

# IMPACTS OF THE MINIMUM WAGE AND INFORMAL EMPLOYMENT ON INCOME EARNINGS IN MEXICO

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## Abstract

The present research examines the issue of how the minimum wage and informal employment impact differences in income earnings. To this end, a Censorship Model is proposed that uses data codified for a subset of the population. Calculations for this model were performed using two econometric methods: Ordinary Least Squares (OLS) and the Generalized Method of Moments (GMM). In both cases, microdata from the National Occupation and Employment Survey were used for each federal entity, covering the period of 2005-2014. The results demonstrate that the minimum wage widens the gap in income earnings, while the informal sector has a reducing effect on differences in income earnings.

**Keywords:** minimum wage; informal employment; income inequality; data panel.

## INTRODUCTION

There has been increasing concern during recent years regarding recuperating the real value of the minimum wage. The subject is under constant debate in academic circles, while in public policy spaces it is understood as a mechanism with which to increase workers' incomes, particularly of the lowest earners in society. It is hoped that fairer income distribution will reduce the growing inequality among the population.

Recent statistics from the ILO's Global Wage Report (2017) show that, on average, the real wage growth has fallen significantly in global terms. Specifically, the aforementioned report indicates that real wage fell by 1.3% in Latin America and the Caribbean during the period 2005-2015, with Mexico experiencing the sharpest fall (-12%) followed by El Salvador (-11%) and Honduras (-6%), far off from countries like Chile and Brazil who experienced a 36% increase in the value of real wages. Although it is known that a country's average wage does not explain the behavior of income distribution between different groups of wage earners, there is sufficient empirical evidence to demonstrate that wage inequality has increased in the majority of countries across the world.

Studies such as Maloney (1999), Addison and Blackburn (1999), Lin and Yun (2016), and Neumark *et al.* (2005) concur that income inequality could, to a certain extent, be a product of the individual worker's profile (for example, level of education, age, or company seniority). Understood in this way, a worker's profile could be the variable which accounts for variation in income across all deciles. However, there is a range of factors that could also account for variation in income levels, such as gender, company size, and structure of the labor market (formal or informal).

Nevertheless, there are ongoing academic and political debates regarding the value of real wages and labor demand. Lin and Yun (2016) and Campos-Vázquez *et al.* (2018a) argue that rising minimum wages reduce employment opportunities for low-wage workers and bolster informal employment. This paper analyzes the impact of the minimum wage and informal employment on differences in income earnings. One of the primary challenges of identifying and understanding employment in the informal labor market is the lack of a consensus on how to define and measure informal employment activity.

Recent literature on the subject indicates that the informal sector is, perhaps, a long-term characteristic of emerging and developing countries, particularly in Africa and Latin America (see Charmes, 2000). Informal employment constitutes a large part of the labor force in these countries. It is therefore crucial to understand how informal employment functions, as this concept is crucial to understanding labor markets and income distribution. One of the principal difficulties faced, perhaps, is the highly heterogeneous nature of the informal sector, a characteristic which makes it difficult to describe how it functions and the role it plays in the economy. According to the conventional view set out by Fields (1975) and Dickens and Lang (1985), wage earners take on informal employment to escape unemployment or, rather, they are removed from the formal sector as the result of the way the labor market is regulated.

Some studies have, however, begun to question this approach, arguing that a significant number of informal workers decide to enter the informal sector voluntarily depending on their preferences, skill-set, and prospective earnings (see Maloney, 1999). Recent labor market models have suggested there is a coexistence of workers who entered the informal sector voluntarily and those who cannot access the high salaries of the formal sector and have no other option but to enter the informal labor market (see Funkhouser, 1998; Blunch *et al.*, 2001, and Fields, 2005). Carneiro and Henley (2001) show that differences in income can be explained by the non-observable characteristics of workers who choose to enter each respective sector. Wu and Li (2006) demonstrate that nearly 90% of observed differences in monthly income between formal and informal workers can be explained by observable characteristics.

According to data from the National Occupation and Employment Survey (ENOE) conducted by INEGI during the period 2005-2014, 53.8% of Mexico's population are employed by the formal sector. Studies on Mexico, such as Samaniego (2006), show that the size of the informal sector is an underlying factor which can explain factors such as income inequality, poverty, and inefficiency of the labor market. Additionally, the size of the informal sector could function as release valve for people whose income falls or who become unemployed. Income decreased across all deciles in 2009 due to the global financial crisis. In the same year, the size of the informal sector increased. This seems to suggest that the informal sector could reduce income inequality.

This paper works from the hypothesis that the minimum wage will have a negative effect on differences in income earnings, with informal employment having a reducing effect on differences in income earnings. To investigate the two propositions described above, this paper uses the Censoring Model proposed by Autor *et al.* (2016). The primary purpose of this model is to examine the first of the aforementioned relations. However, as shown in the study by Bosch and Manacorda (2010), there are other factors -such as the effect of international trade, macroeconomic factors, and the impact of exchange rates- which can help to explain differences in income earnings. This paper seeks, therefore, to engage more deeply with possible explanations for differences in income earnings in Mexico, incorporating the size of the informal sector as a variable.

It should be pointed out here that the present paper conducts a macroeconomic analysis of a sample of 32 federal entities for the period 2005-2014. This analysis is intended to contribute to the debate surrounding the relevance of the value of real wages to income inequality in Mexico, and to verify the positive relation found

by Bosch and Manacorda (2010), assuming this relation is found to persist over time. Due to questions of income variability across different deciles, the database of urban municipalities was substituted for a sample of 32 federal entities, resulting in a more heterogeneous database.

There are several other significant differences between Bosch and Manacorda's (2010) study and the present one; while their study estimates the model using the instrumental variables model, the present one estimates the panel model using Ordinary Least Squares (OLS) with fixed effects in the first instance, and in the second instance uses the Generalized Method of Moments as a robustness test.

The paper is structured as follows: section two reviews the existing literature and debate surrounding the minimum wage and its impact on differences in income, as well as reviewing the literature related to informal employment; section three describes the model used in this re-search; section four is a discussion of the data; and finally, in sections five and six the main results and conclusions are represented, respectively.

## 2. LITERATURE REVIEW

There is a wide range of literature on the minimum wage and its relationship with income inequality. Addison and Blackburn (1999) analyze the effect of minimum wages on poverty levels in Mexico by using a panel model with data by federal entity. They find that the minimum wage has a significant reducing effect on both poverty and on high school dropout rates.

Neumark *et al.* (2005) use a non-parametric method to estimate the effect of the minimum wage on income inequality in the U.S. The findings show that the minimum wage could increase inequality for those at the low end of the income distribution scale. On the other hand, studies focused on Mexico such as Bosch and Manacorda (2010) and Duval-Hernández *et al.* (2016), conclude that the minimum wage can explain a large portion of income inequality. Both authors find that, in the lower levels of income distribution, the majority of income inequality can be attributed to the rapid fall in the real value of minimum wages. They also find that changes in the panel are convergent and that this convergence is more a product of changes in the labor market than changes in worker profiles (education, age, and gender).

Moreno-Brid *et al.* (2014) focus on the effects of increases in the minimum wage on the labor market, highlighting that the minimum wage in Mexico has declined sharply in various decades due to inflation, and that it is necessary to uncouple it as a reference for transactions outside of the occupational sphere. Campos-Vázquez *et al.* (2018b) propose new methodologies to calculate the income of these in the highest ranges of the income distribution scale. The authors employ data obtained from household surveys going back to 1992 to estimate income of those in the highest decile of income distribution in Mexico. In doing so, they correct the misrepresentation of high-earning individuals which results from using data obtained from national surveys. The income of high earners is estimated using interpolations of the Pareto distribution, with findings demonstrating that 25% of income goes to the top 1% of earners.

In another recent study, Campos-Vázquez *et al.* (2018a) investigate the relationship between increases in the minimum wage and employment in Mexico, comparing the minimum wage in two of the country's regions at the end of 2012. The findings indicate that, on average, the probability of being in informal employment fell in areas where the minimum wage increased. Bouchot (2018), meanwhile, empirically evaluates the implications of increases in the minimum wage on income distribution, employment, and informal employment, using the partial harmonization of regional minimum wages in 2012 as a natural experiment. Applying the Estimation of Differences in Difference Method, the findings suggest that there is no evidence of an adverse effect on employment. Instead, the study finds that there were positive effects on real hourly wages and work and employment in the formal sector.

There is only a limited literature on differences in income and their relationship to both formal and informal employment. Studies such as Tansel and Kan (2016) suggest that the informal sector serves as an escape valve after increases in the minimum wage and unemployment in the formal sector. However, workers in the informal sector will always be disadvantaged by the precarious conditions they face and, additionally, the authors also find heightened gender discrimination in the informal sector. These findings concur with the traditional theory that workers in the formal sector receive higher wages than those in the informal sector, who experience a greater extent of job insecurity.

From a more general perspective, there are several studies which focus on differences in income in other countries. Bargain and Kwenda (2010), for example, focus on Brazil, Mexico, and South Africa. The findings from this study confirm that workers in the informal sector receive lower wages principally as a result of their low profile and skillset. Similarly, Staneva and Ar-absheibani (2014), using Tadjikistan as a case study, find that observable income differences are attributable to the low profile and skillset of workers in the informal sector. Rand and Torm's (2012) study focusing on the informal sector in Vietnam confirms the existence of a wage gap between the formal and informal sectors, and that wages in the formal sector are on average 10 to 20% higher than those in the informal sector.

In a separate study focused on China, Zuo (2013) also examines differences in income between formal and informal workers in urban areas in China. The findings reveal that only 33% of the wage differential observed can be accounted for by worker profile, with the remaining 67% being attributed to the effect of segmentation.

## 3. IDENTIFICATION AND SPECIFICATION OF MODEL

This paper's analysis of the effect of minimum wages on income gaps follows on from the studies by Lee (1999) and Autor *et al.* (2016). Lee (1999) examines the relationship between variations in the impact of the minimum wage and wage distribution, identifying the average growth in inequality as being related to the minimum wage and establishing that the theoretical relationship of these variables could be described as truncation, censoring, or spillover.

The Censoring Model was employed to analyze the interaction between the minimum wage and income distribution. The main characteristic of this model is its flexibility to factor in latent variables (variables which are not directly observable). That is to say, the model is based on a latent variable, but one of which it is possible to have censored information. The model also supposes a  $d_i$  indicator via which the censoring process is described, with  $d_i = 0$  being a uncensored observation and  $d_i = 1$  and the censoring equation represented as:

$$x_i^{cm} = (1 - d_i)x_i + d_i\xi \quad (1)$$

Where  $x_i^{cm}$  is the censored version of  $x_i$  and  $\xi$  represents the censoring value, the probability of censoring is denoted as  $p = \Pr \{d = 1\}$  and it is assumed that  $0 < p < 1$ .

Conversely, the  $d_i$  censoring process may be fairly general, and for that reason a censoring process of only one value for each limit is proposed. For example, an upper limit censoring process involves observing  $x_i$  only when it is less than the  $\xi$ , limit. This is expressed as follows:

$$d_i = 1 [x_i > \xi] \quad (2)$$

$\xi$  is the limit of the censoring value. Once the equation which represents the Censoring Model has been established, the next step is to establish the relationship between the minimum wage and income distribution. This relation is calculated using the difference between the objective percentile  $w_{mt}^q$  and the percentage used as a centrality measure  $w_{mt}^p$ , which is expressed as follows:

$$w_{mt}^q - w_{mt}^p = \text{differences in income earnings} \quad (3)$$

$w_{mt}^q$  is the  $q$ -th percentile of the logarithmic income distribution in the state ( $m$ ) and time ( $t$ ). Differences in income earnings can be thought of as a measure of inequality which factors in the difference between the objective percentile and a centrality measure. High values in this variable indicate higher levels of inequality, while low values indicate low levels of inequality. Supposing that a sufficiently high  $p$  percentile exists, wages which are equal to or higher than this percentile will not be affected by the minimum wage. Therefore,  $w_{mt}^p$  is the  $p$ -th percentile which serves as a centrality measure in the state ( $m$ ) and time ( $t$ ). On the other hand, the take-home minimum wage ( $WO$ ) is defined as the difference between the minimum wage and a centrality measure, so as to allow the effect of the minimum wage variable on differences in income to be measured. This is expressed as follows:

$$MW_{mt} - w_{mt}^p = WO \quad (4)$$

$MW_{mt}$  is the nominal minimum wage logarithm in the state ( $m$ ) and time ( $t$ ). Once the variables have been defined, the Censoring Model can be reconsidered. This model is based on the assumption that all workers who receive a latent wage below the minimum wage obtain the minimum wage and workers earning wages higher than this are unaffected. The Censoring Model implies that the income differential of the logarithms  $q$  to  $p$  can be expressed as follows:

$$w_{mt}^q - w_{mt}^p = w_{mt}^{*q} - w_{mt}^{*p} \text{ si } w_{mt}^{*p} \geq MW_{mt} \quad (5)$$

$w_{mt}^{*q} - w_{mt}^{*p}$  is the latent difference in earnings,  $w_{mt}^{*q}$  is the  $q$ -th and  $w_{mt}^{*p}$  is the  $p$ -th latent percentile of the state ( $m$ ) over time ( $t$ ). Therefore, the observed income differential is equal to latent income is  $w_{mt}^{*q}$  is higher than or equal to  $MW_{mt}$ .

$$w_{mt}^q - w_{mt}^p = WO \text{ si } w_{mt}^{*q} < MW_{mt} \quad (6)$$

On the other hand, if  $w_{mt}^{*q}$  is lower than  $MW_{mt}$ , then the observed income differential is equal to the take-home minimum wage. Under such circumstances, the value of the centrality measure  $p$  is fixed. Lee (1999) and Autor *et al.* (2016) find a level of 50, meaning that the 50<sup>th</sup> percentile is the centrality measure in the case of the U.S. The decision to use the 70<sup>th</sup> percentile as a centrality measure is informed by the hypothesis that there are spillover effects. According to Bosch and Mancorda (2010), it could be reasonably assumed that this centrality measure applies to Mexico, given that there is evidence of minimum wage overflows above the 50<sup>th</sup> percentile. Once the centrality measure has been determined, the difference in income earnings can be determined as follows:

$$w_{mt}^q - w_{mt}^{70} = \text{differences in income} \quad (7)$$

Additionally, the equation for the take-home minimum wage which factors in the centrality measure is as follows:

$$MW_{mt} - w_{mt}^{70} = WO \quad (8)$$

On the other hand, making the estimate requires the model to be parametrized. To do so, wage dispersion must be expressed as a function of latent wage dispersion plus the effect of the minimum wage.

$$\text{differences in income} = w_{mt}^{*q} - w_{mt}^{*70} + WO \quad (9)$$

The effect of wages can be expressed as a quadratic function of the real minimum wage, as follows:

$$WO = WO + WO^2 \quad (10)$$

Finally, latent wage dispersion is expressed as follows:

$$w_{mt}^{*q} - w_{mt}^{*70} = \alpha_m^q + X_{mt}' + U_{mt} \quad (11)$$

A  $\alpha_m^q$  are specific characteristics of each state and  $X_{mt}'$  is an additional vector for specific covariables for each state and  $U_{mt}$  is the error term. A new regression model can be obtained from the above calculations. The new regression model is related to the Censoring Model and can be expressed as follows:

$$\text{Differences in income} = \alpha_m^g + \alpha_m^g + \beta_1 WO + B_2 WO^2 + X'_{mt} + u_{mt} \quad (12)$$

$u_{mt}$  is the error term. Equation (12) is an alternative simple parametric to the Censoring Model in equation (11), as well as being the basis of our empirical analysis. It is worth pointing out that  $X'_{mt}$  includes the control variables: number of hours worked ( $HW$ ), percentage of wage earners ( $TA$ ), and the percentage of informality ( $TIL2$ ). The  $HW$  variable is expected to be a negative sign, as workers can increase the number of hours worked to earn higher wages, thereby reducing differences in income. The  $TA$  variable measures the percentage of waged workers. Finally,  $TIL2$  is the variable used to measure the impact of the informal sector on income distribution, which is expected to increase differences in income.

To estimate equation (12), the income percentiles for each of the 32 federal entities which make up the Republic of Mexico were calculated, using data from the fourth quarter of each year of the 2000-2014 period. In an overall sample of 390, 828 individuals per quarter, the individuals who reported having received income were selected, reducing the sample to 118,400 with an average sample of 3,700 per federal entity.

Although no *a priori* restrictions were placed on the values of the parameters, the model ascertains that, at least in the range of variation defined by  $WO$ , the observed differential in income earnings tends toward  $WO$  as  $WO$  increases, and tends towards a  $\gamma_{mt}^g - \gamma_{mt}^g$  as  $WO$  diminishes. This is consistent with the censoring model in equation (11).

One of the advantages of using equation (12) is that it allows for the detection of asymmetries in the minimum wage among the highest distribution percentiles. Panel data was used for the econometric analysis, with equation (12) being estimated using OLS with fixed effects (see Table 2).

One of the main challenges to estimating equation (12) is the possibility of spurious positive correlations between the observed income differential and the minimum take-home wage. This problem is produced by sampling errors and the fact that the 70<sup>th</sup> percentile is present in both sides of the equation. Autor *et al.* (2016) refer to this situation as the "division bias problem." There is a possibility that, when estimating the model with OLS and fixed effects, there is no relation between these two measures or that the relationship, while statistically significant, is small. This type of interaction could be due to biases in the data. The source of the bias must be taken into account when testing to the model's robustness, so as to avoid obtaining unreliable findings. A possible solution to this problem is to estimate equation (13) using GMM. A necessary condition for applying the GMM method is that differences in income earnings are calculated using the logarithm, as done by Kambayashi *et al.* (2013). In this case, the equation to be estimated is as follows:

$$\text{Differences in income} = \beta_0 + \beta_1 \ln WO_{mt} + \beta_2 \ln WO2_{mt} + \beta_3 HW_{mt} + \beta_4 TA_{mt} + \beta_5 TIL2_{mt} + u_{mt} \quad (13)$$

The decision to use GMM to make this estimate is justifiable as GMM is more efficient and flexible due to the fact that more data can be obtained by using control variables and lagged variables to make estimations. Another strength of the GMM technique is that it allows more exhaustive tests to be conducted, especially for the 80<sup>th</sup> and 90<sup>th</sup> percentiles where the minimum wage is not expected to have any impact. The outcomes of this estimate can be seen in Table 3.

#### 4. DESCRIPTIVE ANALYSIS OF THE STATISTICAL INFORMATION

Micro-data from ENOE covering the period 2005-2014 was used to analyze the interaction between the minimum wage and income differences in Mexico. ENOE is the consolidation and fusion of the National Urban Employment Survey (ENEU) and the National Employment Survey (ENE) that, for more than 20 years, has provided data on the working and out-of-work population, similar to the Current Population Survey conducted by the U.S. government.

Similarly, statistical information from ENOE was used to calculate the relation between informal employment and differences in income, as ENOE is the official labor market survey and contains data going back to the end of the 1980s. The sample units are federal entities, which allows data to be structured as a panel composed of 32 data blocs related to Mexico.

Table 1 contains a brief statistical description of the data related to the model's independent variables obtained from ENOE. One feature that stands out in the data shown in Table 1 is that wage efficiency levels always display a negative sign.

Table 1. Statistical description of the model's independent variables

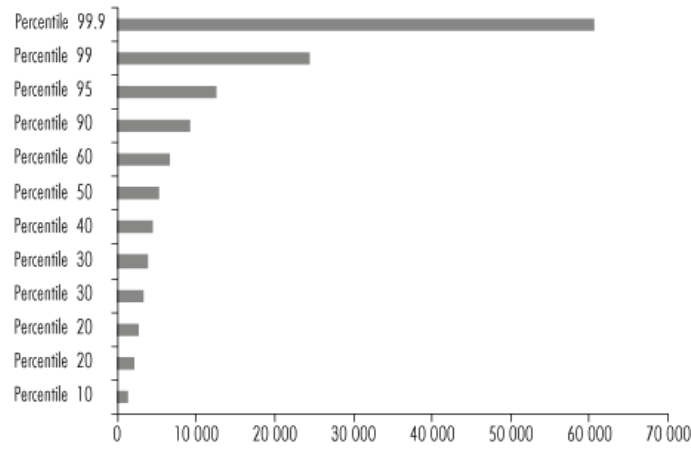
	Abbreviation	Average	Maximum	Minimum	Standard deviation
Number of hours worked	HW	42.4	46.3	37.9	1.6
Informality rate	TIL2	53.8	74.1	32.9	10.11
Percentage of wage earners	TA	61.9	78.7	35.9	9.15
Efficiency wage	WO	-1.19	-0.81	-1.53	0.13

Source: compiled by the authors using data from INEGI-ENOE (2018).

Table 1 presents income distribution as percentages. It can be seen that, in the highest distribution percentile rank, the highest-earning 0.1% of the population receive a remuneration of \$60,547.2 MXN with the average income of the highest 1% of wage earners being \$24, 423.7. On the other hand, the average minimum monthly income for the period 2005-2014 is \$1, 648.3, while the average income of the 10<sup>th</sup> percentile is \$1,379.8 MXN. This means that the average income of the 10<sup>th</sup> percentile is lower than the average minimum wage by \$268.58 MXN. The variability in income distribution across the different deciles can be seen in figure 1.

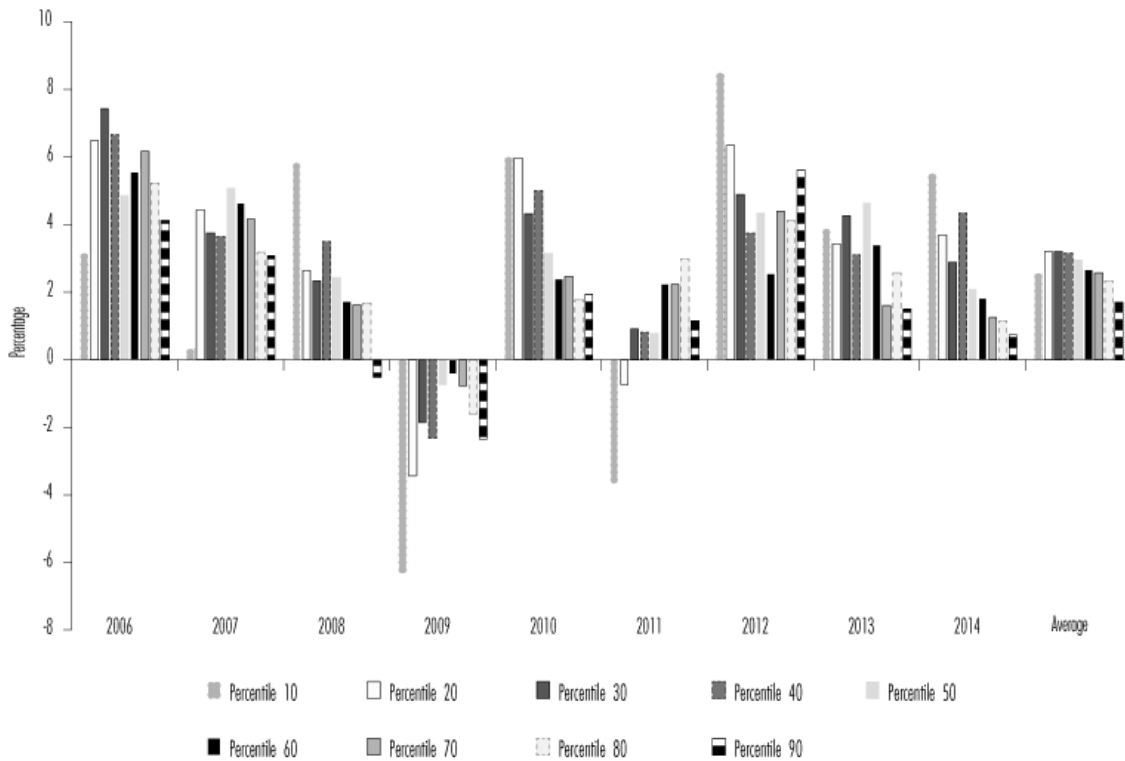
Figure 2 shows that, although there is little variation in real wages during the study period, there is a more visible variation in income between deciles. The figure shows an income growth rate across the 10<sup>th</sup> to the 90<sup>th</sup> percentiles during 2006-2014. In 2009 all percentiles demonstrated a negative growth rate followed by a moderate recovery in 2010. The 10<sup>th</sup> percentile was most highly affected, experiencing a growth rate of -6.3%. In 2011, the 10<sup>th</sup> and 20<sup>th</sup> percentiles recorded a growth-rate of -3.65 and -0.74%, respectively. Finally, the 10<sup>th</sup> percentile experienced its highest growth rate in 2012, reaching 8.48%. The second highest growth rate occurred in 2006 and was recorded at 7.41%.

Figure 1. Average income by percentile, 2005-2014



Source: compiled by the authors using data obtained from INEGI-ENOE (2018).

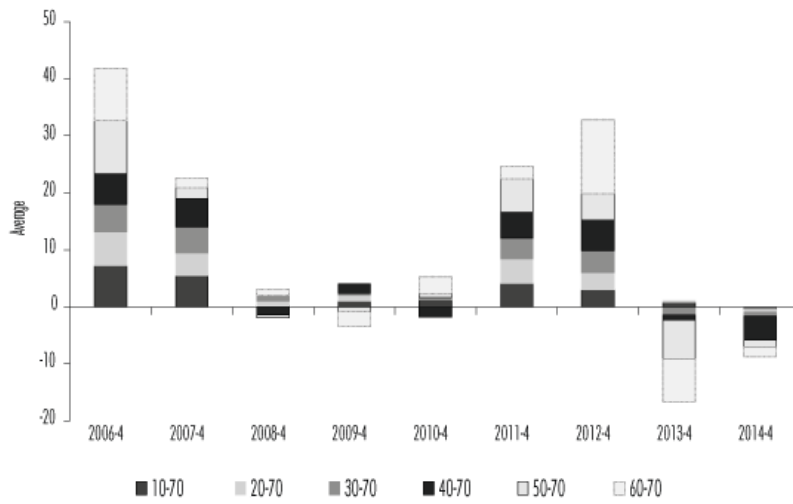
Figure 2. Income growth rate by percentile



Source: compiled by the authors using data obtained from ENOE

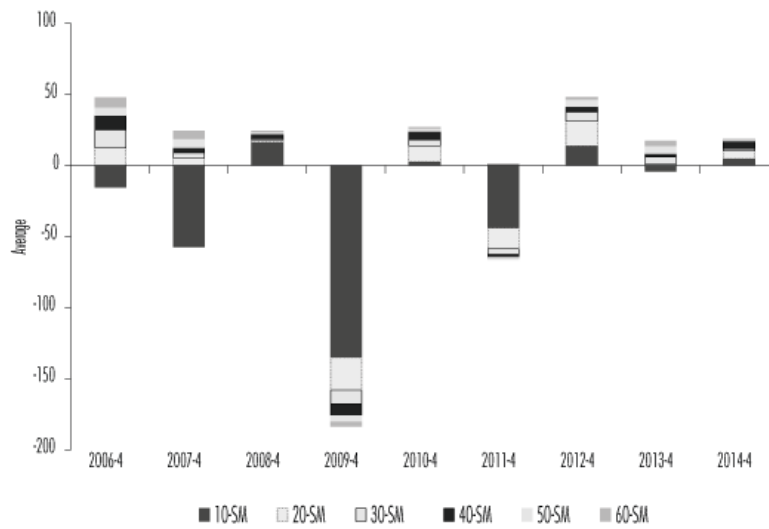
Figures 3, 4, and 5 show the variation of growth in income differences, the variation in the efficiency wage growth rate, and variation in the informal employment growth rate. In figure 3, a fall in the growth rate of income differences can be observed in 2008, 2009, and 2010. Similarly, as can be seen in figure 4, this fall coincides with negative growth rates in wages. Inversely, the same period saw a growth in informal employment, as can be seen in figure 5. This suggests that informal employment could reduce income differences by serving as an alternative to the low wages in the formal sector.

Figure 3. Panel on the growth rate of differences in income, 2006-2014



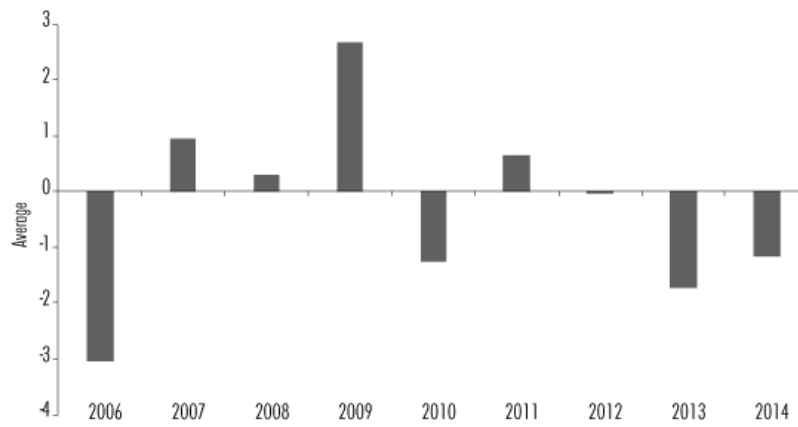
Source: compiled by the authors using data obtained from ENOE.

Figure 4. Panel on the growth rate of the efficiency wage, 2006-2014



Source: compiled by the authors using data obtained from ENOE

Figure 5. Panel on the growth rate of informal employment, 2006-2014



Source: compiled by the authors using data obtained from ENOE

Table 2 displays the outcomes of the estimate made using OLS with fixed effects for the first four deciles. The findings from sample F suggest that, as a whole, all parameters in the models are statistically significant (SS). The Durbin-Watson statistic does not find any evidence of autocorrelation between errors.

Table 2. Impact of the minimum wage on income differentials deciles 1-4, using OLS

<i>Variable</i>	<i>Parameter</i>	<i>10-70 Difference</i>	<i>20-70 Difference</i>	<i>30-70 Difference</i>	<i>40-70 Difference</i>
Intercept	$\beta_0$	-0.863182 (.2134)	-0.971970** (.0314)	-1.057584*** (.0050)	-0.632936* (.0651)
W0	$\beta_1$	0.392261*** (.0001)	0.530740*** (.0000)	0.388220*** (.0000)	0.459841*** (.0000)
W02	$\beta_2$	0.003492 (.9411)	0.112114*** (.0003)	0.076911** (.0028)	0.085185*** (.0003)
HW	$\beta_3$	0.015315* (.0820)	0.010288* (.0720)	0.009612** (.0028)	0.007122 (.1014)
TA	$\beta_4$	-0.000953 (.6986)	0.002183 (.1725)	-0.001156 (.3845)	-0.000506 (.6769)
TIL2	$\beta_5$	-0.009656*** (.0014)	-0.006187*** (.0016)	-0.005751*** (.0004)	-0.003827*** (.0102)
Determination coefficient	$R^2$	.92	.92	.86	.82
F Statistic	F	88.8	80.3	43.6	32.6
Durbin-Watson statistic	DW	1.87	1.77	1.46	1.69

Note: \*\*\* 1% SS, \*\* 5% SS and \* 10% SS.

Source: Compiled by the authors using data obtained from ENOE. Probability values are between parenthesis.

It is worth highlighting that each entry in Tables 2 and 3 relates to the coefficient for each variable of the regression between each difference in income regarding the seventh decile, which acts as a pivot for state and year. The estimates are made using OLS with fixed effects using data obtained from ENOE.

Table 3. Impact of the minimum wage on income differentials deciles 5-9, using OLS

Variable	Parameter	50-70 Difference	60-70 Difference	80-70 Difference	90-70 Difference
Intercept	$\beta_0$	-0.059965 (.8429)	0.536244* (.0617)	0.912822* (.0063)	1.836376*** (.0000)
WO	$\beta_1$	0.459911*** (.0000)	0.337629*** (.0000)	0.275623*** (.0000)	0.348419*** (.0000)
WO2	$\beta_2$	0.076945*** (.0002)	0.063931*** (.0012)	0.044666** (.0495)	0.080556*** (.0066)
HW	$\beta_3$	0.003858 (.3149)	-0.000828 (.9818)	0.001131 (.7882)	-0.000303 (.9559)
TA	$\beta_4$	-0.002074** (.0544)	-0.002584*** (.0114)	-0.002632** (.0262)	-0.004042*** (.0087)
TIL2	$\beta_5$	-0.002929** (.0261)	-0.002246* (.0707)	-0.002517* (.0809)	-0.003576** (.0564)
Determination coefficient	$R^2$	.73	.45	.4	.67
F Statistic	F	18.97	5.87	4.7	14.42
Durbin-Watson statistic	DW	1.69	1.62	1.9	1.78

Note: \*\*\* 1% SS, \*\* 5% SS and \* 10% SS

Source: Compiled by the authors using data obtained from ENOE. Probability values are between parenthesis.

The data contained in Tables 2 and 3 show that the efficiency wage variable has a positive sign and is 1% SS across all income differences. Therefore, a 10% increase in the *WO* variable results in increases of 3.9%, 5.3%, 3.8%, 4.5%, 4.5%, 3.3%, 2.7% and 3.4% for income differences 10-70, 20-70, 30-70, 40-70, 50-70, 60-70, 80-70 and 90-70, respectively.

Likewise, the quadratic term of the efficiency wage has a positive sign and is SS across all income differences, with the exception of the 10-70 difference. *HW* is only significant for the first three income differences and has a positive sign, which was not expected. The *TA* variable is SS for differences 50-70, 60-70, 80-70 and 90-70, and presents a negative sign, which was not expected. The *TIL2* variable is SS and exhibits a negative sign across all differences. A 10% increase in the *TIL2* variable results in a decrease of 0.09%, 0.06%, 0.05%, 0.03%, 0.02%, 0.02%, 0.02% and 0.03% for income differences 10-70, 20-70, 30-70, 40-70, 50-70, 60-70, 80-70 and 90-70, respectively.

Findings show that the greatest impact of take-home wages is observed in the first three percentiles. A lesser positive effect can be observed in the remaining percentiles. In other words, the findings suggest a positive relation between the minimum wage and differences in income earnings. However, division bias could be interfering with these results, as touched upon by Au-tor *et al.* (2016). Therefore, a robustness test was conducted by making an estimation using GMM.

The outcomes of the econometric estimate conducted using GMM are shown in table 4. They show that the parameter coefficients are positive across all income differences for the *WO* variable. This means that a 10% increase in wages results in a 2.4% increase in differences in income earnings in the 10-70 difference. The highest value for the *WO* variable's determination coefficient was 3.2, occurring in the 30-70 income difference. The lowest value in the determination coefficient for the *WO* variable is 0.9%, occurring in the 90-70 difference. On the other hand, the *WO* variable is 1% SS across all income differences with the exception of 80-70 and 90-70. A decrease in the *WO* coefficients can be noted starting after the first three deciles. This was an expected outcome, as it is assumed that the effect of the minimum wage on income differences should disappear as we approach the 70<sup>th</sup> decile.



Table 4. Impact of the minimum wage on income differentials deciles 1-4, using GMM

Variable	Parameter	10-70 Difference	20-70 Difference	30-70 Difference	40-70 Difference
WO	$\beta_1$	0.242819** (.0468)	0.228573*** (.0012)	0.329912*** (.0000)	0.215500*** (.0000)
WO2	$\beta_2$	-0.104078 (.3260)	-0.045369 (.4574)	0.015301 (.7251)	-0.000536 (.9883)
HW	$\beta_3$	-0.008441 (.1981)	-0.009442** (.0128)	-0.005906** (.0289)	-0.007872*** (.0006)
TA	$\beta_4$	0.004331* (.0599)	0.005360*** (.0001)	0.003723*** (.0001)	0.004133*** (.0000)
TIL2	$\beta_5$	-0.016764*** (.0000)	-0.009481*** (.0000)	-0.004974*** (.0000)	-0.002786*** (.0000)
Determination coefficient	$R^2$	0.46	0.54s	0.41	0.36
F Statistic	F	88.8	80.3	43.6	32.6
Durbin-Watson statistic	DW	0.27	0.39	0.34	0.54

Note: \*\*\* 1% SS, \*\* 5%SS and \* 10% SS

Source: Compiled by the authors using data obtained from ENOE. Probability values are between parenthesis.

The coefficients for the *WO2* variable are not statistically significant, with the exception of the 90-70 difference. The *HW* variable is 5% SS in the 20-70 and 30-70 differences and 10% SS in the 40-70, 50-70, and 60-70 differences. All the aforementioned differences have coefficients with a negative sign, which implies that an increase in this variable would result in a reduction in differences in income earnings. A 10% increase in this variable in the 20-70 and 30-70 differences results in a decrease of 0.09% and 0.05% in income differences, which are the highest values.

The percentage of wage earners is calculated using the *TA* variable, which is SS across all differences with the exception of the 80-70 difference. The *TA* variable is 10% SS for the 10-70 difference, and 1% SS for the 20-70, 30-70, 40-70, 50-70, and 60-70 differences. An increase of 10% in the *TA* variable for the 10-70 difference produces an increase of 0.04% in differences in income earnings.

A 10% increase in the *TA* variable results in an increase of 0.05%, 0.03%, 0.04%, 0.03%, and 0.01% in the 20-70, 30-70, 40-70, 50-70, and 60-70 differences, respectively. The *TA* variable is 5% SS in the 90-70 difference and an increase of 10% in this variable produces a 0.01% increase in income differences.

The *TIL2* variable is SS across all differences and has a negative sign in all but the 60-70 difference. An increase in this variable results in a decrease in differences in income earnings. The highest value is the 0.09% decrease in the 10-70 difference, while the lowest value is the 0.02% in the 60-70 difference. Additionally, it can be observed that the results from the J statistic serve to validate the instruments employed.

Each entry in tables 4 and 5 relates to the coefficient for each regression variable between each income gap in regards to the seventh decile by state and year. Estimates are made using GMM with data obtained from ENOE.

Table 5. Impact of the minimum wage on income differentials deciles 5-9, using GMM

Variable	Parameter	50-70 Difference	60-70 Difference	80-70 Difference	90-70 Difference
WO	$\beta_1$	0.153314*** (.0000)	0.096911*** (.0000)	-0.030353 (.2780)	-0.043108 (.3683)
WO2	$\beta_2$	-0.005979 (.8300)	0.025563 (.2080)	0.010338 (.6708)	0.107532** (.0103)
HW	$\beta_3$	-0.006389*** (0.0002)	-0.004028*** (0.0015)	0.002089 (.1656)	0.003432 (.1835)
TA	$\beta_4$	0.003088*** (.0000)	0.001645*** (.0002)	0.000241 (.6477)	0.001697** (.0609)
TIL2	$\beta_5$	-0.001144** (.0112)	-0.000478 (.1440)	0.001054*** (.0075)	0.001783*** (.0082)
Determination coefficient	R <sup>2</sup>	.29	.15	-.02	-.03
F Statistic	F	18.97	5.87	4.7	14.42
Durbin-Watson statistic	DW	1.69	1.62	1.9	1.78

Note: \*\*\* 1% SS, \*\* 5%SS and \* 10% SS

Source: Compiled by the authors using data obtained from ENOE. Probability values are between parenthesis.

According to the proposed robustness tests, the determination coefficients for the 80-70 and 90-70 differences are close to zero, which validates the findings. The second robustness test is the control variables with positive signs for the *TA* variable, an outcome which was expected, and a negative sign for the *HW* variable, which was also expected, in accordance with the findings obtained in the estimation made using GMM.

Tables 4 and 5 show the correlation coefficients for *WO* decrease in relation to the coefficients obtained from the same variable shown in Tables 2 and 3. This is due to spurious positive correlation, a problem alluded to by Autor *et al.* (2016) and one that can be corrected by estimating the model using GMM. Table three contains coefficients with lower values and, in the case of 80-70 and 90-70, the coefficients are not SS.

The findings from the GMM estimation validate the findings of the OLC with fixed effects estimation, namely the existence of a positive relationship between the minimum wage and differences in income earnings. Additionally, this validates the evidence which suggests the existence of a negative relationship between informal employment and income differences in Mexico.

## 6. CONCLUSIONS

One of this paper's main findings suggests that the minimum wage has a direct incremental effect on differences in income earnings. This finding was obtained from the econometric estimate. In other words, it was found that an increase in take-home wages results in an increase in income inequality. The findings suggest that the positive effect is stronger for the first three percentiles of the distribution. In other studies, focused on developing countries, primarily in Latin America, such as Maloney and Nuñez (2000) and Neumark *et al.* (2006), it was found that the impact of the minimum wage is higher on the low end of distribution. On the other hand, there was no evidence in favor of the hypothesized negative relation between the minimum wage and differences in income earnings. These findings concur with the studies by Bosch and Manacorda (2010) and Autor (2016), which both find that the minimum wage increases differences in income, the former focusing on Mexico with the latter focusing on the U.S.A. Lin and Yin's (2016) study, meanwhile, finds that income differences decrease as the minimum wage rises in the case of China. The authors used a Censoring Model to identify the effect of the minimum wage on differences in income. Additionally, the authors also made use of income microdata obtained from ENOE to construct a database covering the state level. Two econometric estimates were carried out: the first using OLS with fixed effects and the second used GMM as a robustness test, with the percentage of wage earners and the number of hours worked serving as control variables. In regards to the percentage of wage earners, it was found that this variable increases income differentials across all differences and also has the predicted sign. The number of hours worked is an indicator of the quantity of work carried out and was found to be SS across all differences with the exceptions of 80-70 and 90-70. This variable reduces income differences and also has the predicted sign.

On the other hand, the findings suggest that the size of the informal sector has a reducing effect on differences in income earnings. That is to say, findings suggest that income inequality reduces as the size of the informal sector grows. This effect can be seen across all differences in income earnings. Findings substantiate the hypothesis of a negative relation between informal employment and differences in income earnings. This contradicts the findings from the studies by Zuo (2016), Xue *et al.* (2014) and Bologna (2016). The studies by Zuo (2016) and Xue *et al.* (2014) analyse the effect of the informal sector on income inequality on China, finding that the informal sector can explain a large share of income inequality. Similarly, Bologna (2016) analyzes the effect of corruption and the informal sector on income levels in Brazil, finding that the informal sector is linked with lower levels of income. It is worth noting that these findings are limited to the study period and the sample considered in the estimate. In addition, future studies will be able to enrich the debate by considering institutional factors, as well as political and economic ones, and their bearing on the impact of the minimum wage.

It was also found that the informal sector could have softened the adverse effects of the 2008 global financial crisis.

Following on from Gindling (2014), increasing minimum wages is inefficient in reducing income inequality. More efficient policies could be orientated around ensuring legal minimum wages are adhered to and raising wages in the informal sector, where minimum wages do not increase workers' productivity from low-

income households in the long-term. These areas could be explored in future studies.

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