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The effect of FDI on low and high-skilled employment and wages in Mexico: a study for the manufacture and service sectors

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Abstract

This study analyzes the effect of Foreign Direct Investment (FDI) inflows on the employment and wages of low- and high-skilled employees in the manufacture and service sectors in Mexico. The study implements a quarterly panel dataset covering the 32 Mexican states from 2005 to 2018. The econometric model is estimated throughout Fixed-Effects (FE) and Panel Corrected Standard Errors (PCSE). Employment results indicate that an increase of FDI inflows into the manufacture sector creates a positive effect in low- and high-skilled employment. In the case of service sector, results are inconclusive across models for both categories of employment. In the case of wages, it is found that FDI inflows by the manufacture sector increase marginally in low-skilled wages and no statistical effect is captured in high-skilled wages. Lastly, in service sector, results indicate the effect of FDI inflows are inconclusive in the case of low-skilled and high-skilled wages.

Keywords: Foreign Direct Investment, Employment, Mexico, Panel data

JEL Classification: F21, F23, F36, J21, J23, R10

1 Introduction

In its World Investment Reports (UNCTAD 2016, 2017, 2018), the United Nations Conference on Trade and Development (UNCTAD) mentioned that Mexico is considered the primary driver of Foreign Direct Investment (FDI) growth in Central America, where the country has participated with approximately 70% of the total FDI inflows to this region in the last years. Nevertheless, the 2017 and 2018 investment reports for Mexico were not very optimistic (UNCTAD 2017, 2018), since FDI inflows in 2016 and 2017 reached $30 billion dollars each year, which is 15% below the amount received in 2015. Such contraction was mainly explained by the uncertainty that existed at that time about the future of the North American Free Trade Agreement (NAFTA), now called United States–Mexico–Canada Agreement (USMCA).

Waldkirch (2010) states that Mexico has been actively trying to attract FDI since the 1980s by relaxing investment restrictions on different economic sectors. In addition, since 1994, NAFTA benefited Mexico as it substantially and permanently increased FDI inflows into the country. As a result, abundant FDI came into the country seeking to exploit Mexico's comparative advantage (Waldkirch 2011). Given the relevance of FDI in the economy since the implementation of NAFTA, abundant literature has emerged analyzing the effects of FDI on different economic variables, such as wages, labor productivity, and employment. Diverse literature has also emerged analyzing the impact of NAFTA on economic sectors, such as manufacturing, maquiladora industry, and the impact on different economic regions in the country.

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Nevertheless, the existing literature about Mexico has paid limited attention to analyze the effect of FDI on employment and wages in the manufacturing and service sectors, even though those two economic sectors have received together around 75% of total FDI inflows that had come into the country since 2005. The scarcity of studies in the field is more noticeable if it is analyzed by the effect of FDI inflows on employment and wages when separating employment in the two categories (low-skilled and high-skilled). Such studies could be of relevance and interest for policy makers, since the design of policies can be focused on the groups that are considered a priority for a country or a government.

The study helps fill the gap in the literature by analyzing employment and wages of low- and high-skilled employees in the manufacturing and service sectors, which according to the number of employees and FDI inflows received in the country, are the two most relevant sectors in the economy. This study is performed using data for each of the 32 states in Mexico, covering the period from 2005 to 2018 at the sub-national level in Mexico. The econometric model implemented in this study is similar to the one used by Hanson (2001), but with a small variation to examine the impact of FDI on low-skilled and high-skilled employment and wages. To obtain the coefficient estimates, a Fixed-Effects model (FE) and a Panel Corrected Standard Errors (PCSE) model are developed and estimated. Results indicate that, in most scenarios, FDI inflows have different effects on low-skilled and high-skilled employment in manufacturing and service sectors.

The remainder of this study is organized as follows: Section 2 provides important background on FDI inflows and their effects on employment and wages. Section 3 describes the econometric model implemented in this study. Section 4 introduces the dataset and explains the distribution of FDI and employment in manufacturing and service sectors around the country. Section 5 discusses the results of the estimated regression, and the last section presents the conclusion of this study.

2 Literature review

Most studies available in the literature which analyze the effects of the FDI inflows on the local economy, commonly mention that FDI inflows bring new and more sophisticated technology into the host economy, expand firms' production capabilities, and create some effects on employment, wages and labor productivity. In addition, an important portion of the literature has focused on categorizing employees according to skill levels and analyzing the effect of FDI inflows on the wages of those different categories of employees. Girma et al. (2002), Owen and Yu (2008), Pandya (2010), Hanousek et al. (2011),

Onaran (2012), Lee and Wie (2015) and Bogliaccini and Egan (2017), are examples of studies which analyze the effect of FDI on low- and high-skilled local wages.

Another set of the literature analyzes exclusively the effect of FDI inflows on low- and high-skilled employment in the host economies. Studies such as Bailey and Driffield (2007), Blanton and Blanton (2012), Raouf and Hafid (2014), Yunus et al. (2015) are examples of this. Lastly, some other literature is just interested in analyzing if FDI inflows have a general positive or negative effect on local employment. Studies such as Radosevic et al. (2003), Waldkirch et al. (2009), Villa (2010), Inekwe (2013) and Bandick and Karpaty (2011) are examples of studies which find that the effect of FDI on employment is positive. On the other hand, Girma (2005) and Jenkins (2006), find that FDI inflows have a negative impact on local employment.

2.1 Literature about the effect of FDI on employment and wages in Mexico

In a pioneer study for the Mexican economy, Feenstra and Hanson (1997) study the impact of FDI on the wages of skilled labor in Mexico over the period 1975–1988. They measure FDI using regional data on foreign assembly plants and conclude that FDI growth is positively correlated with the relative demand for skilled labor, which at the same time has influenced the increase of wages in regions where FDI has concentrated.

Some other studies have been also focused on the effect of FDI on employment according to the skill level. For example, Nunnenkamp and Bremont (2007) estimate dynamic labor demand functions for blue-collar (low-skilled) and white-collar (high-skilled) workers in Mexico for the period 1994–2006. Their findings do not support the widely-held view that FDI inflows add to white-collar employment. However, the positive effect on blue-collar employment diminishes when increasing skill intensity in manufacturing industries. Waldkirch et al. (2009) in a study on employment of non-maquiladora manufacturing activities, find that FDI has a statistically significant and positive effect on both blue and white-collar manufacturing employment. Later, Waldkirch (2010) suggests that wages may be negatively affected by FDI, particularly in maquiladoras, because large FDI tend to reduce skilled wages. Some other studies, such as Turner and Martínez (2003) and Loría and Brito (2005) associate FDI received by multinationals that operate in Mexico with an increase in employment in the country especially in the manufacture sector. Lastly, Vergara et al. (2015) analyze the effect of FDI on five industrial sectors in the northern region of Mexico during the period from 2004 to 2013, and they find a positive correlation between FDI and employment only in the electricity sector.

3 Econometric model

The generic labor market supply and demand equations proposed by Hanson (2001) are used in this study to investigate the effects of FDI on low-skilled and high-skilled employment. The reduced-form equations from such model have the following form:

$$LnL_{jt}^k = \beta lnW_{jt}^{A,k} + A_{jt}\alpha_1 + B_t\alpha_2 + C_t\alpha_3 + \vartheta_{jt} \quad (1)$$

$$LnW_{jt}^k = \lambda lnW_{jt}^{A,k} + A_{jt}\eta_1 + B_t\eta_2 + C_t\eta_3 + \mu_{jt}. \quad (2)$$

Equations (1) and (2) can be obtained by assuming that both labor supply and labor demand are in equilibrium. The terms A, B, and C represent vectors related to state, country, and international conditions, respectively. The superscript k refers to low- or high-skilled categories, while the subscript j and t refer to each of the 32 Mexican states and the quarterly periods during 2005–2018. Additionally, W represents wages, and W^A stands for alternative wages. Briefly, an alternative wage for state j is a weighted average of wages in every state except state j. The terms α_1–α_3, and η_1–η_3 are vectors of parameters; β and λ are scalar values; and ϑ_{jt} and μ_{jt} are error terms assumed to be independent and identically distributed with zero mean and constant variance.

Equations (1) and (2) are estimated in this study throughout different econometric models. Breusch and Pagan Lagrangian multiplier test indicates that the use of panel data techniques is more appropriate than OLS and, similarly, the Hausman test allows to indicate that the use of fixed effects is preferable to random effects in the estimation of both equations. Therefore, tables only show the estimates for fixed effects. Additionally, the possibility of the existence of the classic problems of data panels is considered. The results of the Wooldridge tests to prove the existence of serial correlation in the estimates, as well as a modified Wald test to check for the presence of heteroskedasticity, and a Breusch–Pagan test to identify contemporary correlation problems in the residuals, suggest that it is necessary to correct all of the problems. Moreover, endogeneity problems were tested with the C statistic, yet no evidence was found to state that the estimations should be corrected for endogeneity.

In Cameron and Trivedi (2010), the use of Feasible Generalized Least Squares (FGLS) and Panel Corrected Standard Error (PCSE) is recommended for data panels where T is greater than N (in this study T = 56 and N = 32). However, Beck and Katz (1995) demonstrate that FGLS produces results with strongly underestimated standard errors and, through Monte Carlo simulations, they find that PCSE produces more accurate results of standard errors, with zero or little loss of efficiency, compared to FGLS. Thus, in this study, the problems previously mentioned are addressed using PCSE. Additionally, for comparison purposes, fixed effects regression results are shown.

4 Data

The dataset covers the 32 Mexican states on a quarterly basis from 2005 to 2018. Data are drawn from the Mexican Institute of Statistics, Geography, and Information (INEGI), which collects the dataset for employment and wages via the National Survey of Occupation and Employment (ENOE). Similarly, INEGI includes the dataset for population and the Ministry of Economy keeps track of FDI inflows.

As aforementioned, this study focuses on analyzing the effect of FDI inflows on different low- and high-skilled categories in employment and wages in the manufacturing and service sectors. Table 6 in Appendix shows the average employment distribution for low- and high-skilled employment for the manufacture and service sectors for each of the Mexican states during the period from 2005 to 2018, which is the period analyzed in this study. It can be observed that Estado de Mexico and Mexico City are the places that most capture employment, either low- or high-skilled employment either in the manufacture or service sectors. Those two states together capture around 25% of the total high-skilled employment in manufacture and service sectors in the country. Similarly, Table 6 shows that the top five states, as a group, capture around 50% of high-skilled employment in the country, while the bottom five states in the table capture around 5% of the high-skilled employment in the country, either in the manufacture or service sectors. In the case of the low-skilled employment; shares are less concentrated on the top states and are slightly better distributed across all Mexican states.

Table 7 in Appendix section shows the average monthly salaries in real terms (2013 = 100) for the low- and high-skilled employees working in the manufacture and service sectors in each of the Mexican states during 2005–2018. The manufacture sector shows an important dispersion in salaries between low- and high-skilled employees. For example, the highest salaries in the high-skilled manufacture sector are in Coahuila, registering $7549 real Mexican pesos, a value 76% higher than the highest low-skilled salaries in the manufacture sector in Baja California, with $4301 real Mexican pesos per month. It is worth identifying that some states have high-skilled salaries which are above the country's average, but at the same time those same states report low-skilled salaries below the country average; this is observed in Guanajuato, Colima, Jalisco,

Table 1 Total country FDI 2005–2018; Percentage total FDI. Source: Own estimations using data from the Ministry of Economy

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total FDI (Millions of dollars)	26,013	21,124	32,477	29,468	18,066	27,260	25,601	21,191	48,399	29,879	35,775	30,534	32,915	32,694
Manufacture (% Total FDI)	51.5%	52.9%	42.5%	31.3%	39.8%	52.8%	44.8%	44.4%	64.8%	61.8%	49.3%	57.3%	45.5%	48.3%
Services (% Total FDI)	27.9%	38.9%	36.5%	37.9%	38.7%	24.7%	32.5%	8.4%	12.1%	10.0%	20.6%	19.6%	15.4%	14.2%
Other (% Total FDI)	20.6%	8.2%	21.0%	30.8%	21.5%	22.5%	22.7%	47.2%	23.1%	28.2%	30.2%	23.1%	39.1%	37.5%

Durango, to mention a few. In the case of the service sector, the state with the highest high-skilled salaries in this sector is Baja California Sur (touristic place) with $7696 per month, while its neighbor, the state of Baja California, shows the highest salaries for low-skilled workers with $4538.

Table 1 shows the total FDI received in the country in every year analyzed in this study and the percentage that manufacture and service sectors represent in the total FDI. On the one hand, the lowest value received in FDI in the country is observed in 2009, during the economic crisis when the country received 18,000 million dollars. On the other hand, the highest value is observed in 2013, when the country received more than 48,000 million dollars. It is worth mentioning that the manufacture sector has been historically the economic sector with the highest volumes of FDI inflows into the country. The lowest values appear also during the 2008 economic crisis, when Mexico captured 31% of the total FDI, and the highest value is observed in 2013, when almost 65% of the total FDI came into the country. Regarding the service sector, the lowest value appears in 2012, when it captured 8.4%, and the highest appeared from 2006 to 2009, when the value ranged around 38% of the total FDI received in the country.

Figure 1 illustrates how FDI in the manufacturing and service sectors has been distributed across the country during the period 2005–2018. As it can be seen above, in maps 1a and 2a, the "white" states are those which received the least amount of FDI either in the manufacturing or service sectors during the entire period. In fact, all the "white" states captured less than 1% of the total FDI received by each sector in the whole period. Out of the country's 32 states, there are 14 "white" states in Fig. 1a, all of which, as a group, captured 5.5% of the total FDI in the manufacturing sector received in the country during the 2005–2018 period. In the case of Fig. 2a, the 14 states in "white" captured, as a group, 7.8% of the total FDI received in the country in the service sector in the entire period.

In the case of "light grey" states, they captured more than 1%, but less than 4% of the total FDI received in the country in each respective sector. In the case of the manufacturing sector, there are 8 states out of 32 in "light grey" which, as a group captured around 20% of the total FDI received in the country in the analyzed period. In the case of the service sectors, there are 8 states, which accounted for 12% of the total FDI received in the country in the aforementioned sector. Lastly, the 10 "dark grey" states accounted for 70% of the total FDI received in the manufacturing sector and 80% of the FDI received in the service sector. Figures 1b and 2b show the FDI received by the top five states in each sector in the entire period. These five states captured 49% in the manufacturing sector and 65% in the service sector. These numbers confirm that FDI in both sectors is highly concentrated in a few states. Lastly, Fig. 2 in Appendix section captures how FDI evolved in each of the states in the country during the entire period analyzed in the study.

Table 2 presents descriptive statistics for all variables used in this paper. The effect of FDI upon employment and wages, both disaggregated in low-skilled and high-skilled, are the main variables of interest in this study; therefore, FDI is broken down into two different FDI categories. As previously discussed, this paper explores the effect of FDI on different kinds of employment and wages. For such reason, the dependent variables in the regression model are low-skilled employment and wages in the manufacturing and service sectors, as well as high-skilled employment and wages in the manufacturing and service sectors.

As mentioned earlier, the main independent variable is FDI inflows into the country. With regards to the Ministry of Economy's FDI classification, FDI database is divided in the following categories: new FDI, FDI originated from the reinvestment of profits, and FDI between companies related to transactions made between domestic and foreign companies. New FDI refers to investment that comes exclusively into the country to expand production and is expected to have a direct impact on employment.
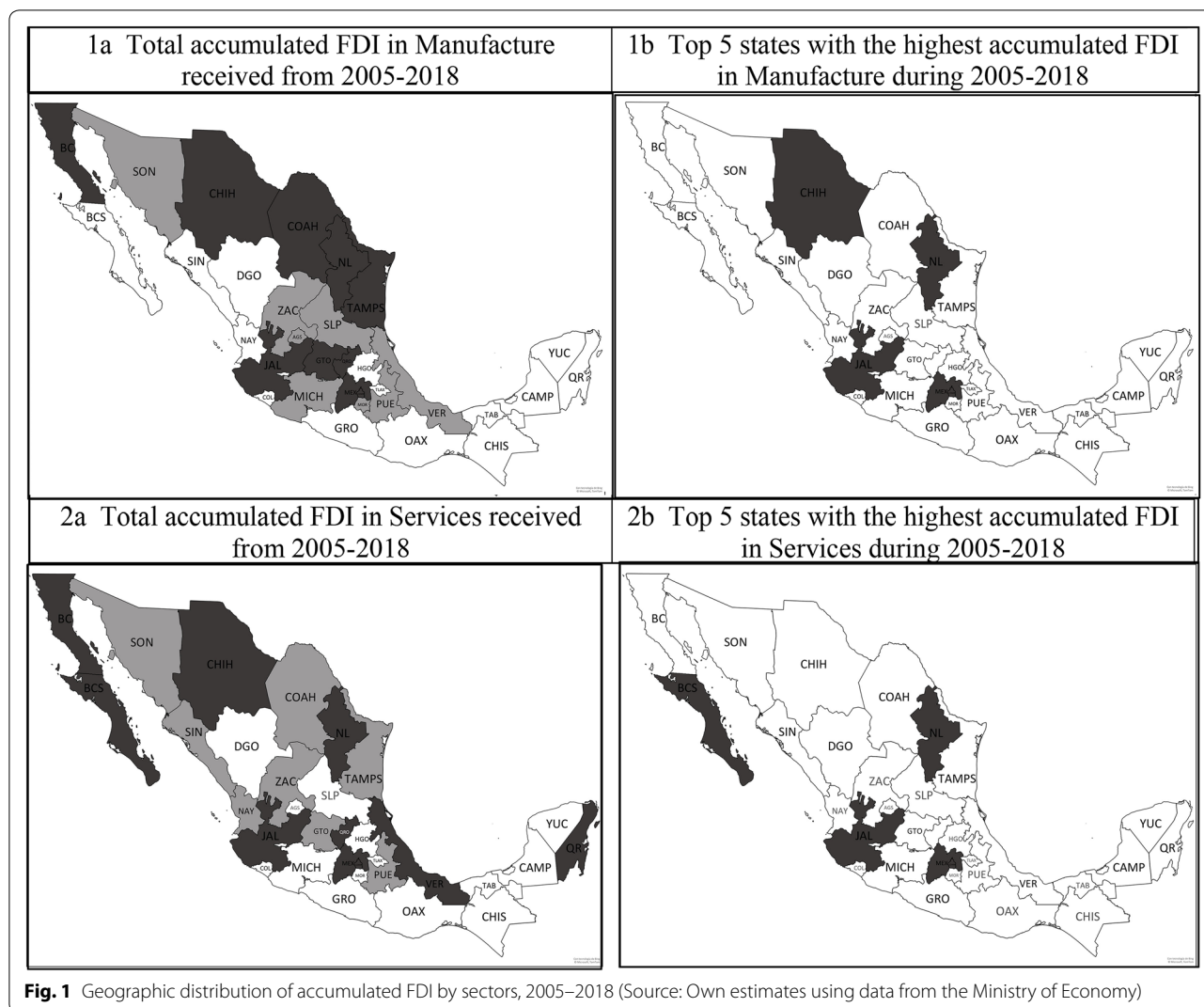
Fig. 1 Geographic distribution of accumulated FDI by sectors, 2005–2018 (Source: Own estimates using data from the Ministry of Economy)

Vergara et al. (2015) and Cabral et al. (2016); both papers focus on the analysis of new FDI inflows among all FDI categories, which is more related with employment. The main independent variable is available in US dollars, so FDI is transformed to real pesos (2013 = 100) by considering the nominal exchange rate for the period, and then a deflator is built based on the 2013 consumer price index from INEGI.

Once FDI inflows are analyzed at state level, it is found that Mexico City has received the highest amount of FDI inflows in the entire nation, reaching up to 19.1% of the total FDI inflows received in the country during the 2005–2018 period. It is important to mention that such numbers can produce a bias in the analysis because, in many cases, headquarters of companies are in Mexico City, which is the capital of the country, and those headquarters receive the money to be invested, but such money (FDI flows) could be invested in a different place

in the country. We identify this issue in our data, but this is the only data available about FDI state inflows, hence there is no way to eliminate such potential bias. Bellak (1998), Jordaan (2008) and Mollick et al. (2006) are papers about FDI inflows which also mention the same bias problem in their analysis. As Chiquiar (2005) suggests, NAFTA (now called USMCA) has given Mexico's regions more economic independence and thus reduced the importance of Mexico City as the country's market leader. Nevertheless, FDI inflows have been strongly concentrated in few states. For example, the top five FDI inflow attractors in the country, namely Mexico City, Estado de Mexico, Nuevo Leon, Chihuahua, and Jalisco, together received around 50% of the total FDI inflows into the country during the period analyzed in this study.

The regression model estimation also includes alternative wage as a control variable. In terms of the former, the approach of Cabral et al. (2016) is applied in considering

Table 2 Statistics period summary: 2005–2018. Source: Author's calculations using data from the INEGI and the Ministry of Economy

Variables	Observations	Mean	Std. dev.	Min	Max
Dependent variables					
Employment					
Secondary school or lower degree, manufacturing sector	1792	189,974	320,008	9231	5,968,144
At least high-school, manufacturing sector	1792	68,294	144,871	2292	2,830,844
Secondary school or lower degree, services sector	1792	377,279	623,435	66,047	11,558,841
At least high-school, services sector	1792	292,862	572,942	43,823	11,004,266
Monthly wage (average in MXN)					
Secondary school or lower degree, manufacturing sector	1792	4194	965	1711	11,470
At least high-school, manufacturing sector	1792	6974	2351	1712	17,764
Secondary school or lower degree, services sector	1792	4419	956	2024	9026
At least high-school, services sector	1792	7773	2335	1894	15,236
Regressors					
Population	1792	3629,924	3056,025	540,154	17,694,804
Alternative monthly wage (average in MXN)					
Secondary school or lower degree, manufacturing sector	1792	4245	765	2689	6569
At least high-school, manufacturing sector	1792	6928	1192	4583	10,138
Secondary school or lower degree, services sector	1792	4454	761	3011	6662
At least high-school, services sector	1792	7724	1314	5333	11,129
Foreign direct investment					
Manufacture (Millions of current dollars)	1792	115.2	225.8	− 326.8	3185.8
Services (Millions of current dollars)	1792	51.9	196.3	− 2450.0	2693.6

state-level real wages of employees in the formal sector (2013 = 100). Regarding the latter, it is possible to estimate a spatial weighted average of wages except for the state i based on the distance that exists between the government statehouse i and government statehouse in the remaining states. Moreover, control variables also include population levels of each state. All these variables in the dataset are available on a quarterly basis. Carlino and Mills (1987), Clark and Murphy (1996) and Lastly, Boarnet (2005) provide arguments to justify why population size is an important factor to explain employment growth.

It is relevant to mention that lagged values for some of the independent variables are included in the econometric models, since it is reasonable to expect that employment levels recorded in a specific quarter of the year are not the result of the explanatory variables of that same quarter, instead it is the result from the past fluctuations of those variables. The optimal lag length for each independent variable was selected through the application of the Akaike information criterion.

5 Empirical results

5.1 The effect of FDI on employment

The aim of this study is to analyze the impact of FDI on different types of employment. Table 3 presents FE and PCSE regression results for the four different employment-dependent variables covered in this study: low-skilled and high-skilled employment in the manufacturing and service sectors. The estimates are obtained throughout a panel that includes the entire country (32 states) and for a panel dataset that includes just 10 states which are the most important receivers of FDI in the country either in manufacture or service sectors. In this sense, Table 3 shows regressions coefficient estimates for the entire country as well as for the top 10 FDI states receivers. The exercise for the top 10 FDI states receivers is included, since FDI inflows received in the country are highly concentrated in few states.[1] According to the Akaike criterion, test results indicate that just one lag period should be included in the regression for the FDI

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[1] Moreover, to test the robustness of the results, estimates were also obtained for the top five FDI states receivers in the country, but they are not reported in the table because the lack of space and because results are similar to those obtained for the entire country and for the top 10 states reported in Table 3. Results for the top five FDI states receivers are available upon request.

Table 3 Employment estimation models according to skill levels; Period: 2005: Q1–2018: Q4

Variables	Manufacture								Services							
	Low-Skilled				High-Skilled				Low-Skilled				High-Skilled			
	FE		PCSE		FE		PCSE		FE		PCSE		FE		PCSE	
	32 states	10 states	32 states	10 states	32 states	10 states	32 states	10 states	32 states	10 states	32 states	10 states	32 states	10 states	32 states	10 states
Log FDI in the Sector	11.9***	7.6***	3.9**	2.2*	12.2***	7.5***	4.4***	2.2**	-0.3*	-0.4**	-0.001	-0.1	-0.2	-0.2	0.1	0.1
	(2.2)	(1.5)	(1.6)	(1.2)	(2.1)	(1.7)	(1.7)	(1.1)	(0.2)	(0.2)	(1.1)	(0.3)	(0.2)	(0.2)	(1.3)	(0.8)
L1. Log FDI in the Sector	10.8***	7.8***	7.2***	5.5***	11.2***	7.7***	7.7***	5.1***	-0.3*	-0.2	-0.1	0.001	-0.8***	-0.7***	-0.4	-0.3
	(2.2)	(1.7)	(1.6)	(1.2)	(2.1)	(1.8)	(1.7)	(1.1)	(0.2)	(0.2)	(1.1)	(0.3)	(0.2)	(0.2)	(1.3)	(0.8)
Log Wages in the Sector	28.0	8.5	22.4***	17.7**	12.6	1.1	2.2	7.9	-2.4	-49.7	-9.1*	-52.2***	-33.1	-42.9	-38.7***	-55.9***
	(25.4)	(45.4)	(5.7)	(7.6)	(21.3)	(35.6)	(4.1)	(5.5)	(40.8)	(34.2)	(5.4)	(8.8)	(26.3)	(31.0)	(4.2)	(6.7)
Log Alt. Wage in the Sector	-79.6	127.3	40.5**	143.1	123.7	-51.4	11.5	-107.1*	-204.1	-162.4	-61.2	61.3	-331.4***	-238.0*	-85.2	-90.8
	(186.2)	(199.9)	(75.5)	(95.3)	(116.6)	(165.6)	(57.9)	(64.5)	(187.3)	(190.3)	(68.0)	(100.1)	(117.6)	(130.5)	(62.1)	(82.3)
Log Total Population	251.7***	137.1*	222.7**	119.3***	307.0***	234.9***	254.0*	222.2***	174.5***	247.3***	158.0***	216.6**	194.8***	259.6***	188.9***	242.5***
	(93.0)	(70.0)	(107.6)	(60.2)	(83.3)	(83.4)	(133.7)	(54.8)	(80.7)	(78.5)	(60.1)	(104.6)	(75.1)	(55.3)	(52.1)	(93.1)
Constant	-2433.3	-2417.1	-2738.0*	-2094.7	-5033.8**	0	-2917.3	-1479.5	536.7	0.001	-413.8	-2032.7	1819.0	-330.0	-345.0	-1032.6
	(2074.3)	(1561.1)	(1433.5)	(1283.4)	(1769.7)	(0)	(2126.8)	(1050.5)	(2167.5)	(0.1)	(868.7)	(1471.3)	(1587.7)	(1207.8)	(705.1)	(1454.1)
Sample Size	1760	550	1760	550	1760	550	1760	550	1760	550	1760	550	1760	550	1760	550
R2 Within	0.109	0.456			0.354	0.576			0.052	0.363			0.326	0.493		
R2 Overall	0.855	0.840	0.882	0.948	0.860	0.829	0.826	0.930	0.820	0.919	0.913	0.948	0.831	0.925	0.906	0.949

Standard errors are in parentheses *$p < 0.10$; **$p < 0.5$; ***$p < 0.01$

Remarks: Regressions include dummy variables to control for fixed and time effects of each state and quarter

The estimated coefficients in the table have been multiplied by 100 to avoid dealing with too many decimals

Heteroskedasticity robust standard errors are shown in parentheses in the case of fixed effect estimation

independent variable, no matter if the model is estimated for the entire country or the top 10 FDI states receivers.

Results in Table 3 indicate that manufacturing FDI has a positive and statistically significant effect on high-skilled manufacture employment, such estimates are consistent either for fixed effects or PCSE models either for the entire country or for the top 10 FDI states receivers. Such results are aligned with those found in most of the previous research studies mentioned in Sect. 2, which argue that FDI inflows in this sector increase the demand for low- and high-skilled jobs. Lagged values presented a higher coefficient than the contemporary FDI in the case of the PCSE estimates. Similar results for Mexico in which FDI inflows in the manufacture sector have a positive effect on employment in the same sector can be found in Waldkirch et al. (2009), who analyze the non-maquiladora manufacturing activities in Mexico during the 1994–2006 period. In a different study about Mexico, Cota (2011) also finds that FDI inflows had a positive effect on high-skilled employment in the manufacture industry. International literature for different countries with similar results can be found in Bailey and Driffield (2007), Raouf and Hafid (2014), Hoxhaj et al. (2016) and Souare and Zhou (2016).

The results for the service sector either for low- or high-skilled employment, shown in the right-hand column in Table 3, are not very conclusive, although, in terms of fixed effects the FDI inflow effects on the different employment categories are negative and statistically significant. Nevertheless, once the correction of econometric problems is considered implementing the PCSE, it is not possible to make inferences about the effects of FDI inflows on the low- or high-skilled employment in the service sector since coefficients are not statistically significant. Results for the top 10 FDI states receivers are also consistent with results obtained for the entire country, either for the fixed effects or PCSE models.

The control variables included in the econometric model highlight the fact that wages present a positive and statistically significant effect only for the PCSE for the low-skilled manufacture sector jobs. In this case, results are also consistent for the entire country and for the top 10 FDI states.

Alternative wages are not statistically significant in most cases. In the case of manufacturing, results are positive and statistically significant for low-skilled jobs, but negative for high-skilled jobs in the case of the top 10 states. Only in the high-skilled service sector the effect of the alternative wages is negative and significant either for the entire country or for the top 10 states when they are estimated with FE. As expected, a negative impact on the level of employment by the variable alternative wages is observed. This is consistent with the idea that

wage differences among regions encourages migration, and implies that when wages increase in the rest of the country, except in state 'i' (alternative wage), then workers in state 'i' have an incentive to leave the state, where wages should subsequently increase to keep more workers from migrating. Lastly, similar to Boarnet (2005), the population variable is positive and significant across all estimates, no matter the econometric model or the number of states included in the analysis.

5.2 The effect of FDI on wages

Table 4 regression results show how FDI has an impact on the different wage categories in the manufacturing and service sectors. As in Table 3, each econometric model is estimated either for the entire country or for the top 10 FDI states receivers in the country. [2] Regarding the number of lags, Akaike criterion indicates similar results as the one obtained for Table 3, no matter if the model is estimated for the entire country or the top 10 FDI states.

In the case of estimates for the entire country, results for the manufacturing sector indicate that FDI inflows either contemporaneous or lagged values both have statistically significant effects on low-skilled wages and such effect are consistent for FE and PCSE models. In the case of top 10 FDI states estimates, results show only a positive and statistically significant effect just for the lagged value of FDI in the PCSE estimates.

Results for the entire country could be an indicator that FDI inflows are replacing low-skilled jobs in the manufacturing sector. Such effect could indicate that new FDI inflows in the manufacturing sector could be creating new jobs that are not well paid. Literature about other countries, such as Bailey and Driffield (2007) and Onaran (2012) found similar results. Estimates obtained in Table 4 also indicate that FDI inflows in the manufacturing sector have no impact on high-skilled wages. Such results are consistent throughout FE and PCSE models, no matter if estimates are for the entire country or for the top 10 FDI states receivers.

Regarding the service sector, wages estimates are not very conclusive for low-skilled and high-skilled wages, regardless of the data used for the estimates, be the entire country or the top 10 FDI states receivers. Such results are inconclusive because in the FE model the FDI variable has a positive and significant effect, but when the PCSE model is estimated, the coefficients are no longer significant. As in the case of service sector employment, results do not allow for a strong inference to be made in terms of the effect of FDI inflows on low-skilled wages. FDI inflows to the service sector are found to increase wages

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[2] To be consistent with Table 3, estimates were also obtained for the top five FDI states receivers in the country, but they are not reported here. Results are available upon request.

Table 4 Wages estimation models according to skill levels; Period: 2005: Q1–2018: Q4

	Manufacture								Services							
	Low-Skilled				High-Skilled				Low-Skilled				High-Skilled			
	FE		PCSE		FE		PCSE		FE		PCSE		FE		PCSE	
Variables	32 states	10 states	32 states	10 states	32 states	10 states	32 states	10 states	32 states	10 states	32 states	10 states	32 states	10 states	32 states	10 states
Log FDI in the Sector	0.7*	0.2	0.6**	0.2	0.4	0.4	0.3	0.1	0.1	0.001	-0.1	-0.1	0.6***	0.4**	0.2	0.3
	(0.4)	(0.6)	(0.3)	(0.3)	(0.7)	(0.8)	(0.7)	(0.6)	(0.1)	(0.1)	(0.4)	(0.5)	(0.2)	(0.2)	(0.5)	(0.4)
L1. Log FDI in the Sector	0.9**	0.6	1.0***	0.8***	0.6	0.3	0.2	-0.1	0.3***	0.3***	-0.001	0.001	0.001	-0.1	-0.4	-0.3
	(0.4)	(0.5)	(0.3)	(0.3)	(0.5)	(0.7)	(0.6)	(0.6)	(0.1)	(0.1)	(0.4)	(0.5)	(0.1)	(0.2)	(0.5)	(0.4)
Log Employment in the Sector	2.6	1.5	2.9***	3.5**	2.3	0.4	1.1	2.7	-0.2	-6.6	-0.7	-7.1***	-6.7	-14.2	-8.0***	-17.7***
	(2.5)	(8.2)	(0.6)	(1.6)	(3.6)	(12.0)	(1.0)	(2.6)	(3.5)	(4.9)	(0.5)	(1.1)	(6.9)	(9.2)	(0.8)	(1.8)
Log Alt. Wage in the Sector	-64.2**	-56.0	-46.0**	-21.8	-66.0	-164.7**	-54.5**	-89.1*	-68.1	-162.4	-13.0	-55.2	-106.9	-133.6	6.2	-32.8
	(29.9)	(48.4)	(20.8)	(43.2)	(53.8)	(77.6)	(26.2)	(46.5)	(52.1)	(108.0)	(23.9)	(51.5)	(68.3)	(111.0)	(25.4)	(52.1)
Log Total Population	-24.0	-19.1	-21.5	-22.0	-7.7	-82.3	2.2	-86.3	-12.6	1.4	-5.2	7.8	-9.8	22.5	7.6	50.2
	(23.5)	(38.2)	(21.4)	(45.8)	(85.9)	(103.1)	(29.4)	(67.5)	(27.9)	(35.6)	(22.7)	(20.1)	(59.6)	(82.4)	(35.0)	(41.7)
Constant	1651.4***	0.001	1460.3***	1324.4	1568.2	3720.2	1347.6***	3020.7***	1585.9**	0.001	1033.6**	1334.7**	2087.3*	1927.4	835.4	716.4
	(446.9)	(0.1)	(354.5)	(833.7)	(1392.7)	(2223.7)	(497.0)	(1052.5)	(709.3)	(0.1)	(408.4)	(620.9)	(1106.9)	(1377.6)	(603.4)	(887.5)
Sample Size	1760	550	1760	550	1760	550	1760	550	1760	550	1760	550	1760	550	1760	550
R2 Within	0.371	0.534			0.571	0.750			0.585	0.689			0.688	0.781		
R2 Overall	0.759	0.758	0.956	0.973	0.721	0.833	0.921	0.946	0.803	0.843	0.980	0.982	0.810	0.857	0.966	0.971

Standard errors are in parentheses *$p < 0.10$; **$p < 0.5$; ***$p < 0.01$

Remarks: Regressions include dummy variables to control for fixed and time effects of each state and quarter

The estimated coefficients in the table have been multiplied by 100 to avoid dealing with too many decimals

Heteroskedasticity robust standard errors are shown in parentheses in the case of fixed effect estimation

Table 5 The effect of FDI on the labor market; A control and treatment effect comparison

		Manufacture								Services							
		Employment				Wages				Employment				Wages			
		Low-skilled		High-skilled		Low-skilled		High-skilled		Low-skilled		High-skilled		Low-skilled		High-skilled	
		Fixed Effects	PCSE	Fixed Effects	PCSE	Fixed Effects	PCSE	Fixed Effects	PCSE	Fixed Effects	PCSE	Fixed Effects	PCSE	Fixed Effects	PCSE	Fixed Effects	PCSE
32 states	Control	15.70	15.64	15.87	15.71	13.51	13.48			15.35		15.47		12.55		12.53	
	Treatment	21.26	20.54	21.29	20.63	18.62	18.59			19.44		19.90		19.05		19.44	
	Difference	5.55	4.91	5.42	4.92	5.11	5.11			4.09		4.42		6.51		6.91	
	Signif. at the 1% level	Yes	Yes	Yes	Yes	Yes	Yes			Yes		Yes		Yes		Yes	
10 states	Control	14.90	15.07	15.54	15.54		13.42			15.71		15.76		10.36		13.17	
	Treatment	20.87	20.17	20.86	20.13		18.15			19.34		19.79		18.81		18.72	
	Difference	5.98	5.10	5.32	4.58		4.72			3.63		4.03		8.45		5.55	
	Signif. at the 1% level	Yes	Yes	Yes	Yes		Yes			Yes		Yes		Yes		Yes	

Columns in grey indicate that FDI in Tables 3 and 4 was not statistically significant, in such scenario the "control effect" model and the "treatment effect" models were equal

in both the high-skilled and low-skilled employment in the case of FE models.

Control variable results indicate that low-skilled jobs in the manufacturing sector have a positive and statistically significant effect on wages. Such results come exclusively from the PCSE model. Estimates for high-skilled jobs are not significant in either the FE or PCSE models. Results are aligned for the entire country panel dataset or the top 10 FDI states dataset. In the case of the service sector, results show that employment level generates a negative and statistically significant effect on wages. As expected, such results are obtained just in the PCSE models in the case of high-skilled jobs.

Regarding alternative wages, results indicate that the alternative wages variable has a negative and statistically significant effect on wages in the manufacturing sector, either for low or high-skilled wages in most econometric models, regardless of the panel dataset included in the regression. Such negative coefficient between alternative wages and wages indicates that an increase in manufacturing wages in state "i" creates a negative effect on wages in the same sector in the remaining states, which is contrary to expectations. When the exercise is replicated for the 10 states that received the higher FDI inflows from each of the sectors, the results remain consistent with those that have been discussed. In the case of the service sector, the alternative wage variable is not statistically significant for any model or panel dataset. Regarding the population variable, results indicate that such variable is not statistically significant across models, regardless of the econometric model or dataset used, and such results are consistent for the manufacturing and service sectors.

The dependent variables in the econometric models in this study are employment and wages. Table 5 compares those econometric models when they are estimated including the FDI independent variable, and when such variable is excluded from the models. The difference obtained in the estimated dependent variable once both types of models are estimated allows us to identify the effect that FDI is having either on employment or wages. When the econometric models do not include the FDI variable they are called "control effect" models, and when the FDI is included, they are referred to as "treatment effect" models.

Once the estimated betas are obtained for the "control effect" model, then an expected employment mean, and an expected wage mean is obtained for each of the states in the entire country. Using the estimated means in employment and wages obtained for each state, a general mean is obtained for both dependent variables. The same process is repeated for the "treatment effect" model and a general mean is obtained again for both dependent variables. Such general mean values are presented in the "control effect" and "treatment effect" cells in Table 5 for each of the econometric models implemented in this study. The row labelled "difference" is just the difference between the general mean obtained for the "control effect" model and the general mean in the "treatment effect" model. Lastly, a t-test is implemented to estimate if there is a statistical difference between both means.[3] If so, then it is indicated as "yes" and then it is concluded that FDI has a statistically significant effect either on employment or wage levels. The same exercise is repeated for each econometric model estimated in the study, and for the econometric panel when 32 or 10 states are included in the study. Masso et al. (2008), Becker and Muendler (2008), Lu et al. (2017) and Bannò et al. (2014) are some

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[3] An $\alpha = 0.01$ is used in the t-test.

studies that analyze the applications of treatment effects, those studies include FDI as a relevant variable.

6 Conclusion

It has been always important to analyze the effect of FDI inflows on labor markets in the host economy. Few studies in the literature have been focused on separating the Mexican labor market according to employee skill categories (education level) and analyzing how FDI inflows influence them. The objective of this study is to contribute to filling this gap by separating employment and wages from the manufacture and service sectors into low- and high-skilled categories and analyzing how FDI inflows into these sectors impact employment and wages of those categories. The study is a panel data analysis made up of the 32 Mexican states, spanning from 2005 to 2018. Manufacturing and service sectors are analyzed, as those are the country's largest receivers of FDI. During the analyzed period in this study, those sectors captured between 60 and 90% of the country's total FDI and created the highest number of jobs among all economic sectors in the country.

When the panel dataset is estimated for the entire country, employment results indicate that an increase of FDI inflows into the manufacture sector creates an increase in both low-skilled and high-skilled employment. The effect persists even when the sample is reduced to the 10 states that received the most FDI in the period under study. Low- and high-skilled employment results in the service sector are inconclusive across the econometric models, regardless of sample reduction. A positive effect in wages is found for FDI inflows received by the manufacture sector when estimated for the entire country, and no statistical effect is captured in high-skilled wages. Lastly, it is found that low-skilled and high-skilled wages results are inconclusive across econometric models, regardless of the sample reduction.

The study of the effect of FDI inflows on the Mexican labor market is a topic that deserves more attention than in other economies, as the proximity of Mexico to the US, the most important economy in the world, makes it an attractive host economy for their investment compared to other countries. Additionally, lower wages and the trade agreement with the US and Canada, have made Mexico an important place to attract foreign companies. Therefore, given the importance of Mexico in the international arena to attract FDI inflows, it is relevant for Mexican policy makers to analyze in more detail the effects that FDI inflows have on employment and wages in specific sectors and geographic regions, in order to develop better policies for the country in these major areas.

Authors' contributions
ES—Has used in a different research paper the econometric model used in this paper. In addition, he has worked previously in topics related with Foreign Direct Investment. So, he provided the idea to analyze the effect of FDI on Employment. In addition, he was involved in the literature review, introduction, and conclusion. TO—Provided some help with the literature review section, interpretation results and with style correction of the text, as English is his native language. HZ—Collected the data and was in charge of the econometrics in this paper. All authors read and approved the final manuscript.

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Appendix

See Tables 6, 7 and Fig. 2.

Table 6 Employment distribution across Mexican States; Average values, 2005–2018. Source: Author´s elaboration with ENOE data

State	Manufacture employment				Services employment			
	Low skilled	%	High skilled	%	Low skilled	%	High skilled	%
Estado de Mexico	820,626	13.5	1,692,239	14.0	311,789	14.3	1,143,951	12.2
Mexico City	303,848	5.0	1,113,072	9.2	179,402	8.2	1,210,375	12.9
Jalisco	426,909	7.0	731,174	6.1	149,888	6.9	539,360	5.8
Veracruz	204,052	3.4	622,907	5.2	80,992	3.7	437,722	4.7
Puebla	307,481	5.1	432,779	3.6	90,090	4.1	319,540	3.4
Nuevo Leon	344,895	5.7	598,906	5.0	106,720	4.9	324,198	3.5
Guanajuato	403,055	6.6	460,579	3.8	102,897	4.7	265,470	2.8
Tamaulipas	166,195	2.7	335,442	2.8	91,132	4.2	254,266	2.7
Baja California	209,704	3.4	288,887	2.4	82,998	3.8	238,976	2.6
Chihuahua	247,651	4.1	295,606	2.4	90,648	4.1	227,961	2.4
Sinaloa	91,119	1.5	253,425	2.1	38,882	1.8	232,437	2.5
Sonora	139,969	2.3	251,248	2.1	60,714	2.8	222,294	2.4
Chiapas	104,600	1.7	283,913	2.4	21,361	1.0	233,473	2.5
Michoacan	245,059	4.0	502,765	4.2	62,376	2.9	332,723	3.6
Coahuila	214,302	3.5	340,929	2.8	89,849	4.1	275,060	2.9
Guerrero	137,781	2.3	282,567	2.3	25,853	1.2	236,446	2.5
Oaxaca	185,636	3.1	311,022	2.6	34,972	1.6	228,359	2.4
Tabasco	53,490	0.9	212,541	1.8	20,833	1.0	172,345	1.8
Hidalgo	124,788	2.1	223,342	1.8	35,036	1.6	169,701	1.8
San Luis Potosi	127,974	2.1	228,552	1.9	41,564	1.9	159,978	1.7
Yucatan	143,443	2.4	276,569	2.3	30,559	1.4	175,605	1.9
Quintana Roo	36,305	0.6	221,175	1.8	11,396	0.5	171,463	1.8
Morelos	68,072	1.1	216,530	1.8	28,209	1.3	153,139	1.6
Queretaro	127,682	2.1	188,952	1.6	54,585	2.5	151,358	1.6
Durango	76,363	1.3	143,698	1.2	20,251	0.9	103,373	1.1
Aguascalientes	491,166	8.1	917,986	7.6	224,607	10.3	858,809	9.2
Nayarit	33,764	0.6	122,654	1.0	11,427	0.5	103,612	1.1
Tlaxcala	94,202	1.5	105,608	0.9	36,114	1.7	94,871	1.0
Zacatecas	53,106	0.9	125,800	1.0	12,821	0.6	89,891	1.0
Baja California Sur	31,268	0.5	101,367	0.8	15,652	0.7	94,966	1.0
Campeche	26,722	0.4	86,395	0.7	6,909	0.3	72,536	0.8
Colima	37,943	0.6	104,294	0.9	14,885	0.7	77,324	0.8
Total	6,079,169	100	12,072,919	100	2,185,413	100	9,371,581	100

Figure 2 shows the FDI flows received by each state along all the period analyzed in this study. As can be seen, FDI inflows show sharp changes in most of the states during the 2008–2009 economic crisis as well as during the 2013–2014 period when some economic sectors deregulated. Some other states such as Mexico City shows permanent swings along the entire analyzed period. All those constant sharp changes shown in most states can be helpful to justify the inclusion of difference-in-difference model into the analysis.

Table 7 Rank average monthly real wage across Mexican States, 2005–2018; Economic sectors and labor skills. Source: Author´s elaboration with ENOE Data

Manufacture sector				Services employment			
Entities	Low skilled	Entities	High skilled	Entities	Low skilled	Entities	High skilled
Baja California	4301	Coahuila	7549	Baja California	4538	Baja California Sur	7696
Baja California Sur	4254	Tamaulipas	6698	Baja California Sur	4480	Sinaloa	7085
Nuevo Leon	4101	Hidalgo	6550	Sinaloa	4146	Coahuila	7057
Coahuila	3892	Nuevo Leon	6471	Sonora	3980	Sonora	7036
Sonora	3841	Baja California	6285	Quintana Roo	3947	Campeche	6978
Chihuahua	3772	Chihuahua	6265	Chihuahua	3912	Quintana Roo	6942
Guanajuato	3760	Sonora	6130	Nuevo Leon	3829	Michoacán	6919
Sinaloa	3747	San Luis Potosi	5987	Michoacán	3722	Hidalgo	6807
Tabasco	3627	Tabasco	5986	Colima	3683	Chihuahua	6740
Colima	3613	Michoacán	5887	Tabasco	3675	Chiapas	6671
Tamaulipas	3575	Sinaloa	5877	Coahuila	3664	Baja California	6656
Quintana Roo	3405	Quintana Roo	5849	Campeche	3592	Colima	6564
Jalisco	3392	Baja California Sur	5702	Nayarit	3557	Tabasco	6476
Durango	3388	Veracruz	5598	Hidalgo	3420	Nayarit	6351
Michoacán	3379	Yucatan	5353	Durango	3389	Yucatan	6303
Average	3225	Average	5259	Average	3383	Nuevo Leon	6069
Hidalgo	3207	Colima	5159	Tamaulipas	3337	Durango	5912
Aguascalientes	3111	Jalisco	5132	Jalisco	3315	Average	5862
Nayarit	3061	Mexico City	5119	Guanajuato	3173	Tamaulipas	5854
Mexico City	3059	Nayarit	4916	Chiapas	3141	San Luis Potosi	5736
San Luis Potosi	3042	Durango	4783	Mexico City	3141	Zacatecas	5719
Veracruz	3015	Guanajuato	4712	Guerrero	3131	Mexico City	5446
Querétaro	2995	Oaxaca	4635	San Luis Potosi	3114	Jalisco	5277
Zacatecas	2773	Querétaro	4629	Veracruz	3040	Oaxaca	5145
Campeche	2765	Puebla	4612	Yucatan	3035	Veracruz	4954
Puebla	2737	Campeche	4497	Oaxaca	3028	Puebla	4819
Estado de Mexico	2692	Chiapas	4496	Querétaro	2992	Guanajuato	4814
Tlaxcala	2612	Aguascalientes	4413	Zacatecas	2860	Tlaxcala	4771
Chiapas	2610	Zacatecas	4400	Aguascalientes	2805	Aguascalientes	4661
Yucatan	2447	Guerrero	3910	Estado de Mexico	2801	Guerrero	4656
Guerrero	2435	Tlaxcala	3809	Puebla	2794	Querétaro	4311
Oaxaca	2386	Estado de Mexico	3684	Tlaxcala	2697	Estado de Mexico	3802
Morelos	2193	Morelos	3197	Morelos	2315	Morelos	3372

Real values, (2013 = 100)
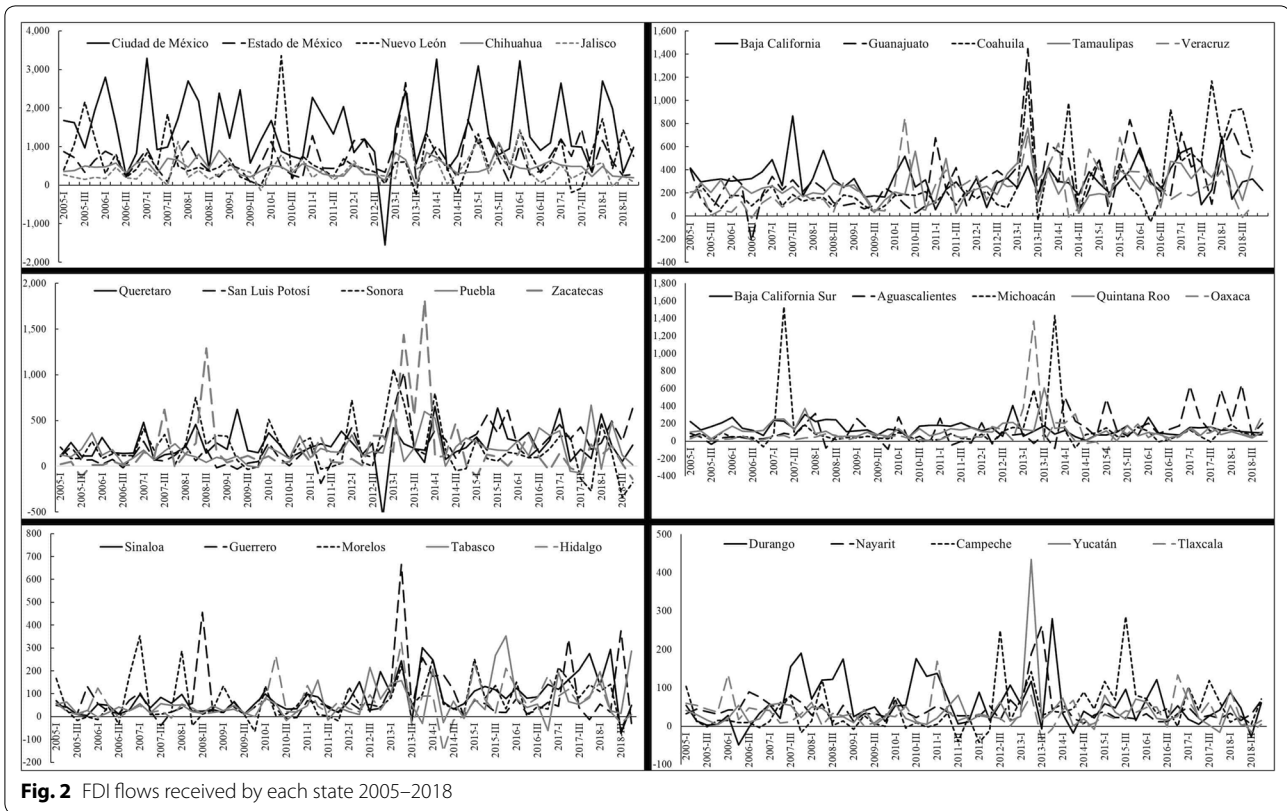
Fig. 2 FDI flows received by each state 2005–2018

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