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Economic impact of Economic Partnership Agreement Mexico – Japan

– theoretical and empirical aspects –

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Japanese Automotive FDI Linkages with Local Suppliers

– Evidence from Survey data in Mexico's Western Region –

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Abstract

Foreign Direct Investment (FDI) may benefit host countries by creating linkages with local suppliers and facilitating the transfer of knowledge, technology and know-how from foreign to domestic firms with eventual productivity enhancements[1]. Using a logistic model and unpublished data from Japanese automotive firms in Mexico's Western Region, this paper analyses the factors that determine the usage of local suppliers. Econometric results show that the quality of local suppliers is a determinant factor for the degree of linkages between Japanese multinationals and endogenous suppliers. Also, a positive relationship is found between time of establishment and local supplier usage. Specifically, Japanese firms with longer periods of establishment are more likely to use local suppliers in the automotive industry.

Introduction

FDI has been in the agenda of developing economies since the 1980s. Most developing countries have actively pursued to attract FDI expecting some type of benefits or economic development primarily through export growth and through externalities or "spillovers" generally associated with FDI (Carkovic & Levine, 2002).

1) This has been extensively reviewed in the FDI literature. For example, see Balasubramanyam, Salisu and Sapsford (1996), Javorcik (2004) and Jordaan (2009).

Between 1970 and 1999, according to data from UNCTAD[2)], FDI inflows to developing countries represented only between 22% and 25% of total FDI inflows. However, from 2000 to 2009 the share jumped to almost 50% of total flows, and in 2012, the share increased to 58% of total FDI. This concentration in recent years of FDI flows in developing countries has been achieved due to the attractiveness of developing countries for long–term investment projects and their active policies to relax restrictions on foreign capital.

The spillovers associated with FDI, according to Reganati and Sica (2007) can be either to firms in the same industry or what is known in the literature as "horizontal spillovers" or to firms in vertically linked industries, also referred to as "vertical spillovers". Also, Javorcik (2008) mentions that spillovers are expected to be larger in vertically related industries due to the fact that foreign firms have incentives to create linkages with local suppliers and facilitate the transfer of knowledge and technology, benefiting the multinational company by cost reduction and improvement of suppliers' processes and quality of inputs. In this sense, it has been of interest by researchers to analyse not only the externalities associated to FDI, but also the process and necessary conditions for linkage creation between foreign firms and local suppliers in developing countries.

The study is focused on Japanese FDI in Mexico's automotive industry. Both countries signed the Economic Partnership Agreement (EPA) in 2005, and increases in FDI inflows from Japan have been observed. For example, according to data from Mexico's Secretary of Economy, FDI inflows from Japan were registered at 139 million dollars in 2003 and by 2012 the inflows had increased to 1,812 million dollars.

This increase in Japanese FDI inflows to Mexico seemed to be an excellent opportunity for Mexican suppliers to enter Japanese production chains, which would in turn improve their productivity and competitiveness. However, after 10 years of the EPA, it seems that linkages between Japanese companies and local suppliers have been scarce due to a limited local supplier base characterised by quality and technological restrictions that inhibit their entrance to Japanese production chains

2） www.unctad.org

(Tokoro, 2006). However, the Mexico-Japan EPA contains a section regarding bilateral cooperation where emphasis is placed on local supporting industry linkages and small and medium size local supplier development for the automotive industry. This in particular provides an area of research for linkages and their necessary conditions. The present study is thus focused on Japanese automotive companies established in Mexico's western region and in certain factors that contribute to the existence of linkages with local suppliers.

The paper is organized as follows: the following section presents the main theoretical arguments regarding linkage creation between foreign companies and local suppliers and the main empirical findings for Mexico; the third section depicts the data used in the analysis and the empirical methodology applied in this study; the fourth section presents the results obtained; finally the fifth section ends with some concluding remarks.

Theoretical Background and Empirical Findings

According to Javorcik (2008), several factors determine the presence and intensity of backward linkages. Fist, foreign firms determine the degree of local input usage depending on the openness of the economy, local customs system and transport costs. A more open economy enables foreign firms to import inputs from other countries. Similarly, low transport costs and an efficient and unerring customs system will also increase the usage of foreign suppliers.

Another determinant factor is if the foreign firm follows a centralized supplier system. When this is the case, local firms will have limited opportunity to enter global production chains since supplier usage decisions are made at headquarters. Rivera (2002) found this to be the case for the electronic industry in the city of Guadalajara, Mexico. The results of the study showed that U.S. multinationals followed a system of input buying agreements negotiated at the headquarter company; creating an international supplier network that eliminated the possibility to incorporate or develop local suppliers. Similarly, Belderbos, Campanelli and Fukao (2001) mention that Japanese multinationals have a tendency to be vertically linked

in industrial groups or "*keiretsu*[3)]" and acquire most of their inputs from Japanese suppliers from the same Keiretsu, limiting the possibility for linkages with local suppliers.

Also, the need for customized inputs will determine the degree of local supplier inputs. The extent of local supplier development and the need for technologically advanced inputs will also decide the amount of linkages with local firms. In this sense, Padilla (2008) found very little evidence of linkage creation between foreign firms and local suppliers for the electronic industry in the states of Baja California and Jalisco in Mexico, where linkages between foreign and domestic firms were confined primarily to indirect inputs with low technological content. Similar results for the electronic industry showing limited linkages from foreign firms with local suppliers were reported by Dussel (1999) and Rivera and Regino (2004) for the state of Jalisco and by Carrillo (2002) for the T.V. industry in Baja California, Mexico. For the case of Japanese firms, Guzman (2014) states that not only the need of customized inputs, but also the quality of these inputs is a determinant factor for local supplier usage in Mexico.

Another important determinant for linkages is the amount of time that the foreign firm has operated in the host country. New FDI projects are less likely to use local inputs since it takes time to create client–supplier relations. The literature suggests that for Japanese firms, this is an important factor. Kiyota, Matsuura, Urata and Wei (2008) found in a study carried out in East and Southeast Asia, that the use of local suppliers was positively related with the time of operation in the host country by the Japanese affiliate. Similar results were found in Belderbos et al. (2001) for the case of 272 Japanese subsidiaries in 24 countries. The study also found that certain factors from the host country increase linkages with Japanese firms. For example, infrastructure quality and the size of the component supporting industry were significant for linkages. On the other hand restrictive trade policies seem to diminish linkages, while local content regulations increased linkages in the host country but not with local suppliers. Also, the presence of joint ventures with local

3) The Keiretsu represents a group of companies with interlaced business relations and sometimes shared stock participation.

companies with lower levels of Research & Development (R&D) contributed to more vertical linkages. These results seem to indicate that for the case of Japanese firms, supplier relations take time to develop, so it is expected that new FDI projects are less likely to source locally.

Finally, even if a foreign firm uses suppliers in the host country, these might be of foreign origin as well. It is common for suppliers of parts and components to follow a multinational company to the host country. If this is the case, FDI flows stimulate linkages to supporting industries, but benefits are only shared among foreign firms. This type of practice is observed by many Japanese firms; especially in those pertaining to the same Keiretsu that acquire most of their inputs from other Japanese suppliers in the host country, eliminating the possibility for linkages with local suppliers. Smith and Florida (1994) analysing Japanese firms in the automotive industry, found that suppliers of parts and components used in Japan by a multinational or in other countries have a tendency to follow car assemblers to new investment locations. For the case of Mexico, limited linkages with local suppliers in the automotive industry have been reported by Lara, Garcia and Trujano (2004) and Peres (1990).

Data and Empirical Model

The data used for this analysis comes from a survey applied in 2013 to 68 Japanese firms in Mexico's Western region by the "Mexico-Japan Studies Program" at the University of Guadalajara, Mexico. Specifically, the states included in the survey were Aguascalientes, Guanajuato, Jalisco, Queretaro and San Luis Potosi. In total, 50 valid answers were obtained, resulting in a response rate of 74%. The firms surveyed were concentrated primarily in Aguascalientes with 37% of total valid answers, and in the automotive industry with 74% respectively. For this analysis, only automotive firms were included given the fact that this type of economic activity is expected to generate linkages with local suppliers due to the amount of parts and components used in their processes (UNCTAD, 2001).

The survey particularly included a section regarding local supplier usage.

Descriptive statistics showed that Japanese firms in terms of input sourcing prefer other foreign suppliers (73%) compared with local suppliers (63%). This difference increases in technologically advanced activities, where foreign suppliers are used by 55% and local firms only by 8% of respondents. Also, questions regarding characteristics of the Japanese firm and perceived qualities of the local suppliers were included.

An important factor to consider is the limited observations in the analysis. Following Peduzzi, Concato, Kemper, Holford and Feinstein (1996) and Hosmer, Lemeshow and Sturdivant (2013), the number of events[4] must be a minimum of 10 per parameter to avoid problems of overestimated and under estimated variances and thus limiting the coverage of Wald-based confidence intervals and Wald test of coefficients. The data used had a total of 33 observations, and 24 events present, limiting the analysis to two explanatory variables.

The independent variables chosen were selected according with the theoretical arguments and empirical results found in previous literature. Specifically from the study of Guzman (2014) where perceived quality of local suppliers and time established in the host country appeared to be important factors for linkages between Japanese firms and local suppliers in Mexico. Since the response variable obtained from the survey is binary in nature, a logistic regression model is proposed to estimate probabilities of local supplier usage dependent on certain characteristics of the local supplier base and of the Japanese multinationals. Two logistic models are estimated and can be expressed as:

$$Y_i = \alpha + \beta_1 Quality_i + \varepsilon_i \qquad (1)$$

$$Y_i = \alpha + \beta_1 Quality_i + \beta_2 Time_i + \varepsilon_i \qquad (2)$$

Where:

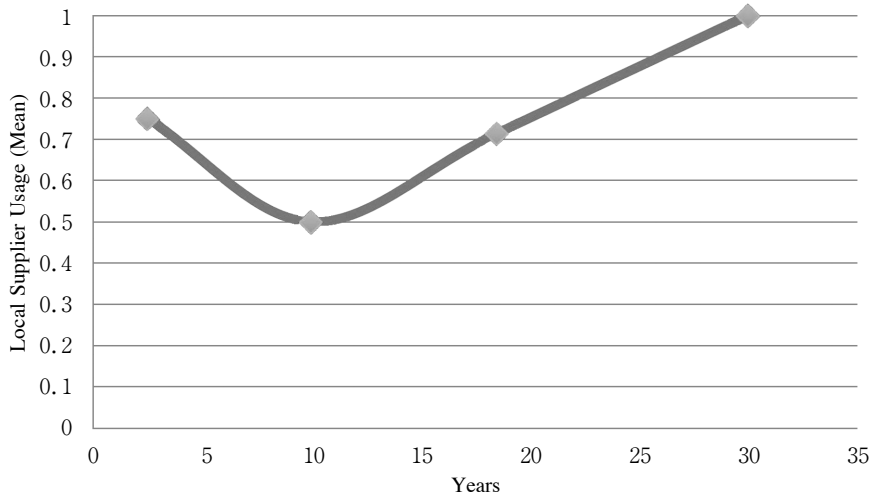
i = 1...33 manufacturing firms with valid answers.

4) Specifically, this represents the number of subjects with the event present or in other words the number of firms with local supplier usage.

Y = Binary response variable that takes the value of 1 if Japanese firm i uses local suppliers in the production process and 0 in the contrary case.
Quality = Perceived quality of local suppliers by Japanese firms surveyed, values are ordinal and range from 1 to 3, where 1 represents "good quality", 2 represents "regular quality" and 3 represents "bad quality".
Time = Number of years that the Japanese firm has been established in Mexico.
ε = Error term.

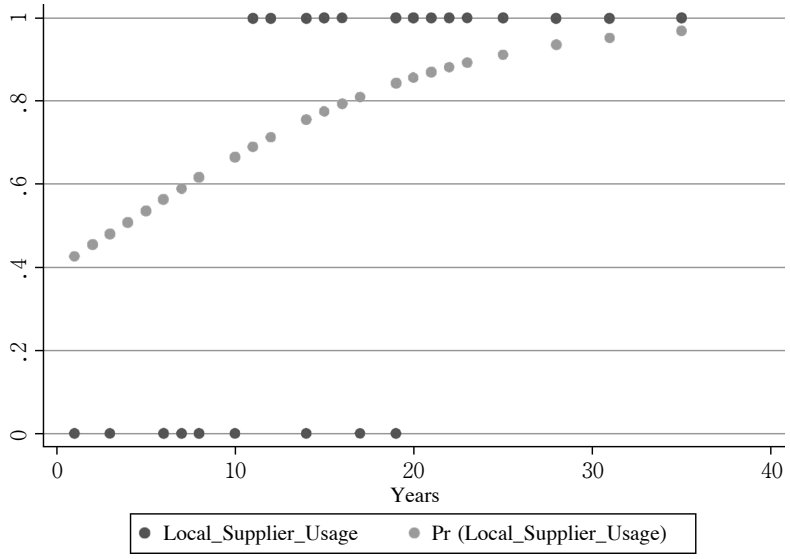
According to Hosmer et al. (2013), an important step to refining the main effects of a logistic model is to determine whether there is linearity in the logit for each continuous variable included in the regression. To test for linearity in the logit, the method of smoothed scatterplots is applied to check linearity with respect to the continuous variable "Time" (measured in years of establishment for the Japanese firm). First, **graph 1** shows the relationship between time and local supplier usage, where the "mean" values provide an estimate of $E(Y|x)$. In this sense, it is assumed that the estimated values plotted in **graph 1** are close enough to the true values of $E(Y|x)$ to provide an assessment of the functional relationship between Local Supplier Usage and Time. The graph shows a gradual approach between zero and

Graph 1. Relationship between Years Established and Local Supplier Usage



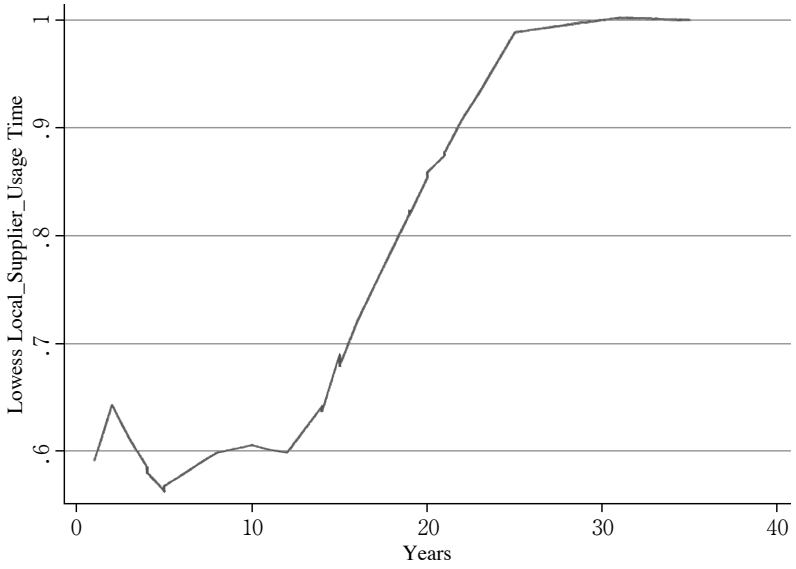
Source: Author's calculations based on survey data from PROMEJ

Graph 2. Probability of Supplier Usage



Source: Author's calculations based on survey data from PROMEJ

Graph 3. Lowess Plot for Linearity Assumption



Source: Author's calculations based on survey data from PROMEJ

one, especially after 10 years of establishment. Similarly, **graph 2** shows the probability of usage of local suppliers given time of establishment. As shown in this graph, there is a positive relationship between time of establishment and the

estimated logistic probabilities of local supplier usage. Finally, as suggested by Hosmer et al. (2013), the lowess smooth scatterplot is presented in **graph 3**. This method computes a smoothed value for the response variable for each observation, which is a weighted average of the values of the dependent variable over all observations. The plot shows also a positive and linear relationship between the response variable and the continuous predictor variable.

Estimation Results

After the linearity test carried out on the data, model 1 and model 2 were estimated. Results from model 1 show the relationship between linkages from Japanese firms and local suppliers dependent on the quality perceived by Japanese firms of the local supplier base. These results are presented in **table 1**. From the predictor variable, results show that quality is a determinant factor for linkages between Japanese firms and local suppliers in the automotive industry. When perceived quality of the local supplier base transitions from a bad quality to a regular quality the coefficient for linkages is 1.79, translating to an odds ratio of 6.00 and statistically significant at a 95% interval. In other words, local firms with regular quality are 6 times more likely to be used by Japanese firms than those with bad quality. Since quality is registered as a categorical variable, “good quality” is also observed in the data. Results for this variable indicate also a positive coefficient for good quality in the local supplier base. However, this coefficient was statistically non−significant which might be explained by few local suppliers with this specific characteristic in the database. These results seem to support those mentioned by Tokoro (2006) and Guzman (2014) for the case of Japanese firms, whom consider that supplier quality to be the main factor to explain the existence or lack of linkages with local firms in Mexico.

Model 2 included also the continuous time variable since it might take time for supplier relationships to develop, results are presented in **table 2**. These results show that the regular quality variable remains positive and statistically significant (at the 5% level). Interestingly, after controlling for time the coefficient increases to 2.22 or

an odds ratio of 9.23. The time variable is also positive and statistically significant at the 5% level. The coefficient for time is 0.13 and exponentiated gives a value of 1.14, meaning that the odds ratio for usage of local suppliers increases 1.14 times for each additional year the Japanese automotive firm is established in Mexico. **Table 3** includes the time variable results in intervals to show the increasing importance of this variable in linkage creation. Firms that have been established for 5 years are almost 2 times more likely to use local suppliers than those of new arrival. Similarly, firms that have periods of 10, 15 and 20 years are 3.74, 7.22, and 13.97 times more likely to use local suppliers respectively. These results suggest that the arrival date of a Japanese firm is an important factor, where firms with more established time are more likely to create linkages with local firms. The findings seem to corroborate the theoretical contribution from Javorcik (2008) and the empirical findings from Kiyota et al. (2008) and Belderbos et al. (2001) regarding

TABLE 1: ESTIMATION RESULTS (MODEL 1)

Predictor	β	$SE\beta$	z	p	e^{β}
Quality (good)	1.39	1.38	1.00	0.32	4.00
Quality (regular)	1.79	0.94	1.90	0.05	6.00
Constant	–0.29	0.76	–0.38	0.70	0.75

Notes: N = 33 obs / Overall model evaluation: $X^2 = 3.75$, $df = 2$, $p = 0.15$
Column with e^{β} results show exponentiated coefficients or the odds ratio for each variable.

TABLE 2: ESTIMATION RESULTS (MODEL 2)

Predictor	β	$SE\beta$	z	p	e^{β}
Quality (good)	1.83	1.71	1.07	0.28	6.22
Quality (regular)	2.22	1.10	2.02	0.04	9.23
Time	0.13	0.07	2.01	0.04	1.14
Constant	–2.25	1.32	–1.71	0.09	0.11

Notes: N = 33 obs / Overall model evaluation: $X^2 = 9.17$, $df = 3$, $p = 0.03$
Column with e^{β} results show exponentiated coefficients or the odds ratio for each variable.

TABLE 3: ODDS RATIO FOR TIME VARIABLE (PERIOD INTERVALS)

Variable	5 *Years*	10 *Years*	15 *Years*	20 *Years*
Time	1.93	3.74	7.22	13.97

Notes: Estimations based on results from Model 2.

time as an important factor that determines linkages between multinationals and local suppliers since it takes time to create supplier-client relations with local firms

To test for the goodness-of-fit of the model, a collapsed table on deciles of estimated probabilities was calculated along with the Hosmer-Lemshow statistic. The fitness of the model is presented in **table 4**. The Hosmer-Lemeshow X^2 statistic of 4.60 with 8 degrees of freedom suggests that the model fits the data. This can be verified in a comparison between observed and expected values from the model. For example, the group in the first decile has a probability of 40% of using local suppliers. For this case the actual data has 1 observation that uses local suppliers and 3 firms do not. The model estimated expects that 1 observed firm uses local suppliers and that 3 will not use local suppliers. For the fifth decile, with 81% of probability of using local suppliers, the observed dependent variable is equal to 2 for Y = 1 and 1 for Y = 0, while the constructed model expects that 2.3 firms will use local suppliers and 0.7 will not. The tenth decile with 99% probability has 3 observed cases and the model estimates that 2.9 firms will use local suppliers. The rest of the deciles are presented in **table 4**.

TABLE 4: COLLAPSED DECILES OF ESTIMATED PROBABILITIES

Group	Probability	Observed $Y = 1$	Expected $\tilde{Y} = 1$	Observed $Y = 0$	Expected $\tilde{Y} = 0$	Total
1	0.40	1	1.0	3	3.0	4
2	0.56	1	1.5	2	1.5	3
3	0.62	2	2.4	2	1.6	4
4	0.69	3	2.0	0	1.0	3
5	0.81	2	2.3	1	0.7	3
6	0.87	4	3.4	0	0.6	4
7	0.92	3	3.6	1	0.4	4
8	0.93	2	1.9	0	0.1	2
9	0.95	3	2.8	0	0.2	3
10	0.99	3	2.9	0	0.1	3

Notes: N = 33 obs / Number of groups = 10 / Hosmer-Lemeshow $X^2 = 4.60$, $df = 8$, $p = 0.80$

The "Observed" values represent the actual cases in the data according to the decile of probability of using local suppliers while the "Expected" values represent the model predictions based on the estimated coefficients.

Conclusions

FDI and its effects on local economies is a topic that has been extensively researched and debated in the economic literature without a clear consensus. Recently, special attention has been focused on possible linkages that multinational firms may develop with local suppliers, especially since it is theoretically argued that vertical linkages create necessary conditions for spillovers to occur. Using survey data from Japanese automotive firms located in Mexico's western region, this paper analysed factors that determine the usage of local suppliers.

Results showed that quality is a determinant factor for local input usage by Japanese firms in Mexico. Specifically, when local firms transition from a bad to a regular quality, Japanese automotive firms are 6 times more likely to employ local suppliers. When a supplier exhibits good quality, the results were non-statistically significant which may be due to the fact that few suppliers exhibited this characteristic in the data. The results reported here support those mentioned by Tokoro (2006) and Guzman (2014) for the case of Japanese firms in Mexico.

Another model was included adding the time of arrival of the Japanese firm. Results remained consistent in terms of quality, providing further evidence that this is a determinant factor in linkage creation by Japanese firms. Specifically, the odds ratio for firms with regular quality increases to 9.23 compared with model 1. Also, the time of arrival was significant for linkages with local firms. Japanese firms that have an extra year of establishment in Mexico increase their odds of supplying locally 1.14 times or in other words, are 1.14 times more likely to create linkages with local suppliers.

To facilitate the analysis of the time variable for supplier usage, intervals were included. For different time intervals the odds ratio of supplier usage transitioned from values of 1.93 in 5 years of establishment to 3.74 in 10 years, 7.22 in 15 years, and 13.97 in 20 years. These results show the importance of time to develop supplier relations and suggest that new FDI projects are less likely of using local suppliers especially for the case of Japanese firms. These results confirm the

theoretical contributions from Javorcik (2008), where time is a determinant factor for linkages with local suppliers, and support those results reported by Kiyota et al. (2008), Belderbos et al. (2001) and Guzman (2014) for the specific case of Japanese firms.

Also, the goodness-of-fit of the model was analyzed through a collapsed table on deciles of estimated probabilities and the Hosmer-Lemeshow test statistic. The results from these tests suggest that the model fits the data reasonably well. However, further test of the model with a different database and more observations is encouraged.

As a concluding remark, it is important to point out from these results that local governments must not only generate necessary conditions for local supplier development, but it seems that local firms must also increase the quality of inputs to be able to enter Japanese production chains. Also, the arrival time of Japanese firms is an important factor that seems to determine linkages. However, future research is encouraged in this topic. The use of qualitative tools to analyse specific cases where linkages are present may be a good course of action for future research. Finally, the use of a larger sample with more observations and registered cases for the variable of interest may benefit the robustness of future results and allow for the inclusion of more explanatory variables in the model.

References

Balasubramanyam, V.N., Salisu M. & Sapsford D. (1996). Foreign Direct Investment and Growth in EP and IS Countries. *The Economic Journal,* Vol. 106, pp. 92-105.

Belderbos R., Campanelli G. & Fukao K. (2001). Backward Vertical Linkages of Foreign Manufacturing Affiliates: Evidence from Japanese Multinationals. *World Development,* Vol. 29, No. 1, pp. 189-208.

Carkovic, M. & Levine R. (2002). Does Foreign Direct Investment Accelerate Economic Growth? *Working Paper, University of Minnesota Department of Finance*.

Carrillo, J. (2002). La Industria de los Televisores en México: Integración y Proveedores Locales en Tijuana. *Asian Journal of Latin American Studies,* Vol. 15, No. 1, pp. 173-198.

Dussel Peters, E. (1999). La Subcontratación como Proceso de Aprendizaje: El Caso de la Electrónica en Jalisco (México) en la Década de los Noventa. *Serie Desarrollo Productivo CEPAL,* No. 55

Guzman, L. (2014) Factores de Localización de la Inversión Extranjera Directa Japonesa en México. In Okabe, T. and Carrillo, S. (eds.). *Relaciones México-Japón en el contexto del Acuerdo de Asociación Económica*. Mexico: Juan Pablos Editor.

Hosmer, D., Lemeshow S. & Sturdivant R. (2013). *Applied Logistic Regression*. New Jersey: John Wiley & Sons Inc.

Javorcik, B. (2004). Does Foreign Direct Investment Increase the Productivity of Local Firms? In Search of Spillovers through Backward Linkages. *American Economic Review,* Vol. 94, No. 3, pp. 605-627.

Javorcik, B. (2008). Can Survey Evidence Shed Light on Spillovers from Foreign Direct Investment? *The World Bank Research Observer,* Vol. 23, No. 2, pp. 139-159.

Jordaan, J. A. (2009). *Foregin Direct Investment, Agglomeration and Externalities: Empirical Evidence from Mexican Manufacturing Industries*. England: Ashgate.

Kiyota, K., Matsuura T., Urata S. & Wei Y. (2008). Reconsidering the Backward Vertical Linkages of Foreign Manufacturing Affiliates: Evidence from Japanese Multinationals. *World Development,* Vol. 36, No. 8, pp. 1398-1414.

Lara, R. A., Garnica García A. & Trujano G. (2004). Cooperación y Competencia en el Sector de las Autopartes: El Caso de los Asientos, en Arturo Lara, editor, *Tecnología y Finanzas en un Marco de Política Económica Sistémica.* México: UAM-X, CSH, Depto. de Producción Económica.

Padilla Perez, R. (2008). A Regional Approach to Study Technology Transfers through Foreign Direct Investment: The Electronics Industry in Two Mexican Regions. *Research Policy,* Vol. 37, No. 5, pp. 849-860.

Peduzzi, P. N., Concato, J., Kemper, E, Holford, T. R., & Feinstein A. (1996). A Simulation Study of the Number of Events per Variable in Logistic Regression Analysis. *Journal of Clinical Epidemiology,* Vol. 49, No. 12, pp. 1373-1379.

Peres, W. (1990). *Foreign Direct Investment and Industrial Development in Mexico*. Paris: OECD Publications.

Reganati, F. & Sica E. (2007). Horizontal and Vertical Spillovers from FDI: Evidence from Panel Data for the Italian Manufacturing Sector. *Journal of Business Economics and Management,* Vol. 7, No. 4, pp. 259-266.

Rivera Vargas, M. I. (2002). *Technology Transfer Via University-Industry Relationship: The case of the Foreign High Technology Industry in Mexico's Silicon Valley*. New York: Routledge Falmer.

Rivera Vargas, M. I. & Regino J. (2004). Entrenamiento y Aprendizaje Tecnológico en la Subcontratación: El Caso de los Proveedores Endógenos en la Industria Tecnológica. *Comercio Exterior,* Vol. 54, No. 3, pp. 196-206.

Smith, D. F. & Florida R. (1994). Agglomeration and industrial location: An econometric analysis of Japanese-affiliated manufacturing establishments in automotive-related industries. *Journal of Urban Economics,* Vol. 36, No. 1, pp. 23-41.

Tokoro, Y. (2006). México y Japón: Una Perspectiva del Acuerdo de Asociación Económica. EconomíaUNAM, Vol. 3, No. 7, pp. 47-68.

UNCTAD (2001). *World Investment Report 2001: Promoting Linkages*. New York & Geneva: United Nations Publications.