	**622**	66	Hospitals
331	27	Basic Metals	**623**	67	Residences of Social Assistance and Health Care
332	28	Fabricated Metal	**624**	68	Other Social Services
333	29	Machinery and Equipment	**711**	69	Artistic, Cultural and Sport services
334	30	Electrical and Electronic Equipment	**712**	70	Museums, Zoos, Historical places and similar
335	31	Electrical and Electronic Accessories	**713**	71	Entertaining
336	32	Transport Equipment Production	**721**	72	Hotels
337	33	Furniture, Mattress and Shutter	**722**	73	Restaurants
339	34	Other Manufacturing industries	**811**	74	Maintenance and Repair services
431	35	Commerce	**812**	75	Personal services
481	36	Air Transport	**813**	76	Associations and Organizations
482	37	Rail Transport	**814**	77	Private Households with Employed Persons
483	38	Water Transport	**931**	78	Public Admin and Defence; Compulsory Social Security
484	39	Cargo Transport	**932**	79	International and Extraterritorial Organisms
485	40	Passenger Transport			

Source: INEGI (2013).

Two different sets of database were utilized in this work; the first one was obtained from the *World Input-Output Database* (Timmer, 2012), and has the advantage that it reports a small quantity of empty cells, which allows having a broader image of the relations that occur within the system, this database is from 2009. The Input-Output table is aggregated in 35 sectors and is measured in millions of US dollars, the level of employment obtained from the *WOID Social Accounts* is measured in millions of hours worked.

The second database was obtained from the Mexican Institute of Statistics and Geography (INEGI, 2013). It reports the Input-Output table in the very disaggregated level of 79 industries that allows a better identification of the key industries. This database is from 2008; the Input-Output table is measured in millions of Mexican pesos and the level of employment in number of employees. The industrial classification is different in both databases, the WOID utilizes the International Standard Industrial Classification (*ISIC*) and INEGI database uses the North American Industry Classification System (*NAICS*). The classification of the industries of both databases is shown in tables 3.3 and 3.4.

The reason why two different databases are utilized to realise the same analysis is that it will enable a comparison of the results obtained and that by this means we will make sure that the results obtained with one database match with results obtained with the other one.

3.2.1 The subsystem analysis

To achieve the objectives of this work, we need to measure the impact that capital accumulation has on employment in a given period of time, in order to do so we would need to adapt and solve equation (9) of the subsystem analysis, that is, as we are interested in identifying only the effect of investment on employment and not the effect of final demand on employment, then we would have to solve equation (9) only for the part of final demand that corresponds to Gross Fixed Capital Formation; i.e. $\boldsymbol{y}$

will be our vector of *GFCF*. We should always keep in mind that each set of data registers the level of employment, total output and final demand in different units of measurement.

Then after solving the subsystem equation (9) for both sets of data we will obtain a square matrix $\boldsymbol{x_e}$ of size 35 (see table 1 of the Appendix) and another one of size 79 (table 2 of the Appendix), which show how investment (*GFCF*) was distributed across the different sectors and the level of employment that each sector required in order to satisfy the given level of investment demand, i.e. it shows the level of employment associated with the level of investment in each sector; it associates the distribution of investment with the distribution of employment. Nevertheless, as it may not be practical to report in these pages the resulting $\boldsymbol{x_e}$ matrices, in tables 3.5 and 3.6 we present the most important results. Tables 3.5 and 3.6 report information about employment and information about investment; the employment side registers the information obtained from solving the subsystem $\boldsymbol{x_e}$ and the investment side deals with the information of the *GFCF*.

The first column of the employment side of each table registers the column-wise addition of $\boldsymbol{x_e}$ and it shows how much working force each sector of the subsystem directly and indirectly *required* to satisfy the given investment demand, i.e. it shows the units of employment embodied in the inputs that the (column) sector in question required to satisfy investment demand.

The second column registers the row-wise addition of $\boldsymbol{x_e}$ and it shows the units of employment that were *delivered* from the (row) sector to the rest of the system, i.e. it represents the distribution of the (row) sector's production in terms of labour to the rest of the industries. The third column shows the difference between column 1 and column 2, if the difference is positive, then it means that the sector in question required more employment than the level of employment that it delivered (i.e. the sector *imports* labour). If the difference is negative it means that the sector required less units of labour than what it actually delivered (i.e. the sector *exports* labour).

Table 3.5 The Subsystem Analysis: Mexico, 2009 with data from WIOD

	Employment side[a]						Investment side[b]		
Sector ISIC	*1) Addition (column-wise)*	*2) Addition (row-wise)*	*3)= 1) - 2)*	*X or M*	*Top Ranking*	*% Main Diagonal with respect to 1)*	*GFCF*	*% GFCF with respect to total GFCF*	*Top Ranking*
AtB	202.85	272.65	-69.81	X		91.22	1,359	0.90	
C	102.80	72.43	30.37	M	3	45.02	9,054	5.97	2
15t16	18.01	18.96	-0.95	X		41.75	258	0.17	
17t18	4.47	38.30	-33.83	X		87.07	25	0.02	
19	0.54	6.41	-5.87	X		73.22	6	0.00	
20	0.81	36.13	-35.32	X		50.40	9	0.01	
21t22	2.15	45.12	-42.97	X		70.86	34	0.02	
23	2.94	9.55	-6.61	X		19.41	181	0.12	
24	7.43	37.29	-29.85	X		46.69	240	0.16	
25	4.83	75.10	-70.27	X		71.41	63	0.04	
26	2.26	252.82	-250.56	X		69.28	43	0.03	
27t28	27.91	162.13	-134.21	X		54.86	791	0.52	
29	108.95	93.60	15.36	M	4	76.95	1,418	0.93	8
30t33	90.62	85.74	4.88	M	5	66.63	2,161	1.42	7
34t35	201.37	126.86	74.51	M	2	57.20	4,349	2.87	5
36t37	106.65	112.07	-5.42	X		74.73	1,193	0.79	
E	5.69	35.39	-29.70	X		50.72	149	0.10	
F	10,656.63	8,556.46	2,100.18	M	1	80.26	113,315	74.66	1
50	4.16	119.62	-115.46	X		91.00	36	0.02	
51	218.94	281.88	-62.94	X	25	65.53	6,953	4.58	3
52	527.38	926.31	-398.93	X	34	89.13	6,117	4.03	4
H	22.10	91.97	-69.87	X		92.75	141	0.09	
60	156.91	307.58	-150.68	X	32	79.72	2,561	1.69	6
61	9.17	21.23	-12.06	X		81.73	56	0.04	
62	3.88	8.18	-4.30	X		51.13	55	0.04	
63	22.45	67.95	-45.50	X		87.14	228	0.15	
64	1.58	13.44	-11.86	X		43.75	79	0.05	
J	0.17	68.01	-67.84	X		51.80	6	0.00	
70	0.23	12.20	-11.97	X		63.12	23	0.01	
71t74	36.49	572.77	-536.28	X		90.49	503	0.33	
L	0.00	5.60	-5.60	X			0	0.00	
M	38.71	43.76	-5.06	X		95.92	295	0.19	
N	2.13	2.53	-0.40	X		85.26	32	0.02	
O	3.59	14.76	-11.17	X		85.65	43	0.03	
P	0.00	0.00	0.00	--			0	0.00	

Source: Own estimates with data from WOID.

Notes: [a] Employment measured in millions of hours. [b] Gross Fixed Capital Formation measured in millions of US dollars.

Table 3.6 The Subsystem Analysis: Mexico, 2008 with data from INEGI

	Employment side[a]						Investment side[b]		
Sector NAICS	*1) Addition (column-wise)*	*2) Addition (row-wise)*	*3)= 1) - 2)*	*X or M*	*Top Ranking*	*% Main Diagonal with respect to 1)*	*GFCF*	*% GFCF with respect to total GFCF*	*Top Ranking*
111	43,922	144,894	-100,972	X		97.92	2,543	0.098	
112	223,622	114,721	108,901	M	5	50.06	27,810	1.069	8
113	0	22,516	-22,516	X		--		0.000	
114	0	156	-156	X		--		0.000	
115	0	1,340	-1,340	X		--		0.000	
211	0	2,485	-2,485	X		--		0.000	
212	0	62,173	-62,173	X		--		0.000	
213	232,589	78,325	154,263	M	3	33.65	132,782	5.105	5
221	0	13,407	-13,407	X		--		0.000	
222	0	7,038	-7,038	X		--		0.000	
236	6,164,690	4,731,164	1,433,525	M	1	76.67	1,265,880	48.672	1
237	1,794,379	1,163,688	630,691	M	2	64.53	454,097	17.460	2
238	86,232	497,695	-411,463	X	76	85.93	16,911	0.650	11
311	0	14,055	-14,055	X		--		0.000	
312	0	636	-636	X		--		0.000	
313	0	3,539	-3,539	X		--		0.000	
314	577	2,846	-2,269	X		63.88	179	0.007	27
315	0	2,288	-2,288	X		--		0.000	
316	0	3,262	-3,262	X		--		0.000	
321	0	55,951	-55,951	X		--		0.000	
322	0	7,566	-7,566	X		--		0.000	
323	0	10,432	-10,432	X		--		0.000	
324	0	3,236	-3,236	X		--		0.000	
325	0	17,157	-17,157	X		--		0.000	
326	4,803	32,267	-27,465	X		49.94	2,208	0.085	21
327	153	183,003	-182,850	X		61.74	55	0.002	28
331	36,348	32,719	3,629	M	8	16.16	26,517	1.020	9
332	41,166	99,311	-58,145	X	70	59.48	15,073	0.580	12
333	57,870	32,531	25,339	M	6	47.08	34,002	1.307	7
334	5,457	3,761	1,696	M	14	58.37	6,741	0.259	16
335	17,408	22,180	-4,773	X		49.35	10,888	0.419	14
336	249,536	98,628	150,908	M	4	38.00	179,240	6.892	4
337	60,869	53,789	7,079	M	7	66.19	14,547	0.559	13
339	1,137	3,883	-2,746	X		73.76	532	0.020	24
431	1,385,402	1,949,759	-564,357	X	77	86.77	290,378	11.165	3
481	1,395	1,638	-243	X		21.81	781	0.030	23
482	5,776	2,751	3,025	M	9	34.54	3,899	0.150	17
483	2,575	1,955	620	M		49.19	1,844	0.071	22
484	191,303	201,714	-10,411	X	58	78.53	76,248	2.932	6
485	14	6,118	-6,104	X		73.32	5	0.000	

Source: Own estimates with data from INEGI.

Notes: [a] Employment measured in number of employees [b] Gross Fixed Capital Formation measured in millions of MX pesos.

CONT. Table 3.6 The Subsystem Analysis: Mexico, 2008 with data from INEGI

	Employment side[a]						Investment side[b]		
Sector NAICS	*1) Addition (column-wise)*	*2) Addition (row-wise)*	*3)= 1) - 2)*	*X or M*	*Top Ranking*	*% Main Diagonal with respect to 1)*	*GFCF*	*% GFCF with respect to total GFCF*	*Top Ranking*
486	4,292	2,324	1,969	M	12	45.83	3,862	0.148	18
487	11	80	-69	X		78.86	2	0.000	
488	15,557	13,616	1,942	M	13	51.06	7,051	0.271	15
491	0	564	-564	X		--		0.000	
492	0	1,347	-1,347	X		--		0.000	
493	0	10,355	-10,355	X		--		0.000	
511	10,913	8,497	2,417	M	10	52.70	3,781	0.145	19
512	1,072	1,027	45	M	16	47.86	369	0.014	26
515	0	47	-47	X		--		0.000	
517	0	8,866	-8,866	X		--		0.000	
518	0	2,068	-2,068	X		--		0.000	
519	0	169	-169	X		--		0.000	
521	0	240	-240	X		--		0.000	
522	0	23,892	-23,892	X		--		0.000	
523	0	5,948	-5,948	X		--		0.000	
524	0	2,990	-2,990	X		--		0.000	
531	0	8,027	-8,027	X		--		0.000	
532	0	13,037	-13,037	X		--		0.000	
533	2,734	321	2,413	M	11	11.20	22,109	0.850	10
541	1,304	100,797	-99,492	X		73.08	518	0.020	25
551	0	3,030	-3,030	X		--		0.000	
561	0	608,092	-608,092	X		--		0.000	
562	0	813	-813	X		--		0.000	
611	0	1,669	-1,669	X		--		0.000	
621	0	183	-183	X		--		0.000	
622	0	242	-242	X		--		0.000	
623	0	2	-2	X		--		0.000	
624	0	4	-4	X		--		0.000	
711	0	233	-233	X		--		0.000	
712	0	60	-60	X		--		0.000	
713	0	158	-158	X		--		0.000	
721	0	15,894	-15,894	X		--		0.000	
722	0	29,105	-29,105	X		--		0.000	
811	0	86,268	-86,268	X		--		0.000	
812	0	737	-737	X		--		0.000	
813	0	5,644	-5,644	X		--		0.000	
814	0	0	0			--		0.000	
931	0	182	-182	X		--		0.000	
932	0	0	0			--		0.000	

Source: Own estimates with data from INEGI.

Notes: [a] Employment measured in number of employees [b] Gross Fixed Capital Formation measured in millions of MX pesos.

The fourth column gives an *M* to those sectors that import labour and an *X* to those that export labour, of course the sectors that become important for our analysis are those that import labour because an increment in the level of investment of these sectors will generate an increase in the general level of employment since they demand high amounts of employment from the rest of the system. The fifth column shows which of the importer sectors imports more labour, 1 is given to the sector importing more labour and 35 (79) to the sector importing the less (exporting more). The sixth column registers the share of each element of the main diagonal with respect to its corresponding column sum; it shows the extent to which the sector is responsible for its own labour force, that is to say, the share of its own labour force delivered to itself.

The seventh column and first column of the investment side shows how much each sector spent on Gross Fixed Capital Formation, the eight column shows the share of investment of each sector with respect to total investment and the last column identifies those sectors that invested more, 1 is given to the sector in which capital investment was the highest and 35 (79) to the sector that reported the lowest capital investment.

Therefore to identify those sectors of the system which positively contribute to the level of employment to satisfy a given investment demand, or in other words in order to identify the main channels through which the general level of employment can be increased, we will need to find those sectors that fulfil the following characteristics:

i. *The sector must be a sector importer of labour:* this will mean that this sector directly and indirectly requires a higher amount of units of labour in order to satisfy its production requirements than what it delivers of labour to the rest of the system. If the sector is a sector importer of labour, then higher investment in this sector will generate greater imports of units of labour and thus, it may be possible (ceteris paribus) that the rest of the sectors from which it obtains

its inputs, will also experience an increase in their level of employment. An importer sector of labour is a sector that is more connected to the rest of the system from the inputs side.

ii. *The share of its own labour force delivered to itself must be at most 50%:* The percentage value of the elements of the main diagonal with respect to the sum of its column should be at most 50%, this would mean that the reason why its labour requirements are higher than its deliveries, is because of the high labour units embodied on the inputs that it required for its production and not because of the labour units required in the production of its own good were high. Therefore if the percentage value is smaller than 50% this suggests that in terms of labour, the sector is more connected and depends more on the rest of the system; then higher investment in this sector will generate an increase in employment not only in its own sector but also in the others.

iii. *A high level of investment should be satisfied with a high level of labour imports:* If the level of investment demand that a sector needs to satisfy is high, we would then expect that in order to produce the required level of its product, it would import also a high level of labour units, that is, we would expect that this sector would indirectly "pull" the rest of the system. On the contrary, if a sector had a high level of investment demand to fulfil, and instead of importing a high level of labour units, it exported a high level of labour units, this would mean that this product or type of product is needed in the majority of the sectors of the system, i.e. the level of production and thus of employment of this sector would automatically be influenced by changes in the production of the others and therefore there would be no need to directly intervene in this sector.

The results from table 3.5 show first of all that the sectors that import labour represent only 15% of the total number of sectors i.e. out of 35 sectors only 5 sectors result labour importers (those highlighted in blue), and second, that not always a high level of investment is related to a high import of labour. More specifically, from table 3.5 we can see that for example sector (F) *Construction*, in order to satisfy the highest given level of investment demand, reports the highest labour imports, that is, it is the

sector that requires more labour units (2,100 millions of hours) from the sectors from which it obtains its inputs, but we also see that 80% of the labour that it required for its production was delivered from itself, i.e. this sector is by itself a labour-intensive sector, so that the degree of connectedness to the rest of the system may be not very strong. Sectors (29) *Machinery*, (30t33) *Electrical and Optical Equipment* and (34t35) *Transport Equipment* are in the same situation, even though it seems that they import labour from the rest of the system to satisfy the given investment demand, more of the 50% of their labour imports come from within themselves. Therefore, an additional increase in the level of investment of these sectors may not generate a very great impact on the level of employment.

However, there is sector (C) Mining and Quarrying that apart from being a sector importer of labour, it requires a higher amount of labour units from other sectors than from itself, i.e. it is more connected to the rest of the system because it depends in a higher degree on the inputs that it requires. Therefore, an additional increase in the level of investment of this sector may cause a positive effect not only on the level of employment of its own sector but also on the other sectors with whom it is connected, it is very likely that through this sector, other sectors would also benefit.

Also from table 3.5 there are other special cases that deserve to be mentioned, these are the cases of sectors (51) *Wholesale trade and Commission trade*, (52) *Retail trade* and (60) *Inland transport* which to satisfy the third, fourth and sixth highest levels of investment report the most negative level of labour imports or in other words the highest labour exports (those highlighted in brown). These sectors in order to satisfy the given high levels of investment demand, delivered a higher amount of labour units to the rest of the system than the amount of labour units that they obtained from other sectors, that is, the labour units from this sectors are to some extent utilized in the production processes of the majority of the system, therefore indirectly, by means of increases of the level of investment in the rest of industries, the level of employment on these sectors may tend to increase.

If we now interpret the results obtained from realising the same exercise, but with the database of INEGI shown in table 3.6, we will see that in fact the results bear out the results obtained with the WIOD database. First of all, because in order to satisfy the given level of investment demand, the sectors that report the highest labour imports coincide with the sectors importer of labour obtained with the WOID database, those sectors (highlighted in blue) are (213) *Services Related to Mining*, (236) *Construction*, (237) *Civil Engineering Works*, (331) *Basic Metals*, (333) *Machinery and Equipment*, (334) *Electrical and Electronic Equipment*, (336) *Transport Equipment Production*, (337) *Furniture, Mattress*, *Shutter Production*, (482) *Rail Transport* and others (see table 3.6).

But this time, from the very disaggregated table 3.6, it can be seen that in fact, sectors such as (213) *Services Related to Mining*, (331) *Basic Metals*, (333) *Machinery and Equipment*, (336) *Transport Equipment Production* and (482) *Rail Transport* represent those sectors that besides of importing labour from the rest of the system, their labour imports are explained to a large extent by the labour units (number of employees in this case) embodied in the inputs that each sector required for its own production, i.e. at most 50% of their labour imports come from other sectors; these sectors represent those sectors that are more connected to the system since they demand in terms of labour, higher amounts of other goods. These sectors depend in a higher degree on other industries. The rest of the sectors highlighted in blue that were not mentioned in this paragraph constitute those sectors that were only labour importers but that their degree of connectedness with the rest of industries was not very strong.

Additionally, from table 3.6 we also observe that the sectors, which in order to satisfy also high levels of given investment demand, export also a high level of employment are sectors (238) *Specialized Works for Construction*, (332) *Fabricated Metal*, (431) *Commerce* and (484) *Cargo Transport*.

The estimates of the subsystem analysis with a more disaggregated database allowed a better identification of those sectors that could positively contribute to the level of employment of the Mexican economy, some of the sectors that in the WIOD database appeared only as importers of labour, in the INEGI database appeared also to be highly connected to the rest of the system, this because these "subsectors" reported by INEGI database were, lets say, contained on the sectors reported by the WIOD database. Therefore from this analysis we could say that future and additional investment in sectors such as *Services Related to Mining*, *Basic Metals*, *Machinery and Equipment*, *Transport Equipment Production* and *Rail Transportation* directly and indirectly could have positive effects on the level of employment.

Of course the final decision of whether investing in any of these sectors depends on the social needs and wants of the Mexican economy; that is, if the economic policies are directed to increase or improve the infrastructure, then investing in *Basic Metals* or *Machinery and Equipment* would generate positive effects in the level of employment and the performance of the economy. Moreover, we would need to make sure that the resulting goods produced in any of these sectors, are goods that can be sold and that are economically needed and wanted, otherwise to generate a higher level of employment we would produce goods and services that nobody want and that cannot be sold.

3.2.2 The multiplier analysis and the indices of Rasmussen

As it is our objective to identify those sectors and industries of the Mexican economy that can contribute the most to the level of employment, in this section we will present two things; on the one hand, those sectors that in terms of labour result more benefited from an additional unit of capital investment, i.e. we present the effects that an increase in capital investment has on the level of employment, this by means of the employment multipliers. And on the other hand, by means of the indices of Rasmussen, we will present those sectors that contribute the most to the whole economic system, so that an increase in capital investment in these sectors will

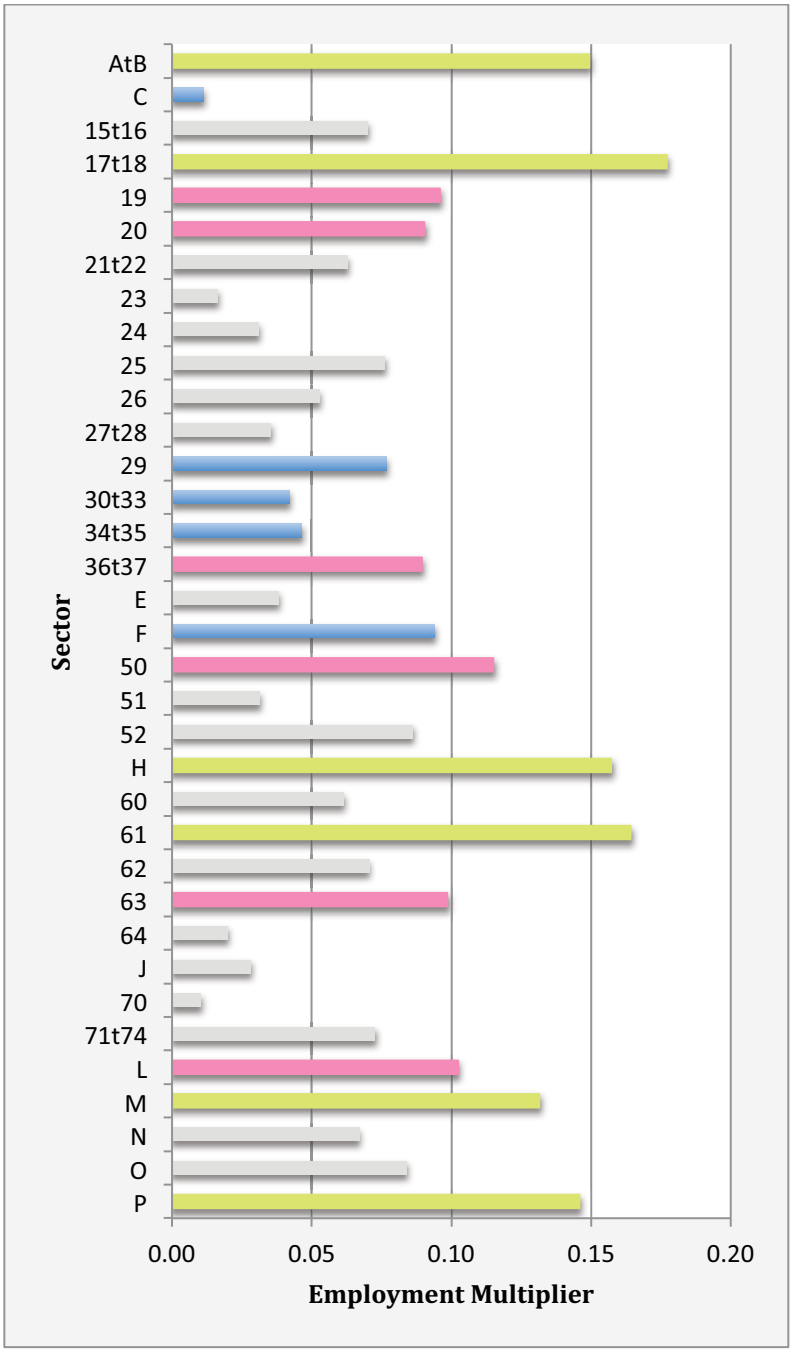
generate positive effects in the majority of the system and uniform effects among the different sectors. After applying equation (10) to both sets of data, we obtained the employment multipliers shown in graphs 3.1 and 3.2. For more details see table 3 and 4 of the appendix.

From graph 3.1 we can see that an additional unit (millions of US dollars) of final demand and thus of capital investment has the greatest impact on the level of employment of the following sectors (highlighted in green): (17t18) *Textiles and Textile Products*, (61) *Water Transport*, (H) *Hotels and Restaurants*, (AtB) *Agriculture, Hunting, Forestry and Fishing*, (P) *Private Households with Employed Persons* and (M) *Education*. It is clear that as these sectors are labour-intensive, additional capital investment in these sectors will generate the greatest increases in the level of employment. For example, sectors as (AtB) *Agriculture, Hunting, Forestry and Fishing* and (P) *Private Households with Employed Persons* are sectors that, in their majority, only require labour to produce agricultural products and domestic activities.

The case of sector (17t18) *Textiles and Textile Products* as the sector with the highest employment multiplier was also expected; Mexico is an economy with one of the largest "maquiladora" industries and they are located in the sector of textiles; the activity of a *maquiladora* consists in assembling, processing and manufacturing imported material (textiles) to then export the resulting products, most of the times to the raw materials' country of origin. De la Garza (2005) defines *maquiladora* as "the program, which central idea is to attract productive capital in order to increase the productive investment, generate employment, achieve the transfer of technologies, increase the qualification of the labour and to balance the capital and goods trade"[4]. Besides the *maquiladoras* are attractive to foreign investors because they are exempt from paying countervailing fees and import and value added taxes.

[4] In addition, De la Garza (2005) states that the main characteristics of the maquiladora industries are the following: Fordist model of production, no qualified labour, majority of women, low wages, repetitive and tedious activities, technologies based on tools or no automotive machines, Taylorist division of labour and few productive linkages inside the country.

Graph 3.1 Employment multipliers: Mexico, 2009 with data from WIOD



Source: Own estimates with data from WIOD

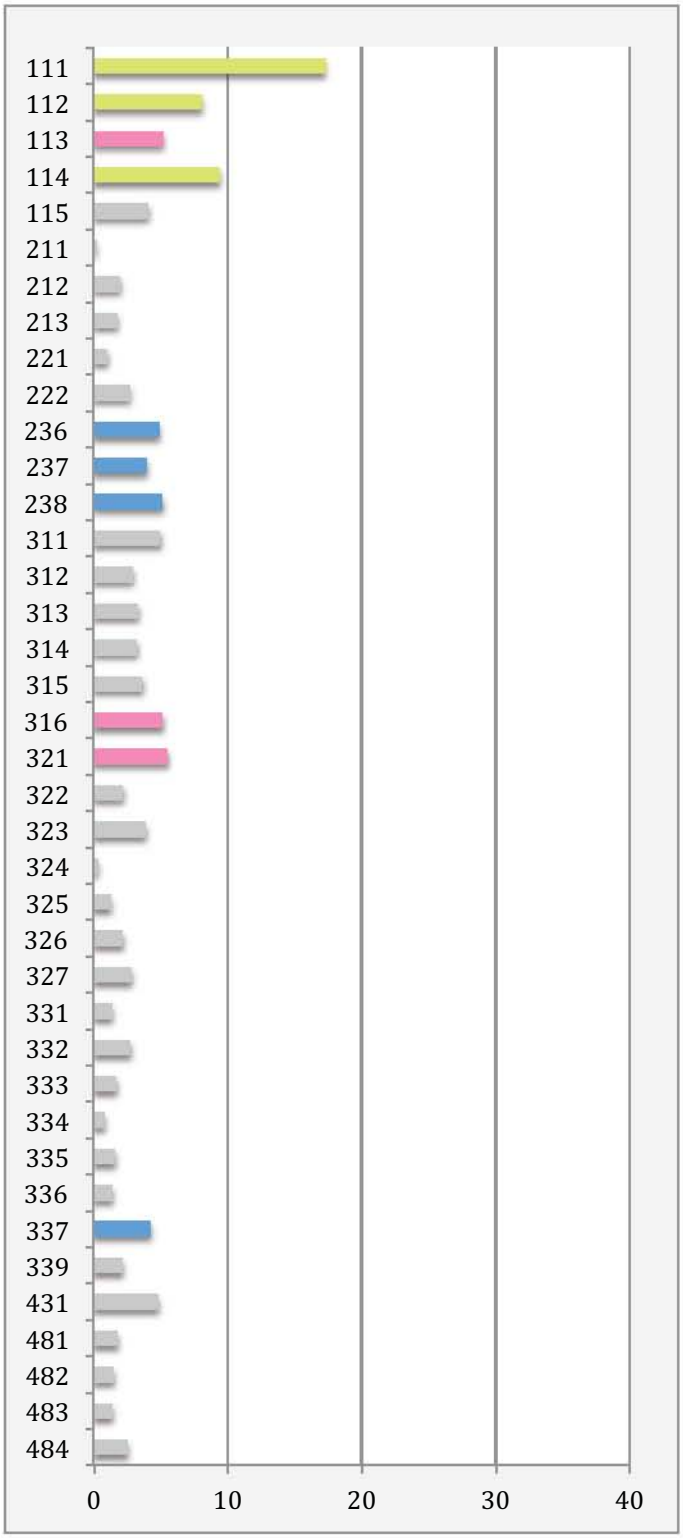
Therefore, the only resource and activity that this sector (17t18) offers is the rent or lease of the Mexican labour force; this is reason why an increment in the capital investment of this sector will tremendously increase the level of employment; an additional investment of 1 million of US dollars will create 177,000 (0.177 x 1,000,000) additional hours of labour, which in terms of number of employees (if we assume working journeys of 8 hours) could represent a total of 22,125 new jobs.

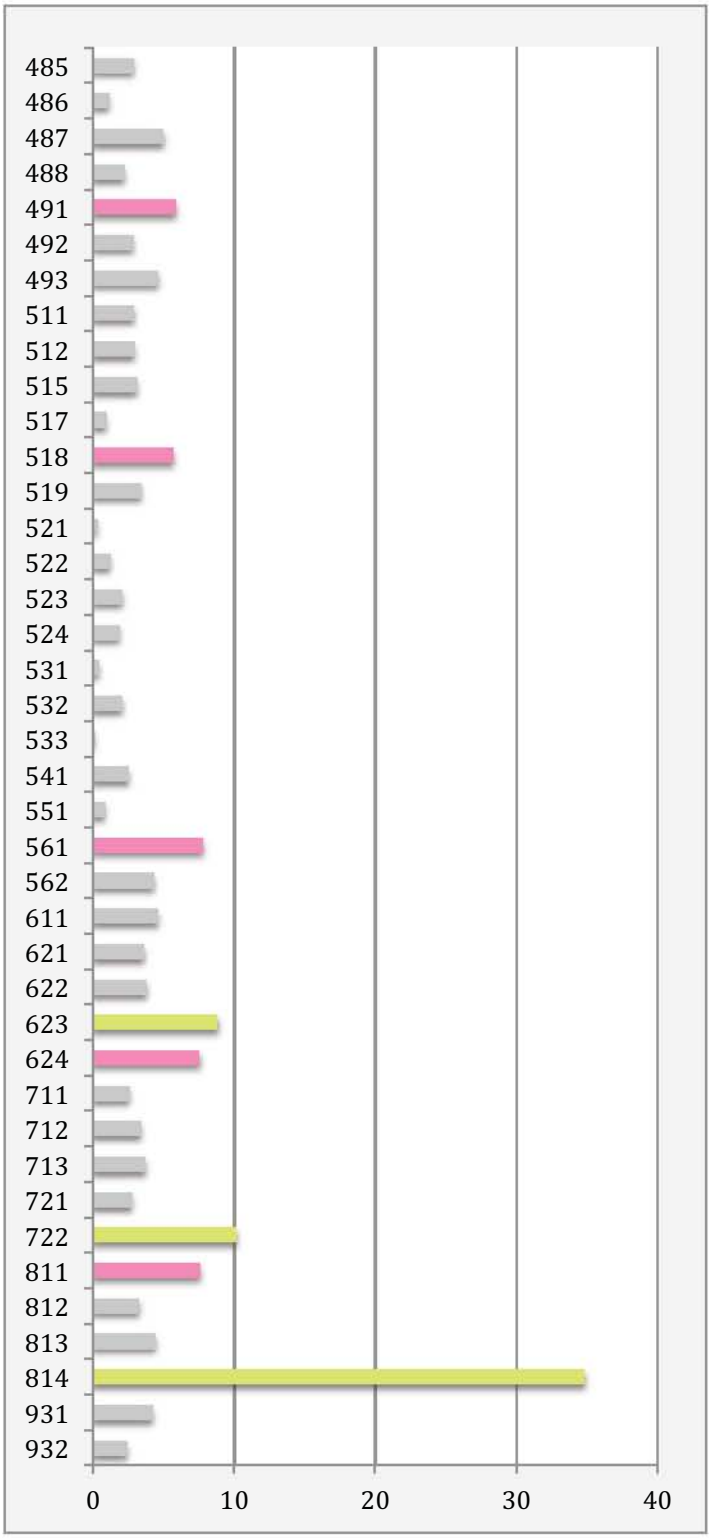
In the case of sectors (61) *Water Transport*, (H) *Hotels and Restaurants* and (M) *Education* something similar occurs; for example, an additional capital investment of a million of US dollars in sector (61) *Water Transport* will mean additional acquisition of transport equipment, name it ships, ferries or boats, which in order to transport passengers and freight will demand a higher amount of workers to drive the ship, carry the freight, give maintenance to the ship, etc.

Consequently, from my point of view we should be cautious in actually considering increasing the level of investment in these sectors, first of all, because many of these activities do not generate any value added, second, because any technical progress or innovation can be transmitted to the rest of the system by investing in these sectors and thirdly because the labour needed in the realization of these activities does not require a high level of qualification (except for the Education sector).

Nevertheless, in graph 3.1 we can also identify those sectors that from the Subsystem analysis resulted to be those sectors that in terms of labour are more connected to the rest of the system (highlighted in blue), and as can be seen, none of them report any of the 10 highest values of the employment multipliers, however the multipliers of sectors (F) and (29) are not in a bad position, 11 and 16 respectively. In the case of the Construction sector (F), an additional million of US dollars worth of investment will generate 94,000 additional hours of labour; an additional investment of one million dollars in the sector of Machinery (29) will generate 77,000 additional hours of labour.

Graph 3.2 Employment multipliers: Mexico, 2008 with data from INEGI





Source: Own estimates with data from INEGI

From graph 3.1 we can also say that the employment multipliers of positions 7 (sector 50: *Sale, Maintenance and Repair of Motor Vehicles*), 8 (L: *Public Admin and Defence*), 9 (63: *Other Supporting and Auxiliary Transport Activities*), 10 (19: *Leather and Footwear*), 12 (20: *Wood and Products of Wood and Cork*), 13 (36t37: *Manufacturing Furniture and Recycling)* and 15 (O: *Other Community, Social and Personal Service*) have, until some extent, also good employment multipliers; an increase in the level of investment of these sectors, apart from positively increasing the units of employment, for the realization of the activities of these sectors certain degree of qualification of the labour force is required; therefore, the impact on employment, from investing in these industries, is as positive in the number of hours of labour as in terms of the qualification of labour.

In graph 3.2, we present the employment multipliers obtained with the INEGI database. As will be shown, the highest values of the employment multipliers from this exercise (highlighted in green) are to a large extent the same as those obtained with the WIOD database. We have that sectors (814) *Private Households with Employed Persons*, (111) *Agriculture*, (722) *Restaurants*, (114) *Hunting, Fishing and Animal Capture*, (623) *Residences of Social Assistance and Health Care* and (112) *Breeding and Stocking of Animals* report the six largest bars in the graph, and as can be seen, all of them except for sector (623) were also in the first positions of graph 3.1. Again the high values in the employment multipliers of these sectors result from the high labour requirements for the realization of these activities, mainly of the domestic activities, and of the agricultural and farming activities. Thus higher levels of investment in these sectors may increase the level of employment.

Nevertheless we can also identify positions 8 (sector 811: *Maintenance and Repair services*), 12 (321: *Wood and Products of Wood*), 13 (114: *Hunting, Fishing and Animal Capture*), 14 (316: Leather), 15 (238: *Specialized works for construction*) and 18 (336: *Transport Equipment Production*) as sectors with good employment multipliers that also coincide with the sectors with good employment multipliers from graph 3.1. Although the sectors of positions 7 (561), 9 (624), 10 (491) and 11(518) don't

coincide with the sectors obtained from graph 3.1, we can say that they also present good employment multipliers, therefore additional capital investment in any of these sectors will generate an increase in the level of employment.

If we now focus on analysing what happened with the sectors, that through the subsystem analysis, were identified as sectors importer of labour, we can see that unfortunately not all of them report high employment multipliers, only the sectors (236) *Construction*, (238) *Specialized works for construction* and (337) *Furniture, Mattress*, *Shutter Production* were identified for being sectors with relatively high employment multipliers and in which additional capital investment can generate an increase in the level of employment. Even though it looks like the number of sectors that report good results in both analyses becomes smaller, we cannot rule out the possibility that they could have good indices of Rasmussen. It is until we compile the results obtained from the three different analyses that will be able to decide which of them has the greatest positive impact on employment and which on them should be excluded from being considered as a sector that can generate positive impacts on the level of employment.

So far we have identified those sectors of the economic system in which additional levels of capital investment generate positive effects in the level of employment. Nevertheless it is also important to make sure that additional investment in one sector has positive impacts on the greatest possible number of industries, so that the impact does not benefit only one or a narrow number of industries. Therefore, by means of the indices of Rasmussen we will be able to identify those industries in which *a)* the effects of an increase in final demand are dispersed through the economic system and *b)* the effects are uniformly spread among all the industries affected. First we will present the results from applying the dispersion and the variance indices for the WIOD database given by equations (12) and (13) and then the results from applying the same equations for the set of data from INEGI.

Graphs 3.3 and 3.4 show the dispersion and the variance indices respectively. On the one side, from graph 3.3 we can recognize the key industries, the backward-linked industries, the forward-linked industries and the non-key industries. Industries highlighted in colours different from grey are those identified as key industries, those that have a bar in dark red are the forward-linked industries and those with a bar in light red are the backward-linked industries. On the other side, from graph 3.4 we can obtain those sectors of the economic system that uniformly distribute the impacts of an increase in final demand among all sectors of the economic system, in the following lines we discuss the main results obtained through the indices of Rasmussen; for more details see tables 5 and 6 of the appendix.

Industries like (AtB) *Agriculture, Hunting, Forestry and Fishing*, (21t22) *Manufacture of Paper, Publishing and Printing*, (23) *Refined Petroleum and Nuclear Fuel*, (24) *Manufacture of Chemicals and Chemical Products*, (27t28) *Basic Metals and Fabricated Metal* and (E) *Electricity, Gas and Water supply* enter to the classification of key industries because the values of their backward and forward linkages are greater than one. An increase in the final demand of these industries will generate positive effects in all the sectors from which they obtain their inputs and in all the sectors to which they sell their products. These are sectors that from the demand-side pull the economic system and that from the supply-side push it. More explicitly, they are said to be key industries because of two facts: *a)* there is an increase in the total output of the entire system needed to satisfy the increase in final demand for the products of these industries and *b)* there is an increase of final demand for their products delivered to the system in general.

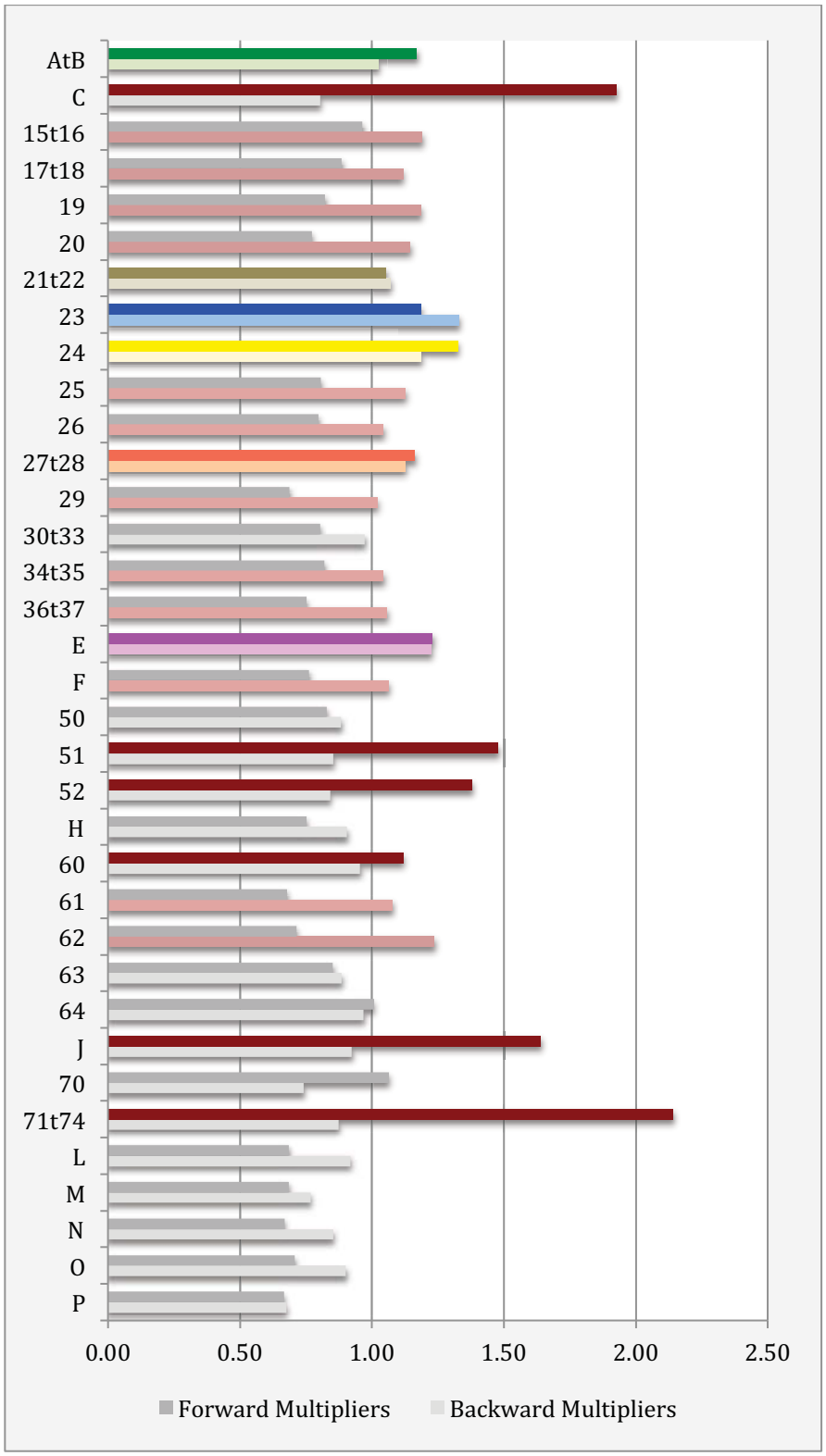
Some of the backward-linked sectors are sectors like (15t16) *Food, Beverages and Tobacco*, (17t18) *Textiles and Textile Products*, (19) *Leather*, (20) *Wood and Products of Wood*, (25) *Rubber and Plastics*, (26) *Other non-Metallic Minerals*, (34t35) *Manufacture of Transport Equipment*, (36t37) *Manufacture of Furniture*, (F) *Construction*, (61) *Water Transport* and (62) *Air Transport,* and they are said to be backward-linked because in order to satisfy a greater final demand in these

industries, an increase in the total output of the majority of the industries of the system will also have to increase. Therefore additional investment in these sectors will generate positive effects on sectors from which they obtain their inputs.

We should now highlight the resemblance of the results of the indices of dispersion with the results obtained from the subsystem analysis. For example, through the subsystem analysis we could identify those sectors that in terms of labour are more connected to the sectors from which they obtain their inputs (sectors importer of labour) and those sectors that are more connected to the sectors to which they sell they output to (sectors exporter of labour); in the case of the dispersion index of Rasmussen the different sectors are also classified in sectors that are more connected to the sectors from which they obtain their inputs (backward linked sector) and in sectors that are more connected to the sectors to which they sell their output to (forward linked sector). Therefore, the results from both analyses should until some extent match; the sectors that are importer of labour and also backward linked are sectors such as (34t35) *Manufacture of Transport Equipment* and (F) *Construction*.

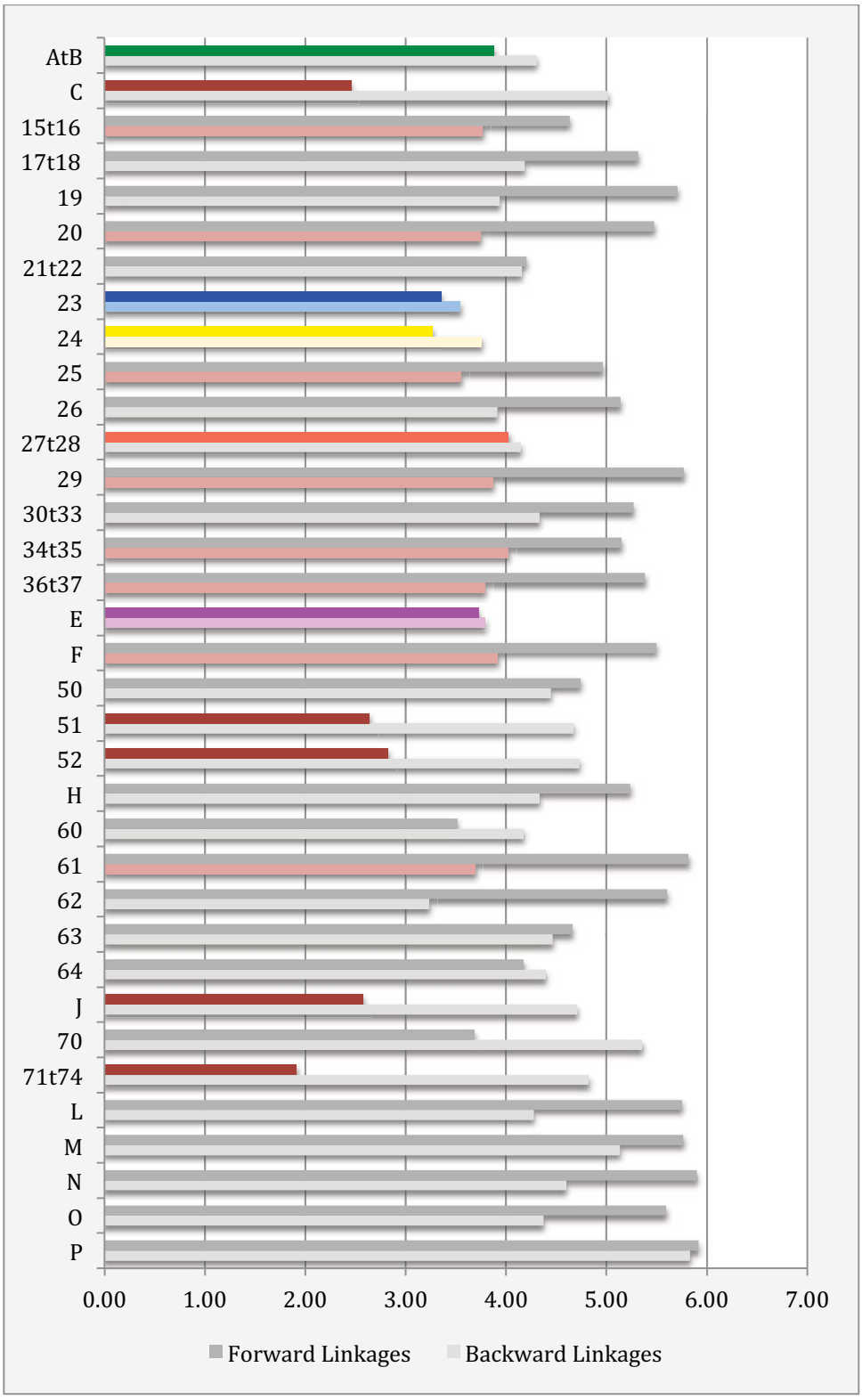
Alternatively, the sectors that are identified as forward-linked sectors are the following: (C) *Mining and Quarrying*, (51) *Wholesale Trade*, (52) *Retail Trade*, (J) *Financial Intermediation* and (71t74) *Renting of Machinery and Equipment*. When there is a unit increase in the final demand of all industries, the production of these industries, identified as forward-linked sectors, will significantly increase. That is, they deliver a very important share of their output to the majority of the industries in the system; their products (services) are needed in almost all the production processes. The fact that sector (C) *Mining and Quarrying* is classified with the index of Rasmussen as a sector that is forward linked is contradictory because in the subsystem analysis it was classified as one of the sectors with the highest levels of labour imports. Then we should be cautious with the results that will be obtained for this sector in previous and further analyses.

Graph 3.3 Dispersion Index: Mexico, 2009 with data from WIOD



Source: Own estimates with data from WIOD

Graph 3.4 Variance Index: Mexico, 2009 with data from WIOD



Source: Own estimates with data from WIOD

Also the case of the sector of *Financial Intermediation (J)* deserves to be discussed; because of the nature of the activities that it realises, this sector is connected only from the supply side to the rest of the economy; it does not produce any physical good, it does not require any kind of input and thus has no connection with the demand side of the economy. Moreover, additional investment in this sector will not generate an increase in the level of employment; it actually sucks and takes ownership of the labour inherited in the goods of the sectors from which it borrows and takes money.

If we now consider also the results from the variance index showed in graph 3.4, we can see that the number of industries that generate a uniform effect in the economic system by means of an increase in final demand becomes smaller. For the case of the variance index we will try to find those sectors in which either one or both of the variance of the backward and the forward linkages is (are) small, hoping that the results don't differ from the ones obtained with the dispersion index.

The industries that uniformly distribute the effects of an increase in final demand among the rest of the system can be identified in graph 3.4 as the sectors with the shortest bars, they are highlighted in colours different from grey and are the following: (23) *Refined Petroleum and Nuclear Fuel*, (24) *Manufacture of Chemicals and Chemical Products*, (27t28) *Basic Metals and Fabricated Metal* and (E) *Electricity, Gas and Water supply*. Even though not all the sectors classified as key sectors in graph 3.3 reported small values in their variance indices, these sectors will in fact have positive repercussions in all the economic system and not only in a small part of it.

We can also see that those sectors that were classified as backward-linked sectors report the smallest variance index of the backward linkages, this suggest that even though these sectors only impact the level of output of the sectors from which they buy their inputs, the effects of these impacts are evenly distributed among the different sectors. The same happens with the forward-linked industries, all of them

report small variance indices of the forward linkages, and thus, even if they only affect the industries to which they sell their output, these positive impacts are evenly distributed among the economic system.

Then, if we summarize the results obtained from applying the indices of Rasmussen to the WIOD database, we can see that the sectors that produce goods like *Refined Petroleum, Basic Metals, Electricity and Chemicals* are the sectors that were classified as key sectors and that reported the smallest variance indices of the backward and of the forward linkages. These results reveal what to some extent is evident; all these products are needed for the production of all goods but also require of the production of other sectors to realise their production and consequently, when there is an increase in the level of production of any industry, then the production of these sectors will also increase in order to satisfy the increment in their final demand.

What we can also see is that the sectors that are backward linked to the economic system are those that depend on the production of other sectors to realize their activities, that is, the inputs needed in their production processes are obtained from a high number of industries of the system. Therefore a direct increase in their level of production will lead to a higher input demand and with this, the level of production of the sectors from which they obtain their inputs will also increase.

But if we now evaluate the results in terms of the indices of Rasmussen for the sectors that from the subsystem analysis and the employment multipliers were identified as those with the greatest impacts in the level of employment, i.e. sectors (C), (29), (30t33), (34t35) and (F), we can see that only sectors (29) *Machinery*, (34t35) *Transport Equipment Production* and (F) *Construction* have acceptable indices of dispersion from the side of the inputs, thus are backward-linked (their values in the light red bars are greater than one) and also have relatively small values on the variance indices related to their backward linkages.

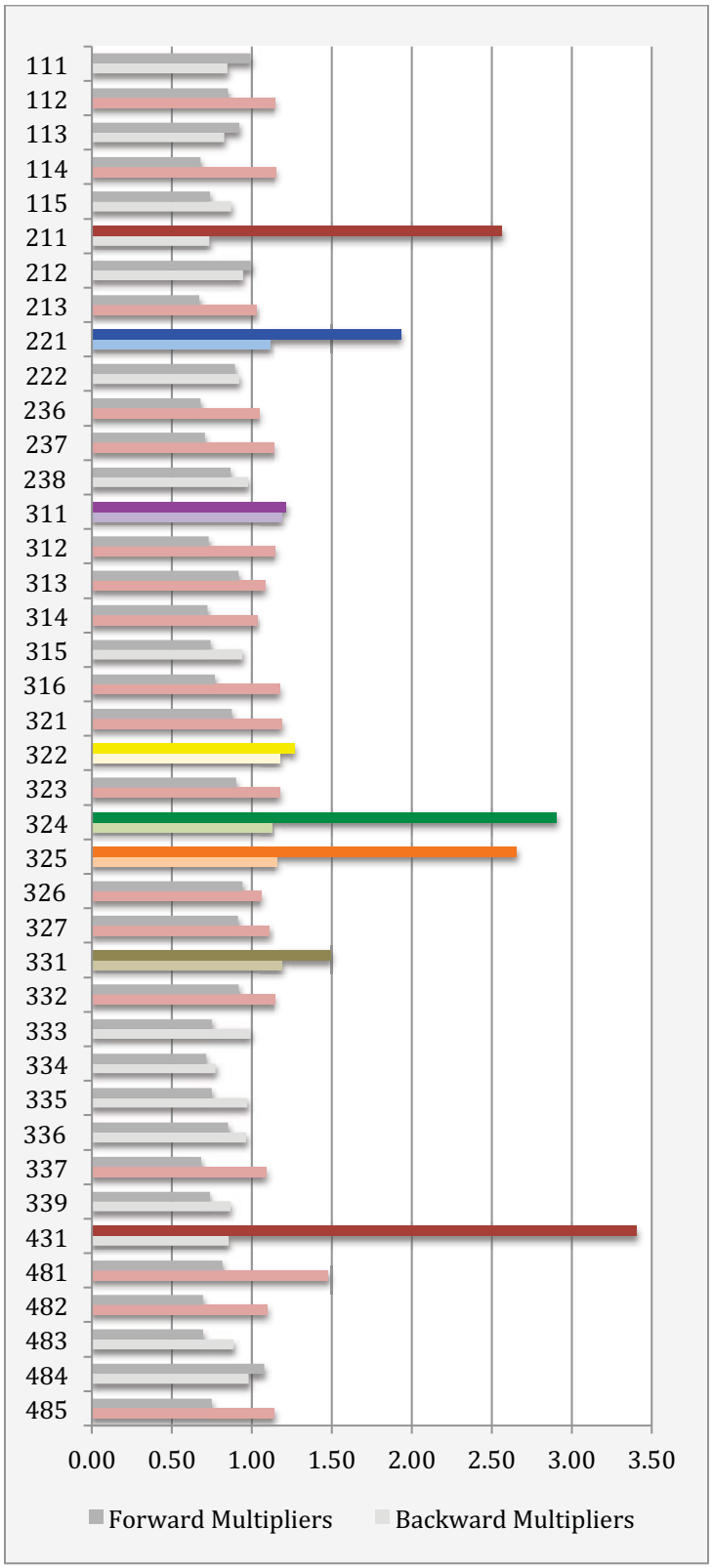
This suggests that additional investment in these sectors (29), (34t35) and (F) apart from leading to an increase in the level of employment of the system, it will also lead to an increase in the level of output of the majority of the system in an evenly form so that all other sectors will not only benefit from an increase in the capital investment in these sectors but that the benefits will be more or less equally distributed among the system.

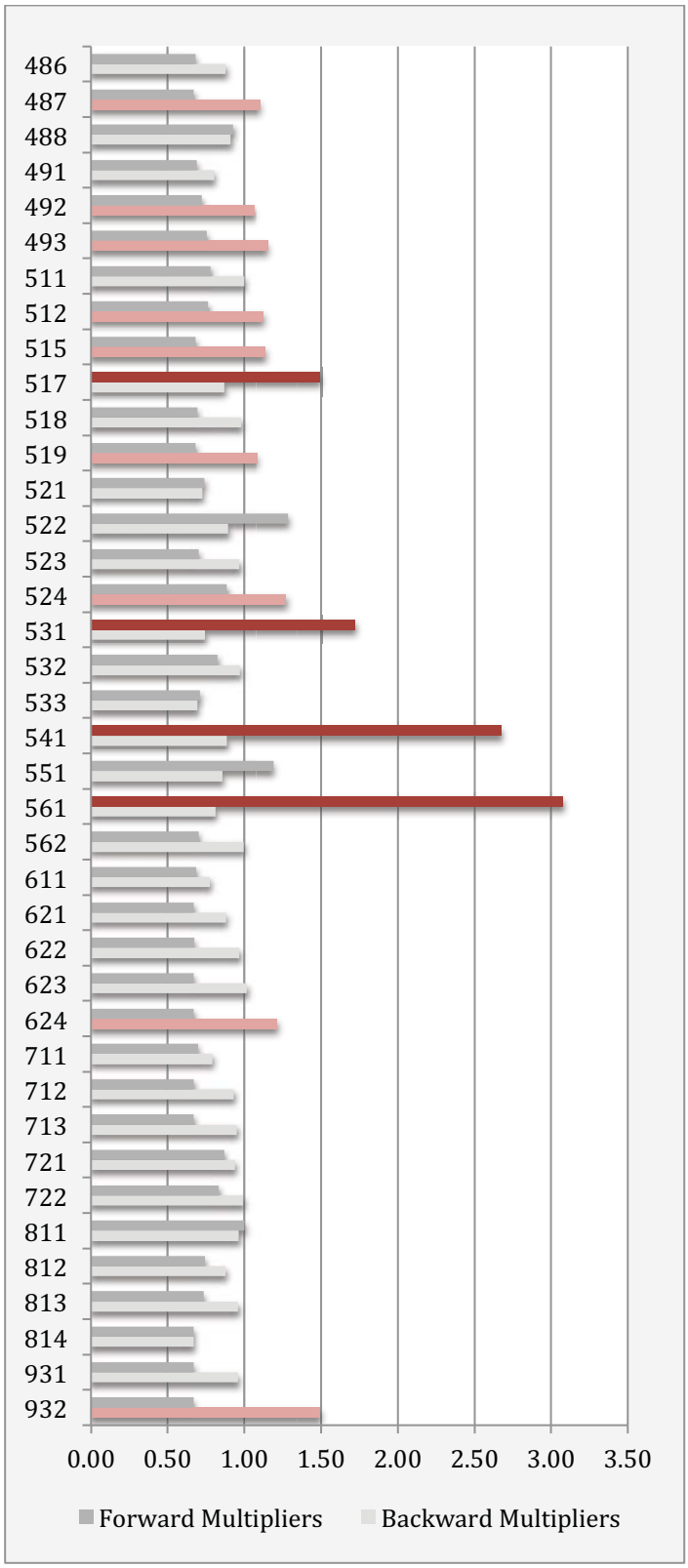
Thus their impacts on the rest of the system are relevant because their degree of connectedness with the sectors from which they obtain their inputs is strong, because they are linked with all the system from the inputs side and because their effects on the system are evenly distributed among all industries affected.

If we now apply the dispersion and the variance indices to the database from INEGI, we obtain the results shown in graphs 3.5 and 3.6; for more details see tables 7 and 8 from the appendix. The sectors of this database that were classified as key sectors are the following: (221) *Generation and Distribution of Electric Energy*, (311) *Food*, (322) *Paper*, (324) *Products derived from Oil and Coal*, (325) *Chemical Industry* and (331) *Basic Metals*; as we see these sectors coincide with the sectors classified as key sectors with the WIOD database, and again we must say that this is because the products from these industries are required in every and each one of the production processes of the system.

Some of the sectors that are classified as backward-linked sectors are the following: (112) *Breeding and Stocking of Animals*, (114) *Hunting, Fishing and Animal Capture*, (213) *Services Related to Mining*, (236) *Construction*, (237) *Civil Engineering Works*, (313) *Textile inputs*, (314) *Textile Products*, (337) *Furniture Production*, and (624) *Other Social Services*, an increase in the final demand of any of these sectors will generate an increase in the level of production of all the sectors from which they buy their inputs.

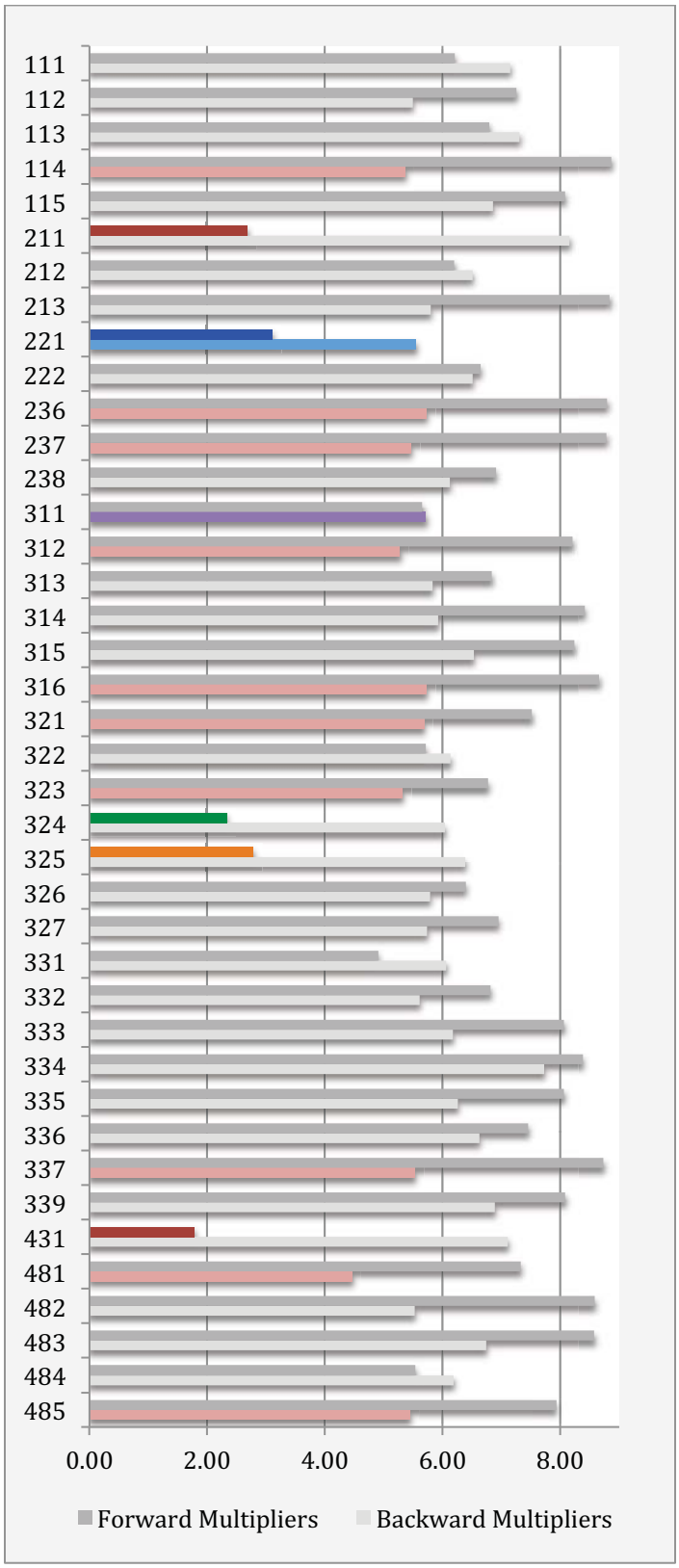
Graph 3.5 Dispersion Index: Mexico, 2008 with data from INEGI

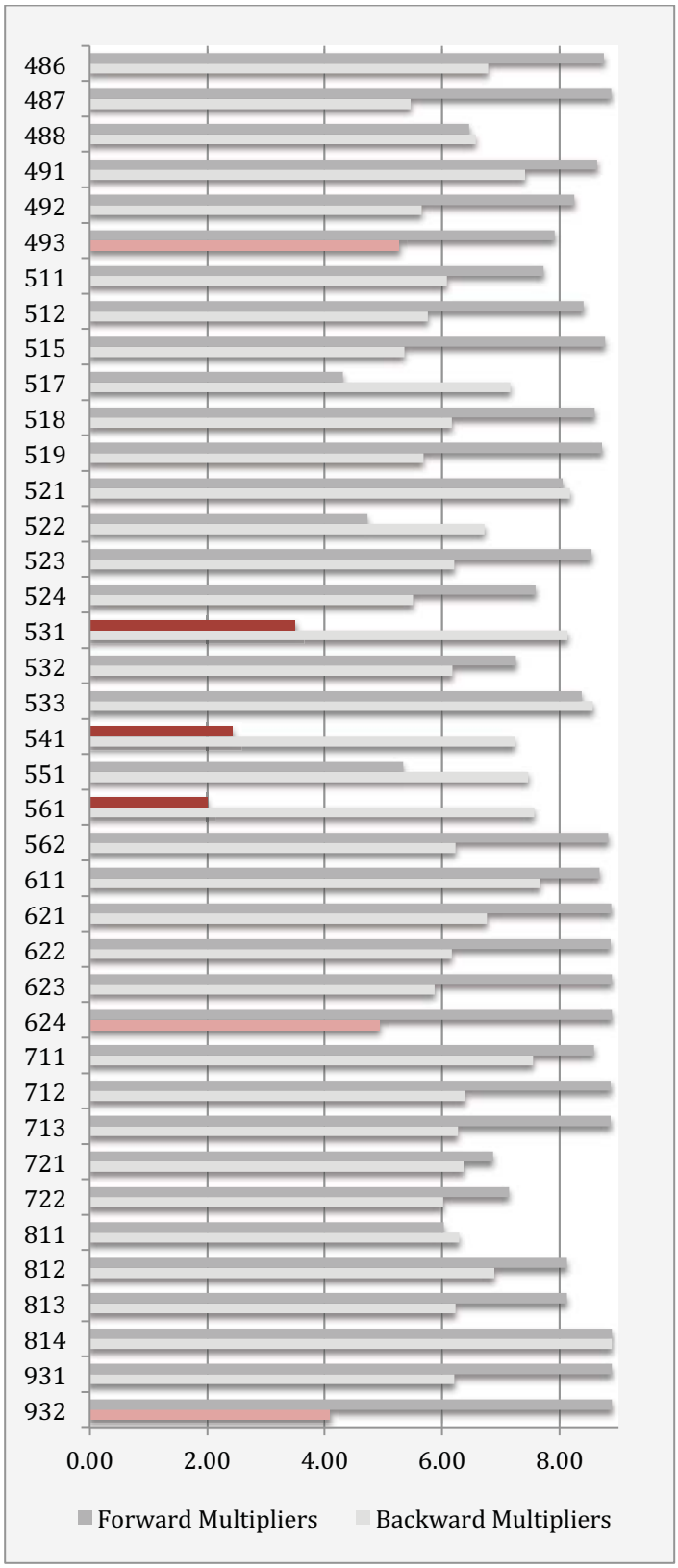




Source: Own estimates with data from INEGI

Graph 3.6 Variance Index: Mexico, 2008 with data from INEGI





Source: Own estimates with data from INEGI

As we can see, some of these sectors identified as backward linked, were also identified in the subsystem analysis as sectors importer of labour, and these are sectors (213) *Services Related to Mining*, (236) *Construction*, (237) *Civil Engineering Works*, (331) *Basic Metals* and (337) *Furniture Production*, they are connected to the economic system from the inputs side and additional investment in them will cause an increase in the general level of employment and in the level of output of all the sectors from which they obtain their inputs.

Alternatively the sectors with forward linkages are the following: (211) *Oil and Gas extraction*, (431) *Commerce*, (517) *Other Telecommunications*, (531) *Real State Activities* and (541) *Professional, Scientific and Technical Services*. These goods (services) are required in the production processes of all or almost all industries, therefore an increase in the level of production of any other industry will automatically generate an increase in the level of production of these industries.

But now, as we want the effects of these industries to be evenly distributed among the system, we need to make sure that from the sectors identified through the dispersion index as key sectors, backward-linked sectors and forward-linked sectors, their variance indices are small. For the case of the key industries, we found that the only industry that actually has small variance indices is the sector (221) *Generation and Distribution of Electric Energy*; this is the only industry that evenly distributes the effects of an increase in final demand among the sectors from which it obtains its inputs and the sectors to which it delivers its product.

Additionally, from graph 3.6 we also observe that the backward-linked industries that distribute their effects uniformly to the rest of the sectors with which they are connected, are sectors (114) *Hunting, Fishing and Animal Capture*, (311) *Food*, (313) *Textile inputs* and (634) *Other Social Services*. We should also mention that all the sectors that were identified as forward-linked sectors appear to have very small variance indices, which suggests that the effects of an additional unit of final demand will be evenly distributed among the sectors to which they deliver their total output.

Moreover we need to evaluate the sectors that from the subsystem analysis and the employment multipliers resulted to be the sectors that contribute the most to the level of employment. If besides from having the greatest effects on the level of employment, they have dispersion indices greater than one and variance indices relatively small, then this would mean that additional capital investment in these sectors will generate very good outcomes in terms of labour and production. The sectors that from the subsystem analysis and the employment multipliers were considered as sectors with positive impacts in the level of employment are sectors (236), (237), (238) and (337). And from the four of them, only three seem to also have significant indices of dispersion and variance; sectors (236) *Construction*, (237) *Civil Engineering Works* and (337) *Furniture Production*, are sectors that are backward-linked and that have relatively small variance index. From this set of data, we find that these are the only sectors in which additional investment will generate positive effects in the level of employment, and in the level of production of the system.

3.2.3 The sectors with positive effects on employment and output

From the subsystem analysis, the employment multipliers and the indices of Rasmussen we have obtained some sectors in which an increase in their capital investment will generate the largest possible effects in terms of labour and output, table 3.7 summarizes the results from the WIOD and the INEGI databases. In table 3.7 a tick is given to the sector if it possesses the characteristic required in each category, if contrary, then it will get a cross. Those sectors that obtained three or four ticks will be those sectors that become important for our analysis.

From the WIOD database we obtained three sectors (highlighted in dark green) in which additional capital investment will surely generate positive outcomes in terms of employment and output, and these are the sectors: (29) *Machinery Production*, (34t35) *Transport Equipment Production* and (F) *Construction*; these sectors fulfil the characteristics required by every single method, these are sectors that import labour from almost all the other sectors, they report relatively high employment multipliers,

Table 3.7 Sectors with positive effects on employment and output

Sector	*Importer of labour in Subsystem analysis*	*Relatively high Employment Multiplier*	*Indices of Rasmussen*	
			Key or backward-linked industry by dispersion index	*Low variance index of the key or backward-linked industry*
WIOD				
AtB	✗	✓	✓	✓
C	✓	✗	✗	✗
17t18	✗	✓	✓	✗
19	✗	✓	✓	✗
20	✗	✓	✓	✓
29	✓	✓	✓	✓
30t33	✓	½	✗	✗
34t35	✓	½	✓	✓
36t37	✗	✓	✓	✓
F	✓	✓	✓	✓
50	✗	✓	✗	✗
H	✗	✓	✗	✗
61	✗	✓	✓	✓
63	✗	✓	✗	✗
L	✗	✓	✗	✗
M	✗	✓	✗	✗
P	✗	✓	✗	✗
INEGI				
111	✗	✓	✗	✗
112	✗	✓	✓	✗
113	✗	✓	✗	✗
114	✗	✓	✓	✓
213	✓	✗	✓	✗
236	✓	✓	✓	✓
237	✓	✗	✓	✓
238	✗	✓	✗	✗
316	✗	✓	✓	✓
321	✗	✓	✓	✓
331	✓	✓	✓	✗
333	✓	✗	✗	✗
334	✓	✗	✗	✗
336	✓	✗	✗	✗
337	✓	✗	✓	✓
486	✓	✗	✗	✗
491	✗	✓	✗	✗
518	✗	✓	✗	✗
561	✗	✓	✗	✗
623	✗	✓	✗	✗
624	✗	✓	✓	✓
722	✗	✓	✗	✗
811	✗	✓	✗	✗
814	✗	✓	✗	✗

Source: Own estimates.

they are also very connected to the rest of the system, and additionally, they assure that the positive effects of external positive shocks are distributed in an evenly way among all the system.

From the WIOD database we also have sectors that obtained three ticks out of four, these sectors are (AtB) *Agriculture, Hunting, Forestry and Fishing*, (20) *Wood and Products of Wood and Cork*, (36t37) *Furniture Manufacturing* and (61) *Water Transportation,* it must be said that the characteristic that they have in common is that neither of them is importer of labour, they are exporters of labour, which means that either they are labour-intensive sectors or that they are in fact required in the production of all other sectors.

In the case of the INEGI database surprisingly we only obtained one sector that fulfils all the characteristics set by every single method, it is sector (236) *Construction* the one that resulted from the very disaggregated table as the sector in which additional investment will generate positive effects in the level of employment. As we can see, the results obtained from both sets of data coincide with respect to the fact that the sector Construction is one of the sectors that possesses the characteristics of a sector that could positively influence the level of employment and production of the system.

In the INEGI database the sectors that obtained three ticks out of four are sectors (114) *Hunting, Fishing and Animal Capture*, (316) *Leather Production*, (321) *Wood*, (331) *Basic Metals*, (337) *Manufacture of Furniture* and (624) *Other Social Services*; even if they report a weak point, higher investment in these sectors will generate positive impacts, maybe not the greatest impacts or the most evenly distributed, but surely will generate better outcomes than those from investing in another sector(s).

What also needs to be stood out is the fact that the sectors that produce *wood and furniture* were found in both databases as sectors in which additional investment can generate positive effects on the level of employment; this bears out that the results obtained from this exercise do not differ because of the database utilised and thus we

can certainly say that this analysis reveals those paths through which exogenous changes can be spread to the whole economic system.

Even though the database from INEGI does not suggest that sectors like *Machinery Production* and *Transport Equipment Production* are sectors in which higher capital investment will lead to a higher level of employment and production in the system, there are many reasons why we should not ignore these industries, first of all, because these are industries that add value to the productive processes, second, because new methods of production can be developed and adopted in these industries and third because they require qualified labour for their production. Thus the level of employment by these means will be increased not only in quantity but also in quality.

CONCLUSIONS

It is evident that the pace of growth of the Mexican economy in terms of Gross Domestic Product (GDP), Gross Fixed Investment (GFI) and Employment has extremely declined over the last three decades. We could see that the trend towards high rates of economic expansion and job generation observed during the 1970's came to an end at the beginning of the 1980's and have not recovered since then. Several economic changes that were realised in order to encourage the economic activity such as the trade liberalizations, privatizations and financial liberalizations had failed to promote the growth of the Mexican economy and the ability to generate new and better jobs.

The role that capital accumulation plays on economic growth and generation of employment is of great importance; this research showed that an increase in GFI could lead to significant increases in the level of employment of certain industries. It showed that, because of several facts such as the power of labour absorption, the effect of the employment multipliers and the interconnectedness of certain industries with the rest of the productive system, we were able to identify those sectors of the Mexican economy that have the power to generate a positive impact on the generation of jobs in themselves and among other industries

In this research we also demonstrated the virtues and the explanatory power that the Input-Output analysis has. For instance, it allows the realisation of very disaggregated analyses that help to identify the different industries that compose the productive structure of the Mexican economy and the different industries that are key and important for the transmission of any shock. It is because of the Input-Output analysis that we were able to identify those industries such as the *Machinery Production, Transport Equipment Production and Construction industries* in which additional levels of Gross Fixed Investment would generate positive effects in the level of employment.

Therefore it can be argued that the role that capital investment plays in the generation of jobs in Mexico is crucial. It is also evident that the power of dispersion that this additional capital investment has on employment is different among industries; there are industries that, because of their degree of interconnectedness and the quality of being labour importer sectors, are able to generate jobs. However, there are others that do not show any of these characteristics and that are not able to significantly contribute to the level of employment.

This is the reason why an industrial policy plays a crucial role not only in economic expansion, but also in the generation of new jobs. The lack of an industrial policy hinders an optimal resource allocation and thus generates that industries that could help in the expansion and development of an economy are left aside. Additionally, the promotion to those sectors that are important for an economy can lead to very positive effects such as labour specialization, increase in labour productivity and increase in the level of employment and income.

It is also important to highlight the fact that this research did not consider the choice of technique that each industry utilises; it would be interesting for a future research to investigate if additional capital investment in industries that utilise modern capital goods would positively or negatively affect the level of employment of the Mexican economy. In this case, it may be possible that to face the phenomenon of technological unemployment.

References

Acemoglu, D. (2009) *Introduction to Modern Economic Growth.* Princeton University Press. United States of America.

Calderón, F. (1988). "La inversión privada en México: 1970-87". *Economía Mexicana,* num 9-10, México.

De la Garza, E. (2005). *Modelos de la producción de la Maquila de Exportación. La crisis del toyotismo precario.* Plaza y Valdes Editores. Universidad Autónoma Metropolitana. México

Dietzenbacher E. and B. Los. (2002). "Externalities of R&D Expenditures." *Economic Systems Research.* Vol.14, No.4.

Dussel Peters, E. (2003). "Características de las actividades generadoras de empleo en la economía mexicana (1988-2000)", *Investigación Económica*, enero-marzo, año/vol. LXII, núm. 243. Universidad Nacional Autónoma de México. México.

Dussel Peters, E. y Cárdenas Castro (2007). "México y China en la cadena hilo-textil-confección en el mercado de Estados Unidos", *Comercio Exterior*, Vol. 57, Núm. 7, julio. Bancomext.

Fitzgerald, E. et al., (1994). "External Constraints on Investment Decisions." In J. Grunning et al. Ed. *Trade, Aid and Development*. St Martin's Press. London.

Freeman, C. Clark, J. and L. Soete. (1982) *Unemployment and technical innovation*. Greenwood Press Westport Connecticut. United States of America.

Fujii, G. (2011). *Empleo y modalidad de crecimiento económico en México*. Cinca ediciones. México.

Garza, G. (2008). *Macroeconomía del sector servicios en la Ciudad de México, 1960-2003,* El Colegio de México, México.

Guerrero, C. (1997). *La inversión: Teoría y Comportamiento en México: 1981-1995*, tesis de maestría en ciencias económicas, UNAM. México.

Holub H.W. and H. Schnabl. (1994). *Input-Output-Rechnung: Input-Output-Analyse.* Oldenbourds Lehr-und Handbücher der Wirtschafts-und Sozialwissenschaften. München.

Hoshino, T. (1996). “Privatization of Mexico’s Public Enterprises and the Restructuring of the Private Sector “, Developing economics, vol.34, núm.1, pp.34-60.

INEGI. (2013). Input-Output tables. *Instituto Nacional de Estadística, Geografía e Informática.*

INEGI. (2014). Sistema de Cuentas Nacionales. *Instituto Nacional de Estadística, Geografía e Informática.*

Kaldor, N. (1966). *The Causes of the Slow Rate of Economic Growth of the United Kingdom.* Cambridge University Press.

Kalmbach, P. and Kurz, H. D. (1992) *Chips and Jobs. Zu den Beschäftigungswirkungen programmgesteuerter Arbeitsmittel*. Metropolis. Marburg Germany.

Keynes, M. (1973) The General Theory of Employment, Interest and Money. Volume VII. *The Collected Writings of John Maynard Keynes*. The Royal Economic Society. Macmillan Press Ltd. Great Britain.

Kurz, H. D., Dietzenbacher, E. and C. Lager. (1998) *Input-Output Analysis.* The International Library of Critical Writings in Economics 92.

Kurz, H. D. (2010) “Technical progress, capital accumulation and income distribution in Classical economics: Adam Smith, David Ricardo and Karl Marx.” In *The European Journal of the History of Economic Thought.* 17:5 1183-1222 December 2010.

Leontief, W. (1991). “The Economy as a circular flow”. *Structural Change and Economic Dynamics*, 2 (1): 181–212. (Translation of: Leontief, W. (1928). “Die Wirtschaft als Kreislauf.” Archiv fuer *Sozialwissenschaft und Sozialpolitik*, 60 (3): 577–623).

Leontief, W. (1936). “Quantitative input and output relations in the economic system of the United States”. *The review of economic statistics.* August. Vol. XVIII, No. 3

Levy, N. (1993). “Determinantes de la inversión privada en México: 1960-1985: ideas generales”, *Investigación Económica*, vol. LIII, núm.204. México

Lewis, A. (1954). “Economic development with unlimited supplies of labour”. The Manchester School of Economic and Social Studies. Vol. 22, Issue 2: 139-191. The Manchester School.

Loría, E. (2009). "Sobre el lento crecimiento económico de México. Una explicación estructural", *Investigación Económica*, vol. LXVIII, núm. 270, octubre-diciembre, Universidad Nacional Autónoma de México, México.

Loría E. and J. Ramírez. (2011). "Inflation, Monetary Policy and Economic Growth in Mexico. An Inverse Causation, 1970-2009". *Modern Economy*

López, J. (1994). *México, la nueva macroeconomía*. Nuevo Horizonte Editores. México.

López, J. (2000). "El empleo durante las reformas económicas." En Fernando Clavijo Coord. *Reformas económicas en México 1982-1999*. Fondo de Cultura Económica. México.

Marx, K. (1954) *Capital*. Vol. I. Moscow: Progress Publishers.

Marx, K. (1959) *Capital*. Vol. II. Moscow: Progress Publishers.

Máttar, J. y W. Peres. (1997) "La política industrial y de comercio exterior en México." En W. Peres Ed. *Políticas de competitividad industrial: América Latina y el Caribe en los noventa*. México. Siglo XXI editores.

Máttar, J. (2000). "Inversión y crecimiento durante las reformas económicas." En Fernando Clavijo Coord. *Reformas económicas en México 1982-1999*. Fondo de Cultura Económica. México.

Mazzucato, M. (2013) *The Entrepreneurial State.* Anthem Press. New York.

Miller, R.E. and P.D. Blair (2009). *Input-Output Analysis. Foundations and Extensions.* 2nd edition. Cambridge University Press.

Mincer, J. (1974) *Schooling, Experience, and Earnings.* National Bureau of Economic Research. New York.

Montiel, J., A. González y A. López (2007). "Crecimiento del PIB, desempleo y estructura del empleo en Estados Unidos, Francia, Japón y México", *Aportes*. enero-abril, año/vol. XII, núm. 034. Benemérita Universidad Autónoma de Puebla. México.

Moreno-Brid, J. C., and J. Ros. (2009). *Development and Growth in the Mexican Economy. A historical Perspective*. Oxford University Press

Musalem, A. (1989). "Private Investment in Mexico; An Empirical Analysis", *Policy Research Working Paper* WPS No. 183, World Bank. Washington.

Nelson, R. and E. Phelps. (1966) "Investment in Humans, Technological Diffusion, and Economic Growth". *American Economic Review* 56: 69-75

Nelson, R. and S. G. Winter. (1982) *An Evolutionary Theory of Economic Change.* The Belknap Press of Harvard University Press. United States of America

Pasinetti, L. (1980). *Essays on the Theory of Joint Production*. Macmillan. London

Pasinetti, L. (1986). "Sraffa's Circular Process and the Concept of Vertical Integration". *Political Economy.* Vol. 2, No. 1

Ramírez, M. (1991). "The impact of Public Investment on Private Capital Formation: A study relating to Mexico." *Eastern Economic Journal*, vol. XVII no. 4.

Rasmussen, Norregaard. (1963). *Intersectoral Relations.* Ed. Aguilar. Madrid España.

Ricardo, D. (1951-1973) *The Works and Correspondence of David Ricardo,* 11 vols, edited by Piero Sraffa with Collaboration of Maurice H. Dobb. Cambridge University Press.

Ros, Jaime (2008). "La desaceleración del crecimiento económico en México desde 1982", *El Trimestre Económico*. Fondo de Cultura Económica. México, v. 75, n.299.

Rosenberg, N. (2000) S*chumpeter and the Endogeneity of Technology. Some American Perspectives.* The Graz Schumpeter Lectures. Routledge. New York.

Ruiz, C. (2005). "El reto del empleo en México", *Comercio Exterior*, enero de 2005, vol. 55, núm. 1, Banco Nacional de Comercio Exterior, México.

Sacristán, E. (2006). "Las privatizaciones en México". *Economía UNAM* Vol. 3 No. 9. Universidad Nacional Autónoma de México.

Schnabl, H. (2000). *Struktur-Evolution. Innovation, Technologieverflechtung und Sektoraler Strukturwandel*. Oldenbourg Wissenschaftsverlag. München.

Sraffa, P. (1960). *Production of Commodities by Means of Commodities.* Cambridge University Press.

Smith, A. (1776) An Inquiry into the Nature and Causes of the Wealth of Nations, 2 vols. In R.H. Campbell and A.S. Skinner (Eds.), *The Glasgow Edition of the Works and Correspondence of Adam Smith.* Oxford University Press.

Ten Kate, A., y G. Niels. (1996). *Apertura comercial, privatización, desregulación y políticas de competencia en México*. Seminario México y la integración frente al siglo XXI, UNAM.

Timmer, Marcel. (2012). "The World Input-Output Database (WIOD): Contents, Sources and Methods". *WIOD.* Working Paper Number 10.

Tornell, A., and G. Esquivel. (1997). The political economy of Mexico's entry into NAFTA. In T. Ito and A. Krueger eds., *Regionalism Versus Multilateral Trade Arrangements*, NBER-East Asia Seminar on Economics, vol. 6. Chicago: University Press of Chicago.

Warman, F. and A. Thirlwall. (1994). "Interest Rates, Saving, Investment and Growth in Mexico: Test to the Financial Liberalization Hypothesis", *Journal of Development Studies*, vol.80, no. 3.