Labour Demand Effects of Production Fragmentation in Mexico

María Angeles Cadarso-Vecina*, María del Rosario Cervantes**, Nuria Gómez-Sanz*, Luis Antonio López-Santiago* & María Ángeles Tobarra-Gómez*
*Universidad de Castilla-La Mancha
**Universidad Nacional Autónoma de México

Universidad de Castilla-La Mancha
Ftad. de CC. Económicas y Empresariales
Plaza de la Universidad, 2 02071 Albacete (Spain)
Phone: +34 967 599 200 Ext. 2382 & 2383
Fax: +34 967 599 216
Angeles.Cadarso@uclm.es
Nuria.Gomez@uclm.es
Luis.LSantiago@uclm.es
MariaAngeles.Tobarra@uclm.es

ABSTRACT

The aim of this paper is to investigate the effect of offshoring on the level of employment for 42 Mexican manufacturing industries from 1988 to 2004. Following recent literature on the topic, offshoring is measured by intra-industry imports of inputs, using matrices of input-output tables. The impact of intra-industry offshoring in developed countries has been widely studied: Firstly, it favours high-skilled employment, and secondly it decreases low-skilled employment that is displaced to developing countries. Nevertheless, the influence of offshoring on employment in developing countries is far less documented. We find that narrow offshoring and imported input content of exports have a positive impact and significant for industrial employment of México, both high – and low – skilled. Offshoring into Mexico tries to take advantage of the wage differential between both countries, not only for low-skilled labour, but also high-skilled.

1. Introduction

The free trade agreement signed by Mexico with the USA and Canada in 1994 (the North American Free Trade Agreement (NAFTA)) has provoked intense commercial relationships between these countries. As a consequence, the productive structure of the involved countries is changing with effects on production and employment different for developed and developing countries. In this context, North-American firms outsource part of their production and move it to México as a tool to compete in an increasingly globalised world. In this fashion, sometimes they locate part of their production in countries where they find advantages (low wages, legal safety, lower environmental costs, etc.) and sometimes they simply import from external providers located in those countries.

The effect on international trade of both NAFTA and these fragmentation practices has been a significant increase in exchanges of goods and services between these two countries. On one hand intermediate imported inputs from Mexico have greatly increased (offshoring), as those multinational firms move their production to this country. On the other hand, NAFTA has significantly promoted Mexican exports to the US and Canada (Moreno-Brid, et al., 2005). Our objective is to analyse these trade flows and also to estimate its incidence on industrial employment in Mexico.

The impact of imported inputs (offshoring) in the labour of developed countries is highly documented. Firstly, it favours high-skilled employment, and secondly it decreases low-skilled employment that is displaced to developing countries (Feenstra & Hanson (1996, 1999), Strauss-Kahn (2003), Egger & Egger (2003, 2005), Falk & Wolfmayr (2005) and Hijzen et al. (2005)). Nevertheless, the influence of offshoring on employment in developing countries is far less documented. Our aim is to analyse the effect of offshoring on high and low – skilled labour in Mexico.

Mexico being a low-qualified labour-intensive country, we would expect multinationals to move to this country monotonous production stages, and after more value is added the products would be re-exported to other countries (either as final products for demand or to be finished). Our objective, on one hand, is to study the importance of this delocalisation process in the Mexican economy through the evolution of imported

technical coefficients (offshoring) and its final impact on the evolution of both low and high-skilled labour. To this end, offshoring measures are included in a labour demand function estimated using annual data on worked hours for high – and low – skilled labour, added value (net sales minus intermediate purchases) and labour cost. The most appropriate method of estimation, for these panel data with a lagged dependent variable and endogenous and predetermined variables among the regressors, appears to be the GMM system technique (SYS-GMM).

On the other hand, this paper also provides results for a measure of "vertical specialization", as proposed by Hummels et al. (2001). This relates simultaneously the fragmentation of production and exports by sector of activity, as it calculates the direct and indirect imported inputs that are included in a country's exports. Using this measure, we account for the fact that in the making of a product there are at least two countries interacting sequentially, and that the final destination of that product is a country other than the one where the last production stage takes place.

In what follows we will briefly review the recent literature on offshoring and employment in section 2, we will describe our methodology and offshoring measures in section 3, the evolution of those measures is presented in section 4 and our results for the GMM estimations of offshoring on employment in section 5. Section 6 concludes.

2. Offshoring, Vertical Specialization and employment in recent literature

New production methods involve the division of production in different stages that are taken to different geographical locations with important effects on employment: this process is called offshoring (international outsourcing in the old terminology). We prefer the term "offshoring" because it properly reflects the substitution of domestic intermediate inputs for imported inputs since it «implies that tasks formerly undertaken in one country are now being performed abroad» (Grossman & Rossi-Hansberg, 2006) and these changes are more likely to affect employment at home.

A number of papers have analysed this topic in the last decade following the original Feenstra & Hanson (1996) paper, but only for developed countries. Nevertheless, the

influence of offshoring on employment in developing countries is far less documented. Our aim is to analyse its effect on high and low – skilled labour in Mexico.

Feenstra & Hanson (1996) used the non-production share of workers' of the industry wage bill to proxy the relative demand for skilled labour in an industry. This measure is introduced in a labour cost equation (see Berman et al. 1994) that includes other control variables. They conclude that outsourcing is associated with an increase in relative demand for skilled labour in the US labour market, especially when outsourcing comes from low-wage countries.

This framework was extended in Feenstra & Hanson (1999) as they included, together with the measures of trade, variables to reflect technical change as these are the main forces affecting relative demand for skilled labour. More relevant to our study they further elaborate the definition and measure of outsourcing, identifying three types: narrow, difference and broad. Narrow offshoring is restricted to imported inputs from the same sector per unit of production or as a share of intermediate inputs, while difference outsourcing describes intermediate goods imported from sectors other than the one considered (broad outsourcing defines the sum of the other two types).

Empirical applications following Feenstra & Hanson work for European data moved to the estimation of labour demand functions as an alternative to labour cost functions to adjust to the specificities of the European labour market, where wage differences are less important. We comment on some European studies such as Hijzen et al. (2005), Strauss-Kahn (2004), Görg & Hanley (2005) and Amiti & Wei (2005).

Hijzen et al. (2005) empirically investigates the link between international outsourcing and the skill structure of labour demand in the UK by estimating a system of four variable factor demand functions. The relative demand function is augmented by an inter-industrial outsourcing measure, calculated using import-use matrices of input-output tables for manufacturing industries and shows that international outsourcing has had a strong negative effect on the demand for unskilled labour.

A similar result is found in Strauss-Kahn (2004) for 50 French industries, showing that specialization has contributed appreciably to a decline in the within-industry share of

unskilled workers, although “globalization” is not the only element affecting labour - as skilled-biased technological progress seems more important than outsourcing in explaining the reduction in unskilled labour demand.

Görg & Hanley (2005) analyse the effect of outsourcing on total labour at the level of the individual plant. They estimate dynamic labour demand for the Irish electronic sector and find that, in the short-term, there are significant reductions in plant-level labour demand explained by international outsourcing. However, the effect of outsourcing depends on the kind of imported intermediate goods, since there appears to be stronger negative effects from outsourcing of materials than from outsourcing services. Finally, Amiti & Wei (2005) estimate a labour demand function for 78 UK sectors, including services outsourcing and they found no evidence to support the notion that sectors with higher growth of service outsourcing would have a slower rate of job growth.

The enlargements in the EU and increasing international openness by some countries have attracted interest to the topic of offshoring to particular countries or regions affecting domestic labour differently. Egger & Egger (2003, 2005), Geishecker (2005) and Falk & Wolfmayr (2005) are examples of a very recent and not yet quite developed literature. Falk & Wolfmayr (2005), a study with a broader scope, considers information for manufacturing industries in seven EU countries for the period 1995-2000. Their results are consistent with the previous papers as they find a negative impact on the level of employment, particularly for low-skilled sectors, from outsourcing to imports from low-wage countries (CEE, NICs and other East Asian countries).

Hummels et al. (2001) develops the concept of vertical specialization, as mentioned above. This term refers to the direct and indirect (total) imports of inputs required to produce the goods that are exported by a country. These authors conclude that this specialization deepened for 10 OECD countries between 1970 and 1990. Bergoing et al. (2004) show how vertical specialization justifies the growth in international trade in the last 30 years in 22 OECD countries, while the share of manufactures on added value decreases in those countries. Minondo & Rubert (2002) show that, between 1970 and 1994, the Spanish economy reached similar values to the vertical specialisation of medium-sized OECD countries. Cadarso et al. (2007) find that vertical specialization

accelerates in Spain between 1995 and 2000 mainly due to the rise in high-tech imports (particularly ICT inputs) and Gómez et al. (2007) show that this growth in Spanish vertical specialization during those years can be explained by the expansion of imports from low-wage countries (with particular emphasis on new EU members, China and other Asian countries).

Previous literature on the effect from NAFTA on the Mexican economy finds no clear results. Some studies show that, even though the employment generated by exports has increased its share (Ruiz Nápoles, 2004), the behaviour of the labour market has not been as expected in terms of employment and wage inequality (Feliciano, 2001, Revenga, 1997, Cragg & Epelbaum, 1996, Dussel, 2004, 2003 and 1995). Mexico still shows a deficit in job generation for more than 500.000 jobs per year with respect to the growth rate of its active population (Dussel, 2003). At the same time, the wage gap by type of workers has increased since the beginning of the trade openness process, in mid-1980s (Revenga, 1997 y Cragg y Epelbaum, 1996), and it has not decreased alter the signing of the NAFTA, (Ramírez, 2004). Feenstra y Hanson (1997) analyse the effect of FDI on relative wages in Mexico, and their results show that FDI is positively correlated with relative demand for high-skilled labour.

3. Offshoring and imported input content in Mexico

Our study shares with the literature discussed in the previous section the interest on the relationship between offshoring and labour with different skill levels. However we present a different equational approach. As an empirical approximation to the topic we will focus on the impact of offshoring on total employment. Following this, we explore in greater detail the effect of offshoring on each skill-level group by estimating different labour demand equation s for each skill level, instead of the relative skilled labour or wages equation as usual in previous literature.

For the total work we find our labour demand function starting from the CES production function and following the usual procedure of first-order conditions we can obtain the labour demand function augmented with offshoring and fitted to panel data:

$$n_{it} = \alpha_1 y_{it} + \alpha_2 w_{it} + \alpha_3 offshoring_{it} + (\varepsilon_i + u_{it}) \quad (1)$$

where i = 1, ..., N sectors and t = 1,..., T years, n is employment, y is output, w is (real) labour cost (all in logarithms), ε are sector–specific (time–invariant) effects and u is the usual error term.

Equation (1) can be understood as a static or long-term equilibrium relationship but it does not take into account possible dynamic or short-term effects. Therefore, we will estimate the following dynamic specification:

$$n_{it} = \alpha_0 n_{it-1} + \alpha_1 y_{it} + \alpha_2 w_{it} + \alpha_3 offshoring_{it} + (\varepsilon_i + u_{it}) \quad (2)$$

It is possible to find the value of the long-term coefficient for all the variables in expression (2) from the short-term estimated coefficients. Equation (2) must be regarded as a first approach to the dynamic structure of the link between these variables. Additional regressions were performed, including further lags of these variables, to check the adequacy of the specification.

In order to analyse the effect of offshoring on both skill groups we have to move to a simpler equation framework, we define a Cobb-Douglas cost function for three different factors, skilled labour, unskilled labour and capital:

$$C_{it} = w^s n^s + w^u n^u + r\ k$$

where superscript s denotes skilled labour, u denotes unskilled labour and k represent capital. Cost minimization implies a labour demand equation for each group that in its dynamic version becomes:

$$n^s_{it} = \beta^s_0 n^s_{it-1} + \beta_1 y_{it} + \beta^s_2 w^s_{it} + \beta^u_2 w_{it} + \beta^k_2 r_{it} + \beta_3 offshoring_{it} + (\varepsilon_i + u_{it}) \quad (3)$$

$$n^u_{it} = \beta^u_0 n^u_{it-1} + \beta_1 y_{it} + \beta^s_2 w^s_{it} + \beta^u_2 w_{it} + \beta^k_2 r_{it} + \beta_3 offshoring_{it} + (\varepsilon_i + u_{it}) \quad (3')$$

About the offshoring measure, and according to the nature of data, Mexican matrices distinguish between domestic and imported inputs, allowing us to directly measure offshoring as in Hijzen et al. (2005). This is an advantage compared to other international data, such as those used by Feenstra and Hanson (1996, 1999), Egger and Egger (2003, 2005) and Strauss-Kahn (2004) which need to combine input-output tables and trade data to proxy imported inputs by sector.

Also, according to the scope of the offshoring measure, we will focus on narrow offshoring (offshoring from now onwards) i.e. intra-industrial imported inputs. We must consider two important questions: First, why do we only focus in intra-industrial inputs? We analyse the impact of offshoring on employment for each sector, and it is far more likely for sectoral employment to be affected when we replace domestic inputs from the same sector by imported inputs, rather than other inputs that will have an impact on employment in other sectors.

The second question is whether we divide imported inputs by production, added value or total inputs. There is no clear answer in recent literature on this topic: Feenstra & Hanson (1996, 1999) and Amiti & Wei (2005) divide by total inputs non-energy purchases[1]; Egger & Egger (2003), Strauss-Kahn (2003), Gómez *et al.* (2006) and Cadarso *et al.* (2006) divide by effective production; Hijzen et al. (2004) divide by added value, and Görg & Hanley divide by total wages. We would expect Mexican imported inputs and employment to be complementary, as multinational firms move part of their production to this country to employ low-wage workers that will accomplish less skill-intense stages of production. In this sense, we are interested in the ratio intra-industry imported inputs / total inputs, for each sector, as we would expect this variable to be positively correlated with employment in Mexico. If we were to divide by added value or production, as both the numerator (due to rise in imported inputs) and the denominator (due to the growth in total wages as employment increases) will increase, the growth of the resulting offshoring measure will be much slower. For this reason, offshoring measure is obtained by dividing imported inputs purchased from the same type of commodity by total inputs (domestic plus imported)[2]:

$$narrow \quad offshoring_{it} = m_{iit} = \left(\frac{Imported\ Inputs_{ijt}}{\text{Total inputs}_{jt}} \right), \forall i = j \tag{4}$$

The term vertical specialization simultaneously relates to the fragmentation of production and exports by sector, as it calculates the total (direct and indirect) imported inputs included in exports (Hummels et al., 2001). In this way we can describe how

[1] As Mexico is an oil producer and exporter, we do not need to discount energy imports that are very small and not affected by price fluctuations.

[2] We have also calculated (and included in our regressions) the offshoring measure that divides by total production. We find not only a very discrete growth in that variable (compared to the measure that divides by total inputs), but it is also not significant in the labour demand function.

countries are increasingly involved in production in a sequential fashion and what is the foreign added value included in domestic production[3]. To calculated vertical specialization we use the formula propose for Cadarso et al. (2007):

$$EV = M(I - D)^{-1} < X > \quad (5)$$

Where *M* is the matrix of imports coefficients per unit of production, *D* is the matrix of domestic coefficients, and *X* is the diagonalised vector of exports. This diagonalisation in the last term is the main difference between our calculation and that of Hummels et al. The advantage of this formulation is that we can then obtain three types of information:

- On the one hand the sum of the elements contained in the columns of the resulting matrix tells us the intermediate imports of all products that are directly (or indirectly) required to obtain the exports of a sector;
- On the other hand the sum of the elements contained in the rows allows us to calculate the total content of intermediate imports of a particular input for all of the exports of a country. This is the information used in Hummels et al. and Minondo & Rubert (2002) for the Spanish economy until 1995 and it results from the expression above without diagonalising the vector of exports.
- The diagonal elements show the intermediate imports of one product that are directly and indirectly required to produce the exported goods of the associated sector.

The offshoring measured used in the empirical part of this paper is the sum of the elements contained in the columns.

It is important to note that vertical specialization represents the content of total (direct and indirect) intermediate imports included in Mexican exports, while the offshoring measures only consider direct inputs.

4. Offshoring and imported input content in Mexico

Imported inputs in Mexico grew significantly in the period 1993-2000, from 15% of total inputs in 1993 to 19% in 2000. Intra-industry inputs experienced the greatest growth among all inputs, so the narrow offshoring measure (intra-industry imported inputs over total inputs) grew more than 91% in those seven years (Figure 1). This rise

[3] The vertical specialization shows, up to a point, the lack in the production of different intermediate goods as it describes the inputs that our country needs to import, in order to produce and export. However, once the goods are exported, the available data cannot tell whether the production of these goods has been completed as it does not distinguish between exports of final and intermediate goods.

in intra-industry imports is linked to the growing fragmentation of production by multinational firms and their location in countries with lower production costs, moving labour-intensive stages to Mexico due to its lower labour costs. Furthermore, in these years there is some substitution between domestic and imported intra-industry inputs, with a decrease in the former and an important increase of the latter (Figure 2).

<Figure 1 around here>

On the other hand, the financial crisis of 1995 and the devaluation of the Mexican peso could slow down those imports. Nevertheless, if we distinguish between intra-industry and inter-industry imports, only the latter were reduced between 1993 and 1996. Intra-industry imports, linked to fragmentation of production processes and offshoring, are far less sensitive to exchange rate devaluations, as the own multinational firms introduced their semi-manufactured goods to be completed by Mexican workers and then re-exported. That means there is no real currency exchange and the exchange rate volatility is less important for the fragmentation and delocalisation of multinational firms. It could rather be an advantage: the devaluation of the Mexican peso could make its labour force even cheaper.

<Figure 2 around here>

The disaggregation by branches shows that the narrow offshoring is concentrated in a few sectors. It is in the manufacturing industry, and particularly in the maquiladora sector included in the Other manufacturing sectors, where the narrow offshoring is most important: it increases from 16.2% to 39% of total inputs. The narrow offshoring measure is also high in Pharmaceutical products. On the other hand, in branches related to ICT and machinery the share of imported inputs is lower (Tables 1 and 2): Electrical equipment and apparatus, Non-electrical machinery equipment, and Electrical machinery and apparatus. This is due to the fact that multinational firms have located in Mexico the production of some of the inputs of these sectors: although imported inputs grow in some sectors, they decrease in some industries. These results are similar to those found for the rest of OECD countries (Gomez *et al*., 2006), although their effect on employment are different as we will see below.

<Table 1 around here>

<Table 2 around here>

The signing of the NAFTA does not seem to have increased so strongly the imports for the rest of inputs: the difference offshoring measure only increases by 3.7% on average. Electronic equipment and apparatus, Electrical machinery and apparatus, Other manufacturing industries, Other textile industries and Automobiles have seen significant increases in those imports from other sectors. On the other hand, we can point out to the decrease in this measure for Soaps, detergents and cosmetics, Pharmaceutical products, Food oils and Basic chemical industry (Table 3).

<Table 3 around here>

Import content of Mexican exports

We have measured the intra-industry import content per unit of export in the Mexican economy[4] (Figure 3 and Table 4). Between 1993 and 2000, this index grows significantly but below the offshoring measure. This can be a sign of the Mexican productive deficiencies, as it has not yet developed a business sector able to take advantage of delocalisation process: economies of scale, flexibility, cost saving, etc.

When we distinguish intra and inter-industry import content of export, there is a more intense growth in import content from the same sector or intra-industry, as it has risen to a third of total import content in 2000 (Table 4).

<Figure 3 around here>

<Table 4 around here>

In Figure 4 we can see those Mexican sectors where the share of total imported inputs on exports is greater than 30% in 2000. As we saw for offshoring, most of the industries with high import content in 2000 and fast growth between 1993 and 2000 are related to ICT or machinery: Electrical machinery and apparatus, Electronic equipment and apparatus, Non electronic machinery and equipment, Electrical machinery and apparatus. It is also interesting to note the increase in import content of exports in the branches of Pharmaceutical products and Plastic products. There are other sectors where this total import content share of exports has decreased: Animal food and Automobiles.

[4] El problema que presenta el índice (y que proviene de la información solicitada por las tablas input-output) es que no informa si esas exportaciones son de productos ya terminados o finales, o de productos aún intermedios que son finalizados fuera de México.

This latter industry used to import as inputs half of its exported production, but in 2000 that share has been reduced to a third, as now there are more multinational firms producing those inputs inside Mexico.

<Figure 4 around here>

When we focus on intra-industry import content of exports we can see that high and medium-high technology industries according to OECD classification show a spectacular increase in trade (Figure 5). These are low-skilled labour-intensive sectors in Mexico, as the ratio of high and low-skilled labour force is far below the average of the manufacturing sector. The fast growth in intra-industry import content shows that foreign multinational firms have moved to Mexico labour-intensive stages of production (previously located in the US), while the stages where added value and technology are more important are carried out somewhere else in the world. Furthermore, according to data from CEPAL (2004) on trade flows, Mexico has a surplus in high-tech products since 1995. However, our index shows that up to a third of Mexican exports of this type of goods are imported inputs by multinational firms located in Mexico to take advantage of low wages.

<Figure 5 around here>

5. Empirical analysis, data and estimation issues

In this section we explain some of the data used in the estimations and show and discuss the results. Regressions are estimated for 49 Mexican industrial sectoral data for the period 1988-2004. The measures of the imported inputs technical coefficients, the share of inputs on exports and the labour demand equation variables have been calculated with data from two sources, 49 manufacturing Mexican sectors with information from the Mexican National Accounts System (Sistema de Cuentas Nacionales de México) published by INEGI and the input-output tables published by Consultoría Internacional Especializada S.A. Employment refers to all workers, unskilled workers are measured by production workers while skilled workers includes administrative and directive jobs. Production is value added (net sales minus buying of intermediate goods). The labour cost measures are deflated by the Consumer Price National Index, while for value added, net sales, intermediate inputs, exports and imports are deflated by the published constant price index for each variable at the industrial desegregation level.

We now analyse which is the most appropriate estimation method. Our panel is short in terms of observations (49 sectors and 16 years) and the estimation equation has an important dynamic component. The existence of a lagged dependent variable among the regressors generates problems in standard OLS and within estimations. Furthermore our model contains endogenous and predetermined variables which point to the use of GMM techniques as the most suitable ones, more specifically GMM system technique (SYS-GMM) that also avoids problems of weak instruments due to short panel or autocorrelation in the variables (see Blundell and Bond, 1998). SYS-GMM estimator uses all possible lags of regressors as instruments to generate orthogonality restrictions. This estimation technique combines an equation in differences that uses suitable lagged levels as instruments, with an additional equation in levels with suitable lagged first-differences as instruments. The order and number of lags included for each variable depends on whether they are considered endogenous, predetermined or exogenous. The validity for this estimation technique is tested through the use of the Sargan test of over-identifying restrictions and m1 and m2 Arellano and Bond (1991) tests. We must be cautious about results: these techniques are optimal for large samples, while in sectoral studies like this one we only have at our disposal a limited number of observations. Although the data are available for the period 1988-2004, the chosen estimation technique requires two lags of the dependent and other endogenous as instruments, so that the estimation period is 1990-2004.

The estimated labour demand function is similar to the Fajnzylber and Maloney (2001), however our estimation includes a new measure to analyse the direct effect of offshoring on employment. We know of just another paper considering the international productive process fragmentation for Mexico, Feenstra y Hanson (1997), although the work with relative wages as the dependent variable. Their interest variable is foreign direct investment and its effects on wages and they show that foreign direct investment "is positively correlated with the relative demand for skilled labor and that it can account for a large portion of the increase in the skilled labor share of total wages" (Feenstra y Hanson, 1997, p.391).

<Table 5 around here>

Table 5 shows the results for the estimation of the labour demand function for all Mexican workers, column 1, and differentiating for skilled and unskilled workers, columns 2 to 5. Columns 2 and 4 show the results of the estimation similar to equation 2 for each skilled group while columns 3 and 5 are based on the expression 3 and 3', including an extra term, the wage of the alternative skill group. There is a missing variable in this expression, the benefit rate to control for capital cost. Although we have had no access to this variable at this stage, we expect to sort this problem out soon. The alternative skill group wage allows analysing possible substitution or complementarity relations. Estimators' significance is low for some of them, however they behave as expected and according to results in previous literature. For table 1, first we discuss general results and then focus on our interest variable.

The significance of the labour lag in all columns confirms the importance of using a dynamic estimation. In general, the predominant negative sign for wage points to employer being more attracted to contract workers when wage decreases, although this variable is not significant, and the positive sign for value added that employment points to employers being more attracted to contract workers if production increases, although value added is not always significant.

The interest variable shows in column 1 a positive and significant value points to a positive relationship between offshoring and Mexican labour demand. This result leads us to wonder if the positive sign is so for skilled and unskilled labour, so we replicate the regression for both groups of workers separately in columns 2 and 4. Additionally two other regressions are estimated where the wage of the alternative group is included among the regressors in order to analyse whether both groups of workers behave as substitutes or complementary.

Columns 2 and 4 show similar sign and significance for the lag in the dependent variable, wage and value added behave poorly in the estimation. When the alternative group' wage is considered improves own wage for unskilled workers. Column 3 and 5 wages signs are indicative of skilled labour being substitute for unskilled workers, however the opposite cannot be inferred. Employers can contract skilled workers to substitute unskilled if the former group wages are sufficiently reduced, and, supposedly, improving technology to adjust to skilled workers. However it is not possible to contract

unskilled workers to carry out skilled work. Results signs point to a higher substitutability for unskilled workers than it is for skilled ones, so that employers react more to changes in unskilled workers wage than to skilled ones that are more difficult to substitute. However results are not consistent because of the low significance of coefficients.

One of the reasons put forward to explain the low significance of the wages estimators is the relationship between Mexican and foreign wages. Mexican sectors open to international trade, with higher maquila presence, produce domestically less skilled work. Firms bring low skilled stages of production to take advance of the wage differential with the fir's home wage, so the response to Mexican wages change is small. A complete analysis of this suggestion could be done by including in the regression an index of the skilled workers wage in offshoring firms home country, mainly USA for Mexican maquilas, in order to show if more skilled Mexican workers are contracted when USA skilled workers wage increases.

About the value added coefficient, it also behaves poorly. Since Mexican productive structure, and particularly the sector with high maquila presence, is specialised on low value added stages of production we consider that value added is not an adequate measure for output. A none significant coefficient with changing sign is also found in Feenstra and Hanson (1997) and Fajnzylber and Maloney (2001).

The behaviour of the outsourcing measure is quite consistent and its coefficient is always significant. Values are close in columns 1 to 5 and the sign points to offshoring influencing positively employment for both skilled and unskilled workers. The grow in imported intermediate inputs is linked to the relocalisation of foreign industries in Mexico, to produce low skilled stages of a fragmented production process generating jobs in Mexico. NAFTA agreement in 1995 has pushed this process of offshoring[5].

Previous literature shows different sign for the offshoring measure for developed countries, where imported intermediate inputs are substitutes for employment for

[5] It is also worthy to mention that the increase in imported intermediate inputs happens together with an increase in domestically produced intra-industrial intermediate inputs for ITC, machinery and maquila sectors.

unskilled (Hijzen et al. (2005) for UK and Strauss-Kahn, 2004 for France) workers or for total employment (Falk and Wolfmayr, 2005 industries in seven EU countries o Cadarso et al. (2007) for Spanish employment). We conclude that the offshoring complementary effect on employment for Mexico, as a developing country, is different to the developed countries offshoring substituting effect on employment. However the offshoring estimated coefficient is very low pointing to a restricted effect on employment. Ruiz-Napoles (2004) found results in a similar fashion from a different framework. The author worked with Mexican multipliers and shows that the main reason for the reduced NAFTA impact on employment is the low level of backward linkages between exports and the domestic economy, as a result of the opening process, which, on the contrary, has produced an extraordinary increase in imports).

<Table 6 around here>

Most to offshoring developed in Mexico is linked to intermediate stages of production of goods that will be then exported to finish production in a different country, mainly USA. For this reason we have estimated the relationship in Table 1 with a different measure for production fragmentation, the share of imports of exported intermediate goods, results are show in Table 6. Results are close to those in table 5 and the effect of the exports on imports measure on employment is positive and significant. Again results points to international production fragmentation as pushing employment growth for Mexico. The estimated results agree with those of Feenstra and Hanson (1997), however we show that the positive effect for skilled labour is also shared for unskilled ones.

6. Conclusions

The aim of this paper is to investigate the effect of offshoring on the level of employment for 42 Mexican manufacturing industries from 1988 to 2004. In a context of growing international trade, the free trade agreement signed by Mexico with the USA and Canada (culminated when Mexico joined the North American Free Trade Agreement (NAFTA) in 1994) has provoked intense commercial relationships between these countries. As a consequence, their productive structure is changing with effects on production and employment different for developed and developing countries.

We calculated a measure of intra-industry (or narrow) and inter-industry (difference) offshoring for the Mexican economy and a measure of imported input content per unit of export (both in total and intra-industry terms). Our data show a fast growth in narrow offshoring, particularly for sectors producing different types of machinery and equipment, and the Other manufacturing sectors where the maquiladora is included. The calculated measures for imported input content of Mexican exports show a similar behaviour, but with slower growth than offshoring.

Intra-industry offshoring and imported input share of exports measures are included in a labour demand function estimated using annual data on worked hours for high – and low – skilled labour, added value (net sales minus intermediate purchases) and labour cost. The most appropriate method of estimation, for these panel data with a lagged dependent variable and endogenous and predetermined variables among the regressors, appears to be the GMM system technique (SYS-GMM). We find that the effect of offshoring has a positive impact and significant for industrial employment of México, both high – and low – skilled. Outsourcing into Mexico tries to take advantage of the wage differential between both countries, not only for low-skilled labour, but also high-skilled.

7. Bibliography

Amiti, M. and Wei, S-J. (2005): "Fear of Outsourcing: Is it Justified?", *Economic Policy*, April issue, 308-348.

Arellano, M. and Bond, S.R. (1991): "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations", *Review of Economics Studies*, vol. 58, pp. 277-297.

Bergoeing, R.; Kehoe, T. J.; Strauss-Kahn, V. and Yi, K-M. (2004), "Why is Manufacturing Trade Rising Even as Manufacturing Output is Falling?", *American Economic Review*, May, pp. 134-138.

Blecker, R.A. (2006): "Macroeconomic and Structural Constraints on Export-Led Growth in Mexico", Paper presented for the Latin American Studies Association (LASA) Congress in San Juan, Puerto Rico, March 15-18, 2006.

Blundell, R. and Bond, S.R. (1998): "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, vol. 87, pp. 115-143.

Cadarso, M.A.; Gómez, N.; López, L.A. and Tobarra, M.A. (2006): "Outsourcing to EU candidates and Spanish industrial employment in 1993 – 2000", in Peeter Vahtra and Elina Pelto (eds) *The Future Competitiveness of the EU and its Eastern Neighbours***,** Proceedings of the 2006 PEI conference, Turku.

CEPAL (2004): "Panorama de la Inserción Internacional de América Latina y el Caribe 2004", *Tendencias* 2005. CEPAL, www.eclac.org

Cragg, M. I. and Epelbaum, M. (1996) "Why has wage dispersion grown in Mexico? Is the incidence of reforms or the growing demand for skill?", *Journal of Development Economics*, vol. 51, pp. 99-116

Dussel P.E. (1995): "Recent developments in Mexican employment and the impact of NAFTA", *International Contributions to Labour Studies*, vol. 5, pp. 45-69

Dussel P.E. (2003): "Características de las actividades generadoras de empleo en la economía mexicana (1988-2000)", *Investigación Económica*, vol. LXIII; 243, January-March, pp. 123-154.

Dussel P.E. (2004): "Efectos de la Apertura Comercial en el Empleo y el Mercado Laboral de México y sus diferencias con Argentina y Brasil (1990-2003)", *OIT*, Ginebra, Documentos de Estrategias de Empleo (2004/10).

Egger, H. and Egger, P. (2003): "Outsourcing and skill-specific employment in a small economy: Austria and the fall of the Iron Curtain", *Oxford Economic Papers*, vol. 55, pp. 625-643.

Egger, Hartmut - Egger, Peter (2005) Labour market effects of outsourcing under industrial interdependence. **International Review of Economics and Finance**, vol. 14, No. 3, pp. 349-363.

Egger, P.; Pfaffermayr, M. and Weber, A. (2003): "Sectoral adjustment of employment: The impact of outsourcing and trade at the micro level", *IZA Discussion paper* no. 921.

Falk, M. and Wolfmayr, Y. (2005): "The Impact of International Outsourcing on Employment: Empirical Evidence from EU Countries", Paper presented at the *Workshop on Re-location of production and jobs to CEE countries- who gains and who*

loses organized by Hamburg Institute of International Economics and Vienna University of Economics and Business Administration.

Fajnzylber, P. and Maloney, W.F. (2006): "How comparable are labor demand elasticities across countries?", *Policy Research Working Paper Series*, no. 2658, The World Bank.

Feenstra, R.C. and Hanson, G.H. (1996): "Globalization, Outsourcing, and Wage Inequality", *American Economic Review*, vol. 86, pp. 240-245.

Feenstra, R.C. and Hanson, G.H. (1997): "Foreign direct investment and relative wages: Evidence from Mexico's maquiladoras", *Journal of International Economics***,** vol. 42, pp. 371-393.

Feenstra, R.C. and Hanson, G.H. (1999): "The impact of outsourcing and high-technology capital on wages: Estimates for the United States, 1979-1990", *Quarterly Journal of Economics***,** vol. 114, pp. 907-940.

Feliciano, Z.M. (2001): "Workers and trade liberalization: The impact of trade reform in México on wages and employment", *Industrial and Labour Relations Review*, Oct. 2001, vol.55 no. 1, pp. 95-115.

Geishecker, I. (2005): "Does Outsourcing to Central and Eastern Europe really threaten manual workers' jobs in Germany?", Paper presented at the *Workshop on Re-location of production and jobs to CEE countries- who gains and who loses*, organized by Hamburg Institute of International Economics and Vienna University of Economics and Business Administration.

Gómez, N.; López, L.A. and Tobarra, M.A. (2006): "Pautas de deslocalización de la industria española en el entorno europeo (1995-2000). La competencia de los países de bajos salarios", *Boletín Información Comercial Española*, no. 2884, pp. 25-41.

Görg, H. and Hanley, A. (2005): "Labour Demand Effects of International Outsourcing: Evidence from Plant-level Data", *International Review of Economics and Finance*, vol. 14, no. 3, pp. 365-376.

Hijzen, A.; Görg, H. and Hine, R.C. (2005): "International Outsourcing and the Skill Structure of Labour Demand in the United Kingdom", *Economic Journal*, vol. 15, no. 506, pp. 860-878.

Hummels, D.; Ishii, J. and Yi, K-M. (2001): "The nature and growth of vertical specialization in world trade", *Journal of International Economics*, vol. 54, no. 1, pp. 75-96.

López, J. (2000): "El Empleo Durante las Reformas Económicas", F. Clavijo (comp.) Reformas Económicas en México 1982-1999", *El Trimestre Económico*, FCE, CEPAL, ESANE.

Minando, A. and Rubert, G. (2002): "La especialización vertical en el comercio internacional de España", *Revista de Economía* ICE, no. 802, pp. 117-128.

Moreno-Brid, J.C. and Ros. J. (2004): "México: las reformas del mercado desde una perspectiva histórica", *Revista de la CEPAL*, vol. 84, December, pp. 35-57.

Moreno-Brid, J.C; Rivas, J.C. and Santamaría, J. (2005):" Mexico: Economic growth, exports and industrial performance after NAFTA", *Serie Estudios y Perspectivas*, vol. 42, CEPAL, Economic Development Unit, Sede Subregional de la CEPAL en México.

Palma, G. (2003): “Trade liberalization in Mexico: Its impact on growth, employment and wages”, *Employment paper* 2003/55, ILO.

Revenga, A. (1997): “Employment and Wage Effects of Trade Liberalization: The Case of Mexican Manufacturing”, *Journal of Labour Economics*, vol. 15, no. 3.

Ruiz Nápoles, P. (2004): “Exports, growth, and employment in Mexico, 1978-2000”, *Journal of Post Keynesian Economics* , vol. 27, no.1

Strauss-Kahn, V. (2004): “The role of globalization in the within-industry shift away from unskilled workers in France”, in Baldwin, R.E. and Winters, A.L. (eds.): *Challenges to globalization: Analyzing the economics***,** Chicago: University of Chicago Press, pp. 209-31.

Table 1: Narrow offshoring by industry in Mexico, 1993-2000

	Industry	**1993**	**1996**	**2000**	**Growth rate (93-00 %)**
38	Pharmaceutical products	0.30667	0.26737	0.40512	32.10
59	Other manufacturing industries	0.16385	0.29107	0.39565	141.46
54	Electronic equipment and apparatus	0.48660	0.24308	0.24761	-49.12
31	Paper and cardboard	0.31253	0.18442	0.24005	-23.19
47	Non ferric basic industry	0.23831	0.14613	0.23354	-2.00
55	Electrical equipment and apparatus	0.20318	0.20473	0.21766	7.13
51	Non electrical machinery & equipment	0.26405	0.17080	0.20733	-21.48
40	Other chemical products	0.10799	0.14790	0.17225	59.50
33	Oil and oil products	0.07850	0.07983	0.15509	97.56
35	Basic chemical industry	0.14278	0.14590	0.14171	-0.75
57	Bodywork and car parts	0.20907	0.12799	0.13954	-33.26
50	Other metallic products, excluding machinery	0.18985	0.10156	0.12083	-36.35
26	Other textile industries	0.08978	0.06196	0.09540	6.27
52	Electrical machinery & apparatus	0.14325	0.07284	0.09472	-33.87
11	Food and milk	0.07538	0.04779	0.08685	15.22
34	Basic oil chemical industry	0.06054	0.04946	0.08093	33.67
	Average for the economy	***0.04246***	***0.05619***	***0.08186***	***92.79***

Table 2: Domestic intra-industry technical coefficients in México, 1993-2000 (selected branches)

		1993	**1996**	**2000**	**Growth rate (93-00 %)**
51	Non electrical machinery & equipment	0.00331	0.07073	0.03650	1004.3
52	Electrical machinery & apparatus	0.00103	0.02376	0.02538	2374.3
53	Electrical appliances	0.00462	0.26545	0.30213	**6436.1**
54	Electronic equipment and apparatus	0.00311	0.42736	0.52215	16706.6
55	Electrical equipment & apparatus	0.00000	0.01010	0.01116	---
56	Automobiles	0.00024	0.00172	0.00309	1193.9
59	Other manufacturing ind.	0.00208	0.07665	0.06857	3200.8
	Average for the economy	***0.12906***	***0.16035***	***0.17102***	***32.5***

Table 3: Difference offshoring by industry in Mexico, 1993-2000

		1993	1996	2000	Tasa crecimiento
18	Animal food	0.51289	0.42555	0.72867	42.07
56	Automobiles	0.37784	0.35710	0.63440	67.90
42	Plastic products	0.52628	0.35426	0.48285	-8.25
26	Other textile industries	0.25317	0.21065	0.42578	68.18
17	Food oil and fats	0.58676	0.56048	0.41761	-28.83
6	Oil extraction	0.35994	0.22799	0.38917	8.12
55	Electrical equipment & apparatus	0.25388	0.23925	0.38421	51.34
7	Iron ore	0.24333	0.21878	0.34605	42.21
51	Non electrical machinery & equipment	0.27818	0.21245	0.32432	16.59
52	Electrical machinery & apparatus	0.27866	0.22161	0.31726	13.85
10	Other non metallic minerals	0.32588	0.27927	0.31250	-4.11
59	Other manufacturing industries	0.17401	0.14430	0.29369	68.78
50	Other metallic products, excluding machinery	0.29344	0.24604	0.29326	-0.06
39	Soaps, detergents & cosmetics	0.39792	0.23786	0.27714	-30.35
35	Basic chemical industry	0.34027	0.30078	0.26746	-21.40
58	Transport equipment	0.21599	0.18847	0.26419	22.32
32	Publishing	0.22414	0.16245	0.25258	12.69
30	Other wood & cork products	0.16871	0.07117	0.24242	43.69
40	Other chemical products	0.24509	0.17392	0.24028	-1.96
36	Fertilizers	0.24574	0.27724	0.23451	-4.57
38	Pharmaceutical products	0.31932	0.17386	0.22333	-30.06
37	Synthetic resins & chemical fibers	0.26510	0.19463	0.21823	-17.68
27	Garments	0.14389	0.09445	0.20074	39.51
41	Oilcloth products	0.18691	0.19396	0.17203	-7.96
53	Electrical appliances	0.08190	0.08475	0.17103	108.84
54	Electronic equipment & apparatus	0.03090	0.04232	0.16388	430.42
	Average for the economy	***0.11654***	***0.09013***	***0.12089***	***3.73***

Table 4: Import content of Mexican exports, 1993-2000

	1993	1996	2000	Growth rate 1993-2000
Intra-industry	3.72%	4.89%	6.93%	86.29
Total	17.27%	17.39%	21.98%	27.27
Share Intra-industry	*21.55%*	*28.12%*	*31.53%*	*46.31*

Table 5: Offshoring effect on employment, Mexico 1988-2994.

	All Workers		Unskilled Workers		Skilled Workers	
	(1)		(2)	(3)	(4)	(5)
Workers $_{(t-1)}$	0.9352	(0.000)***	0.9600 (0.000)***	0.9786 (0.000)***	1.0657 (0.000)***	1.1534 (0.000)***
Wages	-0.1176	(0.263)				
Unskilled wages			-0.1311 (0.270)	-0.3342 (0.071)*		0.1286 (0.736)
Skilled wages				0.3320 (0.256)	0.1570 (0.247)	0.1165 (0.704)
Y	0.1062	(0. 095)	0.1041 (0.100)*	0.0936 (0.558)	-0.0219 (0.817)	-0.0583 (0.591)
Narrow offshoring	0.0020	(0.000)***	0.0019 (0.000)***	0.0020 (0.005)**	0.0022 (0.000)***	0.0023 (0.000)***
Sargan test:	35.110	[1.000]	35.66 [1.000]	29.200 [1.000]	28.44 [1.000]	26.400 [1.000]
AR(1) test:	-2.529	[0.011]**	151.8 [0.017]**	-2.146 [0.032]**	-1.734 [0.083]*	-1.773 [0.076]*
AR(2) test:	-1.308	[0.191]	123.3 [0.561]	-0.540 [0.590]	0.1050 [0.916]	0.006 [0.995]

Table 6: Exports on imports measure on employment, Mexico 1988-2994.

	All Workers		Unskilled Workers		Skilled Workers	
Workers $_{(t-1)}$	0.8869	(0.000)***	0.9382	(0.000)***	1.1039	(0.000)***
Wages	-0.1788	(0.185)				
Unskilled wages			-0.3561	(0.037)**	0.0340	(0.916)
Skilled wages			0.2903	(0.403)	0.2020	(0.451)
Y	0.1416	(0.051)*	0.1220	(0.414)	-0.0330	(0.783)
VS	0.0020	(0.000)***	0.0020	(0.006)*	0.0020	(0.000)***
Sargan test:	33.95	[1.000]	30.77	[1.000]	28.28	[1.000]
AR(1) test:	-2.276	[0.023]**	-2.175	[0.030]**	-1.743	[0.081]*
AR(2) test:	-1.338	[0.181]	-0.5617	[0.574]	0.0990	[0.921]

Figure 1: Narrow and difference offshoring in Mexico, 1993-2000

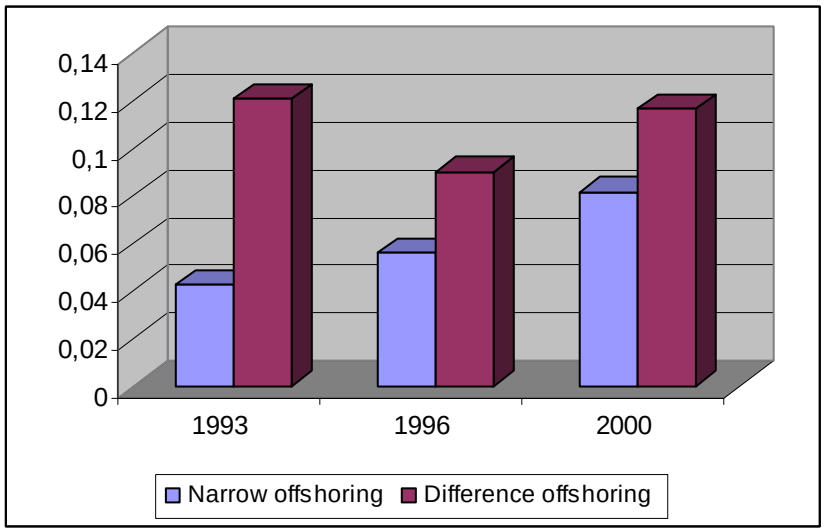

Figure 2: Narrow offshoring and domestic intra-industry technical coefficients in Mexico, 1993-2000

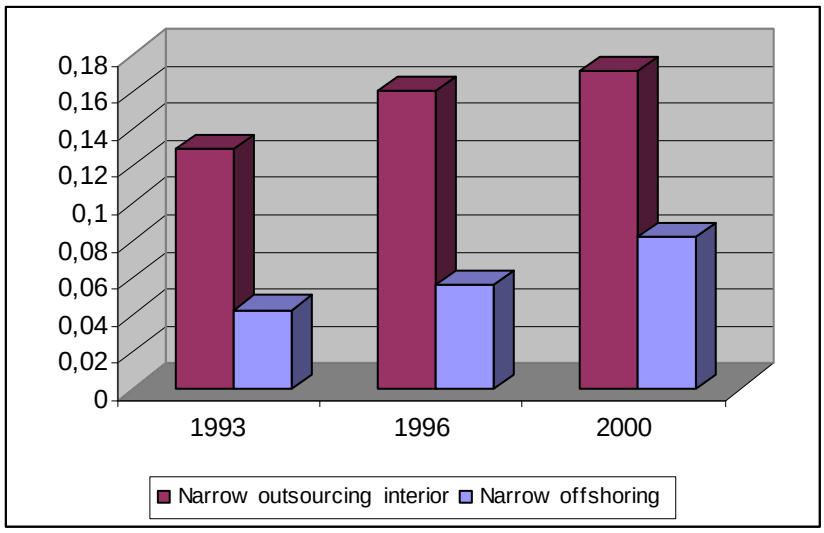

Figure 3: Intra-industry and total import content of Mexican exports, 1993-2000 (%)

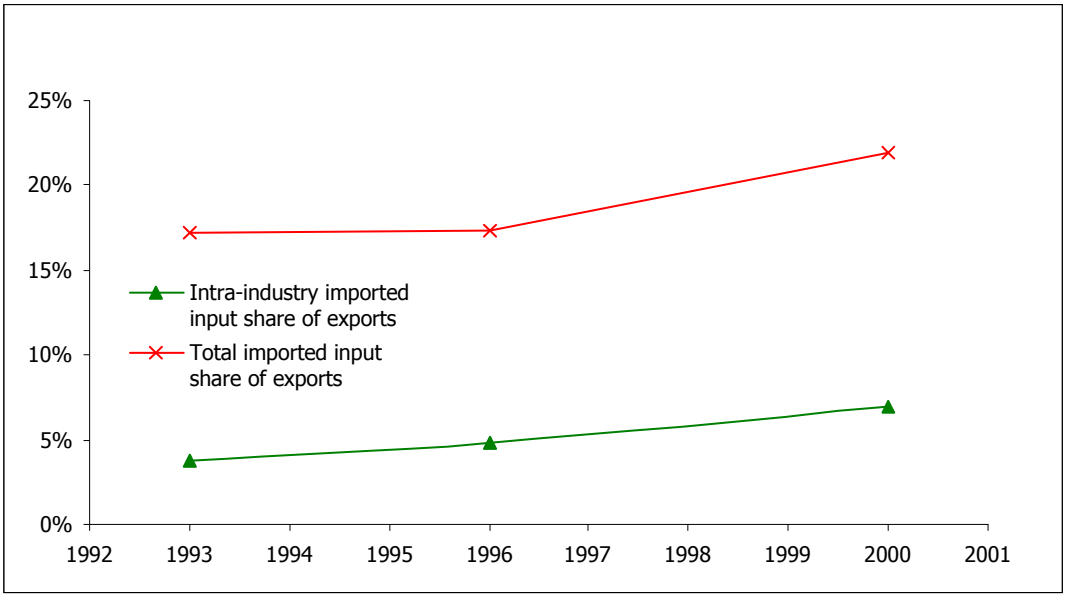

Figure 4: Total import content of Mexican exports, 1993-2000

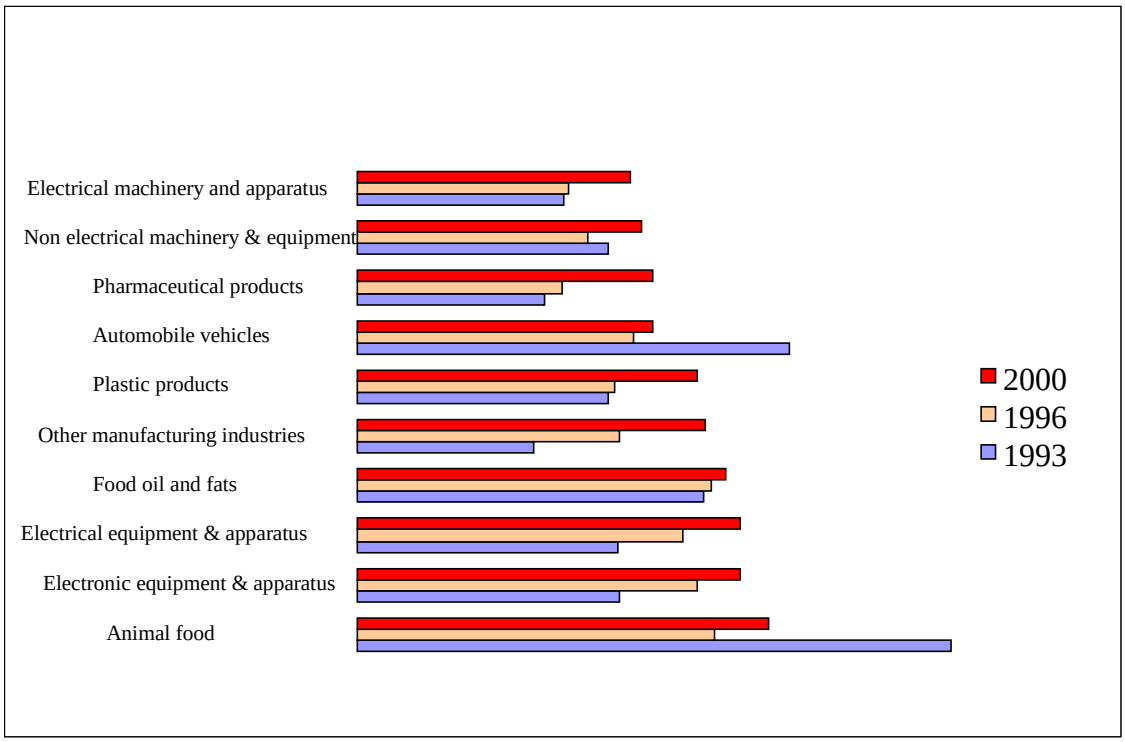

Figure 5: Intra-industry import content of Mexican exports, 1993-2000