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Universidad Nacional de Colombia
Carrera 30 No. 45-03, Edificio 310, primer piso
Correo electrónico: revcuaeco_bog@unal.edu.co
Página web: www.ceconomia.unal.edu.co
Teléfono: (571)3165000 ext. 12308, AA. 055051, Bogotá D. C., Colombia

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ARTÍCULO

EFFECTS OF GOVERNMENT EXPENDITURE ON EMPLOYMENT IN THE MEXICAN STATES, 2006-2018: A SPATIAL PANEL DATA APPROACH

Pablo Mejía-Reyes
Luis Brito-Cruz
Víctor Hugo Torres-Preciado

Mejía-Reyes, P., Brito-Cruz, L., & Torres-Preciado, V. H. (2025). Effects of government expenditure on employment in the Mexican states, 2006-2018: A spatial panel data approach. *Cuadernos de Economía, 44*(95), 1061-1084.

The aim of this paper is to analyse the effects of the main components of government expenditure on the Mexican states´ total formal employment, by controlling by the role of its conventional determinants (production and real wages) and taking into account the possibility of spatial interaction, over the period 2006–2018. Our results confirm the existence of spatial spillovers and the positive effects

Pablo Mejía-Reyes
Autonomous University of the State of Mexico, Faculty of Economics, Centre for Research on Economic Sciences, Toluca (Mexico). Email: pmejiare@uaemex.mx (corresponding author).

L. Brito-Cruz
Autonomous University of the State of Mexico, Faculty of Economics. Toluca (Mexico).
Email: lbritoc@uaemex.mx

V. H. Torres-Preciado
University of Colima, Faculty of Economics. Villa de Álvarez (México). Email: torrespreciado@ucol.mx

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of production on total employment, but they suggest a positive influence of real wages, a result less commonly reported in the literature. Furthermore, our estimates imply a null effect from any type of government expenditure, which reveals the limits of state governments to boost employment.

Keywords: Employment; government expenditure; spatial analysis; panel data.
JEL: C21, E24, E62, J23.

Mejía-Reyes, P., Brito-Cruz, L., & Torres-Preciado, V. H. (2025). Efectos del gasto público sobre el empleo en los estados de México, 2006-2018: un enfoque espacial para panel de datos. *Cuadernos de Economía, 44*(95), 1061-1084.

El objetivo de este artículo es analizar los efectos de los principales componentes del gasto público sobre el empleo formal total de los estados de México, controlando por el papel de sus determinantes convencionales (producción y salario real) y tomando en cuenta la posibilidad de interacción espacial, durante el período 2006-2018. Los resultados confirman la existencia de derrames espaciales y efectos positivos de la producción, pero también sugieren una influencia positiva de los salarios reales, un resultado menos común. Más todavía, nuestras estimaciones implican un efecto nulo del gasto público corriente y de inversión, lo que revela los límites de los gobiernos estatales para impulsar el empleo.

Palabras clave: empleo; gasto público; análisis espacial; datos de panel.
JEL: C21, E24, E62, J23.

INTRODUCTION

The insufficient generation of jobs around the world over the last decades has been a major concern of policymakers and academicians alike.[1] Indeed, the annual average growth rate of working-age population in the world has been around 1.2 % while employment has increased at a roughly equal rate of 1.2. Nonetheless, in the particular case of Mexico, the difference between these figures is far more accentuated, with its population growing at an annual rate of 1.8 %, on average, and its employment at 1.0 %, over the same period (ILO, 2020).

The importance of this phenomenon has led several researchers to analyse the dynamics and determinants of employment for different countries and periods by using a myriad of methodologies. Just to mention a few recent examples, Espín *et al.* (2016) use linear regressions to determine the effects of foreign direct investment, the GDP and real wages in Ecuador between 2007 and 2014; their results suggest that the former has no effects while the latter two variables have positive effects. Successively, by estimating dynamic panel data models for Puerto Rico over the period 1991-2010, Hernández *et al.* (2018) find that minimum wages have a positive relationship with employment in the construction, transportation and commerce sectors, but a negative relationship with those of manufacturing, services and public administration. Dresdner *et al.* (2017) estimate vector autoregressive models and report instability of the income-elasticity of the employment demand, which seems to have contributed to a slow recovery of jobs in the Chilean economy over the period 1995-2007.

Another branch of the literature investigating the effects of economic policy on employment has recently paid special attention to fiscal policy as a channel for stimulating the creation of jobs. In general, the fiscal packages implemented by governments are based on establishing different tax rates on labour and capital income and private consumption to finance public spending (purchase of goods and services, hiring of workers and investment) that seeks improving the general services offered to population (Dhont & Heylen, 2009). In particular, under the Keynesian perspective, it is assumed that higher public spending positively affects aggregate demand and, consequently, production and employment. In contrast, the orthodox economic approach claims that fiscal policy is inefficient when it comes to solving the unemployment problem because public deficits can crowd-out private spending, such as consumption, investment, and net exports.

Furthermore, since the financial crisis of 2008-2009 there has been a notable revival in the theoretical and empirical interest on the macroeconomic effects of fiscal policy, especially because most countries have experienced a prolonged decline in aggregate demand in the context of a tight monetary policy (Hjelm & Stockhammar, 2016). Nevertheless, the empirical evidence regarding the real effects of fiscal policies has been rather mixed. On the one hand, some papers have

[1] See, for example, Schmitt-Grohé and Uribe (2017), Marques *et al.* (2017), and Chen *et al.* (2019).

found a positive relationship between public spending and employment. For example, Dhont and Heylen (2009), by means of constructing an endogenous growth model, argue that low tax rates on labour income, low transfers related to structural non-employment, and productive government expenditure have been effective in promoting employment in core European countries. In turn, Akitoby *et al.* (2019) analyse the experience of the G-7 countries and find that the application of countercyclical fiscal policies during recessions increases the level of employment and output. Other studies have provided further evidence in the same sense, particularly when it comes to countries with relatively high economic development, such as the OECD countries, where higher productive government spending is a preferred instrument (Heylen & Van de Kerckhove, 2013), or in a subset of 17 OECD countries where the multiplier effect of spending mainly affects the employment trend, while tax shocks have a greater impact on potential output (Tafuro, 2015). Hjelm and Stockhammar (2016) arrive to similar results for Sweden.

On the other hand, some studies find opposite or mixed results. In particular, Pappa (2009) reports that in the case of the United States, shocks to government consumption and investment increase real wages and employment, but only in about two thirds of its states; in the others the effects are negative. In a similar fashion, Bredemeier *et al.* (2020) argue that the response of employment to public expenditure shocks varies substantially between industries and types of occupation due to differences in the short-term substitutability between labour and capital services; for example, service and sales related occupations are more responsive than blue-collar jobs. In turn, in a dynamic stochastic general equilibrium model, Cogan *et al.* (2010) report small fiscal multipliers in a New Keynesian framework for the US, which contrasts with the estimates from old Keynesian specifications.

In the case of Mexico, many studies have analysed the effects of the conventional determinants of employment, especially in the case of the manufacturing sector. By using different types of regression analysis, time series techniques and panel data models, at both aggregate and disaggregated levels, most papers find a positive effect of production (commonly used as a measure of effective demand), but their findings of the effects of real wages (a measure of costs) differ in sign and magnitude, which seems to depend on the specific subsector, specification model and sample (e.g., Fajnzylber & Maloney, 2005; Lechuga &Varela, 2001; López, 1999; Mejía *et al.,* 2017; Tavares & Varela, 2019).[2]

Moreover, other papers have sustained that the dynamics and responses of employment (and production) have been heterogeneous across the states, especially after Mexico adopted a market-oriented, open economy development model in the mid-eighties. Indeed, the productive activity, especially manufacturing production, experienced a shift from central Mexico to the northern border with the United States

[2] In general, most of these authors incorporate other explanatory variables in their models such as productivity, capital and exports, and consider the differences between specialised and non-specialised work. We underline the roles of production and real wages because we control for their effects in the analysis of the government expenditure effects.

in order to gain a better access to its main exportation market. Since then, northern states have flourished while central and southern states have relatively declined or stagnated. In particular, employment, production, wages and exports, among other variables, have performed differently in the regions of Mexico, with higher growth rates occurring in the northern and north-central states than in the southern ones (Díaz *et al.,* 2017; De Jesús, 2019; Hanson, 2010; Kehoe & Ruhl, 2010).

This differentiated performance of employment across the Mexican states has been studied by using different methodologies. On the one hand, for example, Mejía *et al.* (2017) estimate spatial cross-section regressions while Escobar (2011) and Carbajal and De Jesús (2017) use conventional panel data models and census information to analyse the driving forces of manufacturing employment. In turn, spatial panel data and census data have recently been used to explain employment of the manufacturing (Brito & Mejía, 2020a; De Jesús, 2019) and construction sectors (Brito & Mejía, 2020b), while Mejía and Torres (2020) use annual data to model the dynamics of manufacturing employment. Although with some differences, the findings of these authors are fairly consistent with those reported at the national levels, namely, the positive effects of production and the non-robust effects of real wages.

Interestingly, there seem to be no studies analysing the effects of fiscal policy or public expenditure on state employment in the Mexican case. In this context, the aim of this paper is to analyse the effects of the main components of government expenditure on Mexican state employment, by controlling by the role of its conventional determinants (production and real wages) and taking into account the possibility of spatial spillovers, over the period 2006–2018. By so doing, this paper seeks to improve our comprehension of such an important variable in two main directions. First, in contrast to existing studies that analyse the performance of employment in specific sectors, this paper studies the dynamics of total employment across the Mexican states. Second, it estimates the effects of government expenditure by distinguishing between its current and investment components. Our results confirm the existence of spatial spillovers and positive effects of production on total employment, but they suggest a positive influence of real wages, a result less commonly reported in the literature. All these results may be rationalised in the frameworks provided by New Keynesian Economics (NKE) and New Economic Geography (NEG). Moreover, our estimates point to a null effect of any type of government expenditure.

The rest of this paper is ozrganised in three sections. The first briefly reviews the arguments advanced by NKE and NEG to explain the expected positive effects of production on employment due to increases in the effective demand and the positive effects of real wages due to real rigidities and agglomeration economies. This section also analyses the reasons for having positive, negative or null effects of government expenditure on the evolution of employment. The second section describes our econometric methodology to specify and estimate spatial panel data models while the third discusses the main results. Finally, conclusions are put forth.

THEORETICAL BACKGROUND

Several studies of employment determinants are based on the arguments advanced by the NKE and NEG theories where the former provides a general framework of analysis and the latter offers an explanation for spatial interaction. In particular, according to NKE, employment depends, on the one hand, on a *sticky* real wage, named efficiency wage, and, on the other hand, on effective demand.[3] Because of different types of rigidities and coordination failures, this wage is greater than the equilibrium one and for the same reason it enhances workers productivity. Under these circumstances, the effective level of employment is determined by the labour demand at the level of the efficiency wage. Hence, in principle, an efficiency wage should have a negative impact on the effective level of employment. Nonetheless, it is also possible that an increase in efficiency wages provokes a raise in the workers' productivity, causing the labour demand to expand at every wage level, delivering a positive relationship between these variables.[4]

Like in most Keynesian models, effective demand is anticipated to be the most important determinant of employment since firms increase their labour demand before increasing current or expected demand for their products (Galí, 2013). Therefore, an increase in effective demand would shift the labour demand curve upward, generating higher levels of employment, given the efficiency wage and the labour supply curve.

In turn, NEG suggests that agglomeration economies resulting from the concentration of human resources, capital and general economic activity in specific geographic areas may give rise to a positive relationship between employment, production and real wages due to accumulative processes. Once it starts, because of the availability of natural resources, closeness to final good markets or promoting policies, the interaction between concentration and growth may be reinforced by increasing returns to scale explained by a growing product variety offered by an equal number of firms (see also Fujita, 1988; Fujita *et al.,* 2001; Krugman, 1991).[5] Furthermore, the equilibrium output of firms at any specific location can depend on the aggregate income, accessibility and competition in their own markets. In this regard, firms' accessibility mediated by the availability of transportation means highlights the importance of geographical proximity and spatial interactions between regions.

Moreover, NEG has coined the "home market" effect, an analytical concept stating that an increase in the home market income at any specific location would lead to a rise in that location's employment and production, but part of that additional

[3] This model is based on conventional schedules of labour supply and demand (Heijdra, 2009; Romer, 2011).

[4] Consequently, firms may have incentives to pay wages greater than the equilibrium one, even if that generates unemployment. See Gordon (1990), Malcomson (1981) and the related papers collected in Mankiw and Romer (1991) for further details.

[5] See also Myrdal (1957), Hirschman (1958) and Hanson (1997).

production may be exported to other accessible locations. This result suggests that both domestic and external income positively boost local employment. Additionally, by assuming an upward-slopping labour supply, a continuous increase in the home market income would also improve paid nominal wages, thus establishing a positive employment–real wage relationship (Fujita *et al.* 2001).

Returning to the NKE framework, effective demand responds to autonomous spending, such as government expenditure (in addition to autonomous private consumption and investment and exports), which makes fiscal policy to in order to become an instrument to both stabilise the economy and enhance output and employment growth. Indeed, under the assumptions of sticky prices and wages and unemployment, public spending may expand aggregate demand and, consequently, production, which would raise the effective demand of employees, without significant changes of prices at least in the short-run (Bils *et al.,* 2013; Fatás & Mihov, 2001).[6] However, these effects may be offset by the "crowding out" effect on private spending, resulting from the increase of real interest rates, and the distortionary effects of the required taxes to fund a greater public expenditure (Finn, 1998; Heijdra, 2009; Romer, 2011).

Moreover, several researchers have claimed that the components of public spending can have differentiated effects on output and production. Particularly, despite all of them being able to augment aggregate demand in the short-run, public investment may be more effective given that it enhances the productivity of the private productive factors, which contrasts with the possibly short-lived effect of the purchases of goods and services (Fatás & Mihov, 2001; Finn, 1998). Furthermore, several papers have highlighted the importance of distinguishing the direct effects of government expenditure on public employment and its indirect effects on private employment (Fatás & Mihov, 2001; Finn, 1998; Pappa, 2009).[7]

[6] Bils *et al.* (2013) *claim that price stickiness may not be essential for labour demand to respond to goods* demand if markups are countercyclical, another phenomenon that requires further investigation in the Mexican case.

[7] In fact, some papers have found that government expenditure has positive and significant effects on employment, especially in recessions, while tax shocks have minor effects in Sweden (Hjelm & Stockhammar, 2016). Notice that real business cycle models also imply a positive correlation between government expenditure and employment, but the transmission mechanism comes from the supply side in this case: the absorption of resources by the government requires that private agents increase their work effort and reduce their consumption (Fatas & Mihov, 2001).

ECONOMETRIC METHODOLOGY AND DATA SET

General econometric model

The empirical analysis of the effects of government expenditure on the Mexican states' employment is based on the NKE´s view and extended to account for possible interactions between spatial units under the theoretical lines of the NEG´s framework.[8] In this regard, according to the NKE, it is assumed that state employment is determined in a standard way by effective demand and real wages, where the former is expected to promote positive growth effects on employment by inducing expansions in regional production and directly boosting public employment, whilst the latter would negatively affect state employment since wages are considered a most important measure of cost. However, real wages may also be positively related to state employment provided firms are able to raise paid wages as to increase production in order to meet both the home and regional demand requirements.

Furthermore, under the NEG framework, expansions in effective demand may influence state employment through two channels. First, the so-called home market effect resulting from the internal or state-specific effects is explained by consumption or expenditure decisions made by local inhabitants, institutions or governments. Second, the neighbourhood effects associated to interregional trade can boost employment in the surrounding regions (Mejía & Torres, 2020).

Both theoretical perspectives thus led us to propose the following general spatial econometric panel data model which includes government expenditure as a potential determinant of state employment in Mexico:

$$e = \rho We + X\beta + WX\theta + \delta + \eta + \nu$$
$$\nu = \lambda W\nu + \varepsilon \qquad (1)$$

The departing specification thus follows a general nested formulation where e is a vector of size Nx1 that represents state total employment in annual growth rates, and x is a matrix of four explanatory variables defined as $X = [y\ w\ gc\ gi]$, where y, w, gc and gi are Nx1 sized vectors describing production, real wages, current and investment government expenditure for each Mexican state, also in annual growth rates, respectively.[9] We suppressed the time subscript for simplicity, but the period spans from 2006 to 2018 across the 32 Mexican states; therefore we have 13 observations over time and 32 cross-sectional units totalling 416

[8] Mejía and Torres (2020) and Brito and Mejía (2020a, 2020b) specify their models on these bases.

[9] Annual growth rates are used in the estimation of the models to avoid possible spurious relationships caused by the non-stationarity of the series, a common problem in the analysis carried out in levels (or logs).

observations. Additionally, *W* denotes a spatial weights matrix of size 32x32 that assumes a queen-type contiguity of order 1 due its flexibility.[10] Accordingly, *We* intends to capture potential endogenous spatial interaction effects between states arising from interregional labour market interdependencies due to spatial proximity, and ρ stands as the corresponding autoregressive parameter. Similarly, the spatially lagged set of explanatory variables, as comprised in the term *WX*, represents potential neighbouring effects between states as measured by the vector of coefficients θ. In addition, due to the heterogeneous nature of spatial data, model (1) also includes the possibility of non-observed time-invariant and spatial-invariant fixed effects denoted, respectively, by the terms δ and η.[11] Finally, the model specification also considers the possibility of having residual autocorrelation represented by the term *Wv* with an autoregressive coefficient λ. The disturbances vector *e* follows a white noise vector process with the conventional properties.

Model specification

We use two approaches to determine whether the empirical model defined in (1) best describes the data generating process underlying the government expenditure effects on state employment (Elhorst, 2014). Accordingly, we first implement a "specific-to-general" approach by estimating Lagrange multiplier tests, both classical and robust, to the residuals of non-spatial panel data models and test whether a spatial autoregressive (SAR) or spatial error specification (SEM) best describes our data.

Then, these results are contrasted against those obtained from the "general-to-specific" approach suggested by LeSage and Pace (2009). Hence, we impose and test a set of restrictions on the general nesting spatial (GNS) model defined in (1) to verify whether it could be simplified to more parsimonious alternatives such as the so-called SAC model (if the null H_0: $\theta = 0$ is not rejected) or the spatial Durbin model (SDM) or the spatial Durbin error model (SDEM) (if the null hypothesis H_0: $\lambda = 0$ or H_0: $\rho = 0$ cannot be rejected, respectively). This strategy is extended further to tests whether even more simple spatial specifications are more appropriate. For example, the SAR or the SEM models could be more suitable if the null H_0: $\lambda = 0$ or H_0: $\rho = 0$ cannot be rejected, respectively, in the SAC model.[12] This approach is implemented by estimating Wald (*W*) and Likelihood Ratio (*LR*) tests over the aforementioned parameter restrictions.

[10] This matrix has entries equal to 1 for two geographical units if they share a border and 0 otherwise.

[11] These terms capture possible heterogeneity associated to each unit (invariant over time) and every time period (invariant over units), respectively. The fixed effects model has been adopted here because it yields consistent estimators under general conditions, especially when possible omitted variables are correlated with the explanatory variables and the number of units is relatively small, among other circumstances (Greene, 1998; Elhorst, 2014). In addition, the results of the random effects were not coherent both with theory and previous empirical evidence.

[12] Additionally, the SAR or the SEM models emerge as alternative specifications when the null H_0: $\theta = 0$ cannot be rejected in the SDM or the SDEM models, respectively (see Elhorst, 2014: 6).

Database

Annual growth rates of all variables are used in the estimation of the econometric models. For each state and period, the measure of employment (*e*) corresponds to formal employment defined as the total number of workers registered at the Mexican Institute of Social Security (IMSS for its acronym in Spanish) while real wages (*w*) were calculated on the basis of the national nominal wage based on the IMSS database, which was then deflated by using the average of the Consumer Price Index of the main cities of each state provided by the National Institute of Statistics and Geography (INEGI for its acronym in Spanish). State GDP has been used to measure production (*y*). Government investment (*gi*) has been taken directly from the database of the INEGI, while current government expenditure (*gc*) has been obtained by adding personal services, materials and supplies and general services. All figures are expressed in real terms.[13]

EMPIRICAL RESULTS

The analysis of government expenditure and other determinants of employment are estimated on the basis of the model defined in expression (1). The explained variable is the growth rate of total formal employment while the explanatory variables are production and real wages, as conventional determinants, and current and investment expenditure of state government, all expressed in growth rates. Their basic statistics are reported on table 1.

The figures show a great heterogeneity among the variables. Specifically, the differences in the standard deviations of the federal and state current and investment government expenditure are noteworthy. Although the literature on the determinants of public spending in Mexico and other countries is scarce, the high heterogeneity and volatility of its growth rates may be associated to a variety of economic, political and natural factors where a discretionary management is also significant (Godínez *et al.,* 2018).[14] Skewness and kurtosis, in turn, suggest a remarkable concentration of high growth rates of real wages, current public spending and public investment in states located in the northern border and central Mexico and characterised by a growing industrial activity.

[13] The web sites of these institutions are www.imss.gob.mx and www.inegi.org.mx, respectively.

[14] These factors are related to the phases of the business cycle, the government terms, the level of debt, the specialisation of the productive structure, the approved budgets and even factors on which there is no control, such as natural phenomena (floods, droughts, earthquakes, etc.), that may require additional resources (Velázquez, 2006).

Table 1.
Descriptive statistics of employment and their determinants in the Mexican states, 2006-2018 (growth rates in percentage)

	Employment *e*	**Production *y***	**Real wage *w***	**Current public expenditure *gc***	**Investment government expenditure *gi***
Mean	2.102	2.444	0.634	5.056	12.446
Median	2.220	2.951	0.685	3.244	0.769
Maximum	8.281	16.627	9.360	199.627	515.783
Minimum	-4.294	-15.452	-5.919	-63.172	-92.621
Std. Dev.	2.026	3.778	1.502	19.054	61.930
Skewness	0.008	-0.760	0.226	4.702	2.314
Kurtosis	3.300	5.992	6.915	41.753	15.102
Jarque-Bera	1.566	195.180	269.199	27564.570	2909.979
Probability	0.457	0.000	0.000	0.000	0.000
Observations	416	416	416	416	416

Source: Own elaboration.

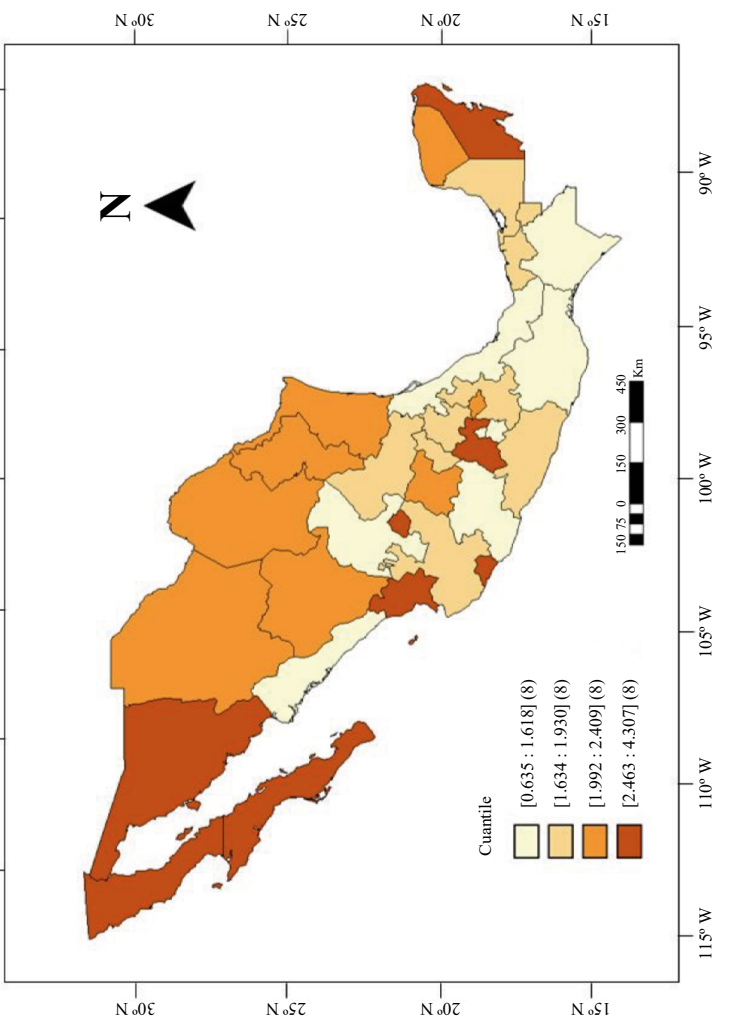
This pattern can also be appreciated on figure 1, which shows the average growth rates of employment across the Mexican states. It is apparent that states having growth rates close to or greater than 2 percentage points are located along the northern border or in a corridor that goes from this area to central Mexico. Furthermore, these states are highly specialised in industrial activities, mainly manufacturing production, which is in line with implications of the NEG. On the contrary, the states with the lowest average growth rates of employment are located to the south (with the exception of Yucatán and Quintana Roo) and in general they are specialised in primary activities and services (Erquizio & Ramírez, 2014; Sobrino, 2016).

The results of the estimation for different specifications of model (1) are presented on Table 2. According to the "general to specific" approach described above, the selection of the most appropriate model starts from the GNS model. Specifically, *LR* statistic tests are applied to contrast the general (unrestricted) model and the specific (restricted) model that is nested in the former. Additionally, the statistical significance of the parameters corresponding to alternative models (θ, ρ, λ, β) is also verified.[15]

As a starting point, notice that the estimates shown in the last column of table 2 provide evidence of spatial dependence in the pooled data model. The *p*-value of the Moran's Index suggests rejecting the null hypothesis of no global spatial dependence in favour of the alternative of the existence of positive spatial dependance between the growth rate of employment of the Mexican states, while the

[15] Note that the same conclusions are obtained from the estimation of the Wald test, available upon request.

Figure 1.
Spatial distribution of the average growth rates of total employment in the Mexican states, 2006-2018.



Source: Own elaboration.

Table 2.
Estimates and specification tests of different spatial panel data models for the growth rates of total employment of the Mexican states, 2006-2018

Explanatory variables	GNS	SAC	SDM	SDEM	SAR	SLX	SEM	Pooled
y	0.149 (0.000)	0.150 (0.000)	0.136 (0.000)	0.136 (0.000)	0.130 (0.000)	0.158 (0.000)	0.147 (0.000)	0.161 (0.000)
w	0.134 (0.055)	0.161 (0.016)	0.159 (0.021)	0.156 (0.020)	0.136 (0.030)	0.122 (0.085)	0.160 (0.016)	0.125 (0.050)
gc	-0.002 (0.668)	-0.001 (0.773)	-0.001 (0.830)	-0.001 (0.802)	-0.0009 (0.847)	-0.003 (0.500)	-0.001 (0.801)	-0.003 (0.467)
gi	-0.000 (0.954)	0.001 (0.443)	0.0009 (0.502)	0.0006 (0.644)	0.0008 (0.529)	0.0004 (0.756)	0.001 (0.459)	0.0004 (0.765)
Wy	0.111 (0.066)		-0.18 (0.679)	0.031 (0.498)		-0.008 (0.841)		
Ww	0.015 (0.899)		-0.050 (0.581)	-0.023 (0.813)		0.028 (0.765)		
Wgc	-0.005 (0.575)		-0.001 (0.852)	-0.002 (0.755)		-0.003 (0.643)		
W gi	-0.004 (0.124)		-0.003 (0.172)	-0.004 (0.158)		-0.002 (0.332)		
Constant						1.699 (0.000)		1.640 (0.000)
ρ	-0.402 (0.004)	-0.200 (0.361)	0.261 (0.000)		0.252 (0.000)			

(*Continued*)

Explanatory variables	**GNS**	**SAC**	**SDM**	**SDEM**	**SAR**	**SLX**	**SEM**	**Pooled**
λ	0.560 (0.000)	0.424 (0.012)		0.266 (0.000)			0.260 (0.000)	
Log L	-822.077	-824.976	-824.260	-823.924	-825.527	-859.013	-825.229	-859.613
AIC	1666.154	1663.953	1668.520	1667.848	1663.055	1736.028	1662.458	1729.226
BIC	1710.492	1692.167	1708.827	1708.155	1687.239	1772.304	1686.642	1749.379
R^2	0.1284	0.1572	0.1343	0.1296	0.1463	0.1112	0.1534	0.1086
LR test		5.800 (0.214)	4.370 (0.036)	3.690 (0.054)	6.900 (0.228)	n.a.	6.300 (0.227)	
Moran's I								4.888 (0.000)
LM-Err								22.376 (0.000)
$LM\text{-}Err_{robust}$								2.002 (0.157)
LM-Lag								20.384 (0.000)
$LM\text{-}Lag_{robust}$								0.011 (0.918)

n.a. = not available. *p*-values in parenthesis.
Source: Own elaboration.

p-values of the Lagrange Multiplier (*LM*) test implies also to do so in both the cases of substantive (*LM-Lag*) and residual (*LM-Err*) spatial autocorrelation. On this basis, we move on to the "general to specific" approach. Table 2 reports both the estimated coefficients of all models and the specification tests. The estimated models incorporate spatial fixed effects.[16]

Hence the corresponding *p*-value of the *LR* statistic suggests not rejecting the null hypothesis H_0: $\theta = 0$, which implies that the SAC model is more appropriate than the GNS model. In contrast, the respective *LR* test indicates that the SDM model is a better specification than the GNS model since the null hypothesis H_0: $\lambda = 0$ is rejected at 5 % of significance and the autoregressive coefficient ρ is significant at 1 %. Analogous results are obtained for the SDEM: the null hypothesis H_0: $\rho = 0$ cannot be rejected at 10 % and λ is significant at 1 %. However, these tests do not incorporate explicitly the null H_0: $\theta = 0$, which is rejected in the comparison of the GNS and the SAC models. Hence, on this basis, we adopt the latter. Furthermore, all spatially lagged explanatory variables are not statistically significant in both versions of the Durbin model.

The alternatives to the SAC model are the SAR and SEM models. The *LR* statistics imply not rejecting the null hypotheses $\theta = 0$ and $\lambda = 0$ for the former and $\rho = 0$ and $\theta = \rho\beta = 0$ for the latter while the statistical significance of the coefficients indicates that any of them are satisfactory approximations to capture both the substantive and residual spatial autocorrelation. Notice also that these models minimise the Akaike (AIC) and the Schwarz (SIC) Information Criteria, which are obtained for the slightly lower values for the SEM model. Hence, these estimates indicate the existence of an interaction between the growth rates of employment or their non-explained proportion among neighbouring states. These spillovers may come from agglomeration economies resulting from similarities in the rhythm of the growth of employment in the states of the north and central north (high growth), on the one hand, and in the states located in the south (low growth), on the other hand.

Indeed, a remarkable feature of our results is the robustness of the estimated coefficients of the explanatory variables across the specification models both in terms of their signs and statistical significance. Indeed, according to previously reported results, the growth rate of production has positive and statistically significant effects on the evolution of employment (Avendaño & Perrotini; 2015; Cruz & Ríos, 2014; Islas & Cortez, 2013; Loría *et al.,* 2015; Rojas, 2019). Yet, contrary to most commonly reported findings, real wages seem to have also a positive and significant impact on employment, which may be rationalised in the framework provided by NEG.[17] Specifically, consistent with the cumulative causation hypothesis, once

[16] Models with time fixed effects and both spatial and time fixed effects were also estimated, but in all of them the autoregressive coefficients become non-statistically significant.

[17] In the case of Mexico, Aguirre (2019), Campos *et al.* (2017) and Mejía *et al.* (2017) report positive effects of real wages on employment, while Martínez (2020) reports non-significant effects.

economic activity starts growing in a specific region due to any particular reason (natural resources endowment or economic policy), the resulting increases of supply and demand of goods and services generate additional increases in labour demand, which cause real wages to rise. The feedback process between these variables and the spillovers among states may deliver a positive relationship between employment and real wages. The significant economic growth of states located in the northern and central regions of Mexico, on the one hand, and the stagnation of southern states, on the other, can explain these findings.

Surprisingly, our results indicate a null effect of government expenditure on state employment. Indeed, despite theoretical and some empirical literature supporting the possibility of having differentiated effects of current expenditure (negative) and public investment (positive) depending on their impact on aggregate demand and, especially, on potential output, our estimates suggest that neither the former nor the latter have statistically significant effects on employment. Nonetheless, although unexpected in some sense, similar results have been reported by Cogan *et al.* (2010) for the US economy and Pappa (2009) and Bredemeier *et al.* (2020) in the cases of its states and sectors. Moreover, Mejía *et al.* (2021) contend that in the case of the Mexican state, government expenditure has not affected output over the period 2004-2018, while Fuentes and Mendoza (2003) claim that public infrastructure had positive effects up to the mid-eighties.[18]

Hence, our results add to the debate on the effectiveness of public spending as a tool to boost employment. Despite Keynesian models sustaining that this policy instrument can affect public employment directly or private employment indirectly, there is a set of factors that may hinder this process. First, it may be possible that public expenditure crowds out private investment, yet there is no information available at state level to test this hypothesis. Second, in our particular case, the restricted capacity of state governments to hire workers –given the low ratio of government expenditure to GDP[19]– the high volatility of public expenditure growth rates, that may be exhibiting a high degree of discretion in its allocation, and the significant diversion of public resources to non-productive activities (Reyes & Mejía, 2016; Velázquez, 2006) might contribute to explain our findings.

[18] In our sample, the correlation coefficients between output and current and investment government expenditure equal 0.095 and 0.022, respectively.

[19] The averages of the ratios of current expenditure and public investment to GDP are around 2.6 and 0.6%, respectively. Finn (1998) points out this feature in the case of the US to explain its weak effect.

Table 3.
Estimation of the total effects, direct and indirect, in a SAR model for the growth rates of total employment, 2006-2018

Variable	Coefficient	Percentage in total effect	Feedback percentage
Direct effects			
y	0.133 (0.000)	75.743	2.684
w	0.135 (0.029)	75.821	-0.324
gc	-0.0004 (0.924)	81.531	-51.373
gi	0.0008 (0.525)	75.264	0.933
Indirect effects			
y	0.042 (0.003)	24.036	
w	0.043 (0.072)	24.179	
gc	-0.0001 (0.947)	18.469	
gi	0.0002 (0.532)	24.728	
Total effects			
y	0.176 (0.000)		
w	0.179 (0.032)		
gc	-0.0005 (0.929)		
gi	0.001 (0.523)		

p-values in parenthesis.
Source: Own elaboration.

Although intuitive, some authors argue that the impact of the explanatory variables on the explained variable should not be read directly based on the estimated coefficients given that they ignore the presence of feedback effects. Hence, it would be more appropriate to carry out the analysis in terms of the direct and indirect (spillover) effects. Essentially, these effects are obtained based on the matrix of partial derivatives of the expected value of e with respect to the kth-explanatory variable in the reduced form of model since changes in the latter provoke variations in the dependent variable of the same unit (direct effect), but also in the dependent variable of other units (indirect effect). In our case, the direct and indirect effects are based on the SAR model and, given that $\theta = 0$, the model exhibits only global

indirect effects arising from a unit located beyond any unit's neighbourhood.[20] Table 3 displays the corresponding estimates.

In general, the direct effects give account of approximately three quarters of the variability of the growth rate of state employment, but they are only significant in the cases of the conventional determinants of employment, namely, the growth of production and real wages; current and investment government expenditure have non-significant effects. In turn, the contribution of the indirect effects is about one quarter, a mild proportion that may be explained by the existence of spillovers of small magnitude resulting from the low value of the autoregressive coefficient ($\rho = 0.252$). Note that for the same reason the estimated coefficients of the SAR model are very similar to the estimated direct effects. Yet, there is a positive and a negative difference (feedback percentage on table 3) between these two sets of estimates for the growth rates of production and real wages, respectively, caused by the endogenous interaction effects.[21] In fact, these feedback effects yield total effects that exceed the estimated coefficients of the SAR model, which provides evidence of the importance of spillovers across states even if they seem to be small.

CONCLUSIONS

This paper has analysed the effects of government expenditure on employment in the Mexican states over the period 2006-2018, controlling for the effects of other conventional determinants. A "general to specific" approach has been followed to choose the most appropriate spatial panel data model.

The most important findings suggest the existence of spatial interactions between the growth rates of employment of the states and those of their neighbouring states. Nonetheless, the explanatory variables of the same space unit continue being the most relevant determinants.

Regarding the conventional determinants of employment, the growth rate of production has positive effects, according to the Keynesian view and the empirical results previously reported in the national and international literature. Notwithstanding, real wages seem to have positive effects on employment, which has been previously reported in several papers analysing the experience of Mexico. Although not commonly found, given that real wages are seen as the main cost of labour, their positive effects on employment may be explained by a continuously growing demand of labour that causes employment and real wages to grow simultaneously, according to the predictions of the New Economic Geography. Notice that the same result may be derived in a New Keynesian Economics framework.

[20] See Elhorst (2014) and LeSage and Pace (2009) for further details.

[21] These feedback effects come from a process in which the impacts affecting the growth rate of employment in certain neighbourhoods pass on to surrounding neighbourhoods and back again to the first ones.

An interesting finding related to the objective of this paper is the null effect of government expenditure, both current and investment, on employment. Although both Keynesian and Neoclassical theories imply a positive effect on employment, the empirical literature is rather mixed. The sign and the magnitude of the effects depend on a variety of factors, such as the existence of a "crowding out" effect, the state of the economy, the size, composition, efficiency and diversion of public spending and the magnitude of corruption, among others. In the particular case of Mexico, our findings call for further analyses seeking to disentangle the impact of such factors both in the short and the long-run by using dynamic models allowing to track those effects over time.

Meanwhile, these are important results since expansionary fiscal policies have been advocated as means to boost economic activity over the last decades given the deceleration of production and trade and the limitations of the tight monetary policies adopted in many countries including Mexico. Furthermore, these results show the inefficacy of the state governments to enhance employment in Mexico and the need to look for alternatives to do so. Notice, however, that these results imply that state government expenditure is not a prime impulse of employment growth despite governments in the Mexican states play a key role in providing infrastructure, advancing education and research, and maintaining law and order.

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95

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9 770121 477005 95