The Unintended Distributional Consequences of the 2012 Rise in The Mexican Minimum Wage

Jorge Bouchot [1]

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Keywords: Minimum Wage, Earnings Distribution, Spillover Effects

Jel Codes: J38, J32, J23

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1 Introduction

Even though the discussion surrounding the impact of minimum wages is often focused on employment effects, the goal of any minimum wages policy is not to affect the level of employment, but to set an earnings floor for workers, and possibly, to reduce inequality. The objective of this paper is twofold: to evaluate if as a consequence of a minimum wage increase in Mexico there is actually an impact on the lowest segment of the earnings distribution, and to verify the existence of spillover effects on higher income workers and spillover effects on the informal

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labour market. To estimate the effect at different points of the earnings distribution we implement unconditional quantile regressions, developed by Firpo et al. (2009), exploiting a natural experiment setting in which in 2012 there was a minimum wage increase in only one out of the three minimum wage zones in Mexico.

We find evidence of positive wage effects on the whole earnings distribution. For the percentiles at the bottom of the distribution the impact is small, but still statistical significant with an elasticity of 0.34. Yet, unconditional quantile regressions reveal income-increasing spillover effects (with elasticities up to 1.9), which increases wage dispersion. To our knowledge, this is the first study documenting spillover effects at the top of the earnings distribution. The Mexican labour market constitutes a unique case in which wages and prices are legally tied to the value of the minimum wage (Fairris et al., 2008; Woodruff, 1999).[1]

With more than 60% of the labour force working under informal conditions, it is essential to consider the informal labour market in the analysis. Our estimates on the earnings distribution for informal workers suggest no effects below the median, although there is a strong positive effect in the rest of the earnings distribution. These findings are in line with previous empirical studies (Lemos, 2009; Khamis, 2013), but not with the only theoretical model that embodies both the formal and informal sectors: the *Welch– Gramlich–Mincer Two Sector Model* (Welch, 1974; Mincer, 1976; Gramlich et al., 1976).

This model, in the presence of an uncovered sector —in this case workers under informal conditions— predicts opposite effects in both sectors. In the formal sector the model predicts a positive effect on wages and a negative impact on employment. In contrast, in the informal sector the wage effect is predicted to be negative (Gramlich et al., 1976), and positive on the level of employment. In this paper we find no evidence of negative effects on any point of the wage distribution, on any of the labour markets.[2]

It is therefore important to verify the effects of the minimum wage policies, both directly and via potential spillover eects, on the level of earnings at all points of the earnings distribution. This paper does this, but also considers the specific characteristics of labour market in a developing country. These include an important share of the labour force under informality conditions, and a particular wage setting in which a set of earnings and benefits are tied to the value of the minimum wage. This empirical evaluation extends the minimum wage literature by demonstrating the existence of income-increasing spillover effects in the Mexican labour market.

The econometric model relies on unconditional quantile regressions. This novel and useful procedure developed by Firpo et al. (2009), is estimated using a re-centered influence function

[1] Until 2016, many forms of benefits and remunerations in the formal and informal sector were tied to multiples of the minimum wages including, for instance, pensions, productivity bonuses, grants for graduate students, among others.

[2] Our research in progress, using also the 2012 minimum wage intervention, suggests that the effect of raising minimum wages is to raise employment in the formal sector and lower it in the informal sector. Thus, formal and informal labour markets are interdependent, they constitute complementary markets where a non-homogeneous labour force chooses and competes for positions.

that offers the analytical advantage of estimating directly marginal effects at any point of the dependent variable's distribution. In consequence, it also allows us to test straightforwardly the existence of spillover effects. Before the development of this technique, previous studies —exploiting differentiated minimum wage settings at the state level in the US— had to use alternative specifications to estimate the minimum wage effect on the state' log-difference of real earnings between percentiles ($w_{p50} - w_{p10}$) (Lee, 1999). The importance of unconditional quantile regressions for our analysis for Mexico is precisely that the lack of changes to the minimum wage at the state level did not allow the use of the state' earnings differential between percentiles as a dependent variable.[3]

By pooled difference in differences specifications and with data from the National Survey on Employment and Occupation (ENOE), for the period 2012Q1-2013Q4, our results suggest that the minimum wage harmonization in 2012 had the weakest wage effects on the lowest percentiles of the distribution, while the institutional setting framework led to spillover effects that increased wage dispersion. The results are robust to different econometric specifications, particularly to the period of analysis, to the control group used and to the exact specification of the difference in differences variable. This corroborates the existence of income-increasing spillover effects in the formal and informal labour market.

The following section presents the literature review on the distributional effects of minimum wages. The institutional framework of the minimum wage regulations is discussed in Section 3. The data source and some descriptive statistics on wage distribution are presented in Section 4. The econometric specifications and the estimation method are described in Section 5. The main results, some falsification tests, and the discussion of the estimates are presented in Section 6. The last section concludes the paper.

2 Literature Review

Although the discussion on the implications of minimum wages has focused mainly on employment effects, there is also much research on the distributional impacts of minimum wages arguing the case for the existence of wage spillover effects. Empirical research during the decade of the 90's demonstrated that the loss of purchasing power of the real minimum wage in the United States was largely responsible of the rise in wage inequality (DiNardo et al., 1996; Lee, 1999). Wage dispersion increased, but not only in relation to the bottom of the distribution, also in percentiles beyond the minimum wage threshold, which revealed the existence of spillover effects. More recently, Autor et al. (2016) reassessed Lee's estimates concluding that although the effect of minimum wage on inequality is significant, and it is not possible to deny the presence of wage spillover effects, its magnitude is lower than estimates in the decade of

[3]Minimum wages zones in Mexico are set at the municipality level depending on their economic development, not their geographic location. Thus, one state can have all the three wage zones, which restricts the use of states for the construction of control and treatment groups.

the 90's (at most up to the fourth decile of the distribution).

The structure of labour markets in developing countries is however different. Previous empirical studies for Latin America have found stronger minimum wage spillover effects,[4] and it is necessary to extend theoretical models to characterize the informal sector.

The *Welch–Gramlich–Mincer Two Sector Model* has been used to characterize a sector outside the covered sector, in this case formal and informal labour markets (for instance, in Lemos, 2004, 2009; Mora and Muro, 2017). Assuming homogeneous labour and perfect competition, this model predicts that the introduction (or an increase) of the minimum wage reduces the level of employment in the covered sector. A fraction of those workers not hired in the covered sector can find a job in the uncovered sector, but the existence of the uncovered sector only partially offsets the employment loss. The wage in the uncovered sector may rise (Mincer, 1976; Gramlich et al., 1976) or fall (Welch, 1974) depending on the assumptions with respect to the possibility of the workers of choosing between covered or uncovered sectors.

Lemos (2009) showed that there were positive minimum wage spillover effects in both sectors for the Brazilian labour market. She argued that opposite results to the *Welch–Gramlich–Mincer Two Sector Model* are explained by the lack of segmented labour markets. Formal and informal sectors could be integrated offering different kind of jobs, which heterogeneous workers can choose from.[5] For Argentina, Khamis (2013) found that wages in the informal labour market were affected by a greater proportion than the formal sector after the minimum wage increase of 1993. This reinforces the idea that minimum wage constitutes a reference rate for remunerations even in non-compliant sectors.

Nevertheless, not all the studies in Latin America find significant effects in the informal sector. Using a similar specification to Lee (1999), Borraz and Gonzlez-Pampillón (2017) found evidence that the minimum wage hikes in Uruguay during the decade of the 2000's (which more than doubled the real minimum wage) increased real monthly wages up to the seventh decile of the earnings distribution, but only in the formal labour market. Similarly, Bosch and Manacorda (2010) demonstrated that real minimum wage reduction in Mexico explained most of the growth of earnings inequality for the period 1989-2001, finding also evidence that minimum wage can affect earnings up to the sixth decile of the earnings distribution, but they failed to find a significant effect on informal workers. However, the main caveat of their analysis is that in the absence of a structural change in the minimum wage for that period, they instrumented the called 'effective minimum wages' using social security data. Thus, they took the erosion of the real minimum wage as exogenous, which is not necessarily true. Moreover, the database used was restricted to urban areas, impeding to observe a significant segment of the informal labour market.

Thus, while the previous literature for Latin America recognizes the existence of spillover

[4]See for example, Maloney and Mendez (2004) and Maurizio (2014) for comparative studies evaluating the implemented policies in the region aiming at the recovery of the real value of the minimum wages.

[5]These results are in line with previous estimates that concluded that minimum wage in Brazil compressed the earnings distribution for both, formal and informal sectors (Lemos, 2004; Fajnzylber, 2001; Carneiro, 2000)

effects even larger than those estimated in industrialized countries (in some cases, also in the informal labour market), in all cases these spillover effects are decreasing in earnings. By the implementation of unconditional quantile regressions, we show that the 2012 minimum wage increase in Mexico affected earnings along the entire distribution. Moreover, the strongest impacts are observed at the top of the earnings distribution in the formal and informal labour markets.

Related to the use of unconditional quantile regressions to evaluate the distributional effects of minimum wage policies, there are two previous studies. Hallward-Driemeier et al. (2017) found evidence of spillover effects in an evaluation of the minimum wage impact on gender gap in Indonesia. Minimum wage increased female earnings up the fifth decile, but no effects were found on the male earnings distribution. Controlling by educational attainment, they found positive effects on workers with at least a high school degree, up to the seventh decile for woman and up to the ninth decile for men. On the other hand, Aeberhardt et al. (2015) exploited the coexistence of several minimum wages in France between 2003 and 2005. They found that the minimum wage increase had positive impacts over a large part of the distribution: up to the seventh decile for men and up to the fifth decile for women, but the effect was decreasing in earnings. Although our estimation method is the same, the identification strategy is not. We use regional differences in the minimum wage setting, while their strategy relies on temporal differences in the adoption of new minimum wage regulations.

3 Policy context: minimum wages as a reference rate

This section describes the institutional framework in Mexico that gives place to the use of the minimum wage as a reference rate, and in consequence can affect the wage setting for workers with higher remunerations than the minimum wage.

During the decade of the 1980's there were policies designed to give minimum wages the function of controlling wages. In 1987 the annual inflation rate reached the highest level ever recorded: 159.17%. As a response, the government implemented a set of stabilization policies, among them the *Economic Solidarity Pacts* and the so called *Incomes policies*, having as a central objective to stop the raising inflation, by restraining wages and prices.

The Pact was signed on 15 December 1987 by the government, and representatives of workers, employers, and agricultural producers. The main characteristics of the agreement were fiscal cuts, tighter monetary policy, trade liberalization, and a comprehensive income policy (Lustig, 2000). It was essential to control wage increases as a mechanism to suppress further rises in commodity and service prices as an instrument also to stop increases in government payroll expenses (Fairris et al., 2008). The target of the wage policies was focused directly on minimum wages.

Even though the agreements on wages increases included in the *The Pact* were applied only

to minimum wages, the variations were proposed as a general 'guide to salary negotiation' (Woodruff, 1999). For instance, the document of the first renewal of the agreements in February 1988 by the Mexican Presidency explicitly states "The business sector will raise contractual salaries to the same extent that minimum wages are increased" (as cited in Woodruff, 1999).

According to the goals set, the stabilization policies were successful. In December 1988 the annual inflation rate was 51.66% and one year later was 19.70%. These agreements were renewed and maintained until 1995, in which annual inflation rate was 7.05%. Even though the key objectives evolved towards strengthening the macroeconomic stability and boosting the economic growth, inflation containment remained as a priority. As a consequence the use of minimum wages also remained as a an instrument of wage setting.

Although episodes of hyperinflation had been overcome, the policy on minimum wages for wage control did not change. In contrast, the use of the minimum wage as a reference rate was taken to different ways of remuneration, not only wages. This include the setting of social security fees, pensions, scholarships for graduate students, productivity bonuses and retirement benefits for teachers, eligibility for housing credits, income tax brackets, and even traffic fines.

By the end of 2015, there were 216 legal regulations, only at the federal level that considered the prevailing value of the minimum wage as a reference rate. Under this framework in which minimum wages are used as an index or 'nummeraire' to determine other remunerations and other prices, changes to the minimum wage level can have repercussions on workers earning beyond the minimum wage level.

Thus, the referencing of the minimum wage in Mexico came about from a need to impose discipline on wage negotiations at different levels and occupations. So that the role of minimum wages as a reference rate, while it may have helped to moderate prices may also heave contributed to exacerbate difficulties in the public policies implementation.

This legal framework remained in force until January 2016 when it was reformed. As part of the discussion on the importance of the implementation public policies to recover the value of the real minimum wage level (Gob.Distrito-Federal, 2014), it was recognized that the first stage before increasing the minimum wage value, was to 'de-index' it from any other form of retributions, earnings or prices. Thus the National Congress passed the 'Decree on the de-indexation of the minimum wage' on 27 January 2016.

Given that the Zone's B minimum wage increase under evaluation took place in 2012, before the 'de-indexation reform', it is expected that its impact on the wage earnings have significant effects on workers above the minimum wage level, as our results demonstrate in Section 6.

4 Data and descriptive statistics

Data were retrieved from the National Survey on Employment and Occupation (ENOE), which contains quarterly information at the individual level. The National Institute of Geography and Statistics (INEGI) is in charge of collecting and publishing the official data on formal and informal employment. In this regard, one of the main advantages of this database is that it is not limited to the formal labour market; it interviews a representative sample (at the national and the state level) of individuals aged 12 independently of employers. We focus on the period 2012Q1-2013Q4, although in Section 6.2 we implement some falsification tests for the period 2011Q1-2012Q4.

We exploit this information to explore the spillover effects of the minimum wage increase not only on workers above the minimum wage level, but also on the 'uncovered' informal sector, in which by definition minimum wage regulations are not enforced.

The dependent variable is the recentered influence function[6] of the logarithm of the hourly real wage.[7] Given that the estimates are focused on the impact at different points of the earnings distribution, we only consider individuals reporting non-zero earnings.

There are two restrictions imposed on the sample. First, following previous research on wage distribution effects of minimum wage changes, self-employed workers are excluded (Lee, 1999; Autor et al., 2016) independently of their formality condition. Second, in line with the procedure by Autor et al. (2016), to reduce the influence of the outliers, the data *winsorizes* the extreme 0.2 percentiles of the wage distribution by assigning the 0.02 and 99.8 percentile value to the respective extreme quantiles. These modifications do not alter significantly the estimates obtained, nor the conclusions of the analysis.

It is important to discuss a crucial limitation of the data. Workers with the highest level of earnings are not properly captured in the survey. One of the major disadvantages of surveys at the household level is that top income households are sub-represented, so aggregate earnings tend to be underestimated. ENOE has the particular problem that non-response observations on wages have increased, going from 14% in 2005 to 25% in 2013 (Rodríguez-Oreggia and López-Videla, 2015). And more importantly, non-responses are not independent of socio-demographic features. More educated workers are precisely those who do not respond to earnings questions. (Campos-Vázquez et al., 2013; Rodríguez-Oreggia and López-Videla, 2015). For our analysis, this implies that we by and large do not observe top-income earners.

Table 1 illustrates this, by detailing the average wage by monthly earnings deciles. The monthly minimum wage corresponds to $1,866 MXN (average weighted by zones' labour force), hence median earnings ($4,019.04 MXN, $246.10 USD for comparison purposes) are just 2.15 times the minimum wage. Regarding mean wage of the 9th decile ($9,38.34 MXN), this corresponds to 4.94 times the minimum wage. So, when we talk about top-income individ-

[6]The details of the estimation of the recentered influence function are explained in Section 5.1.

[7]Nominal wages in ENOE are deflated using the National Price Index, also obtained from INEGI.

uals, we are not referring to the richest in Mexico, nor to white-collar workers.

Table 1
Mean earnings by deciles, 2012-2013
(constant pesos (MXN) of 2010)

Earnings deciles by ln(monthly wage)	ln(hourly wage)	Monthly wage (MXN)	Monthly wage (USD*)
1	2.5871	1,714.67	105.00
2	2.6642	2,459.47	150.60
3	2.8179	3,057.13	187.20
4	2.8876	3,565.07	218.30
5	3.0081	4,019.04	246.10
6	3.1288	4,742.20	290.38
7	3.3441	5,540.70	339.28
8	3.6135	6,702.81	410.44
9	3.9228	9,238.34	565.69
Mean	3.1021	5,038.46	308.52

Source: own computations with data from ENOE. Self employed workers are excluded. Earning population values were computed using expansion factors.
*Computed using the average exchange rate for 2012-2013 (13.004 USD/MXN).

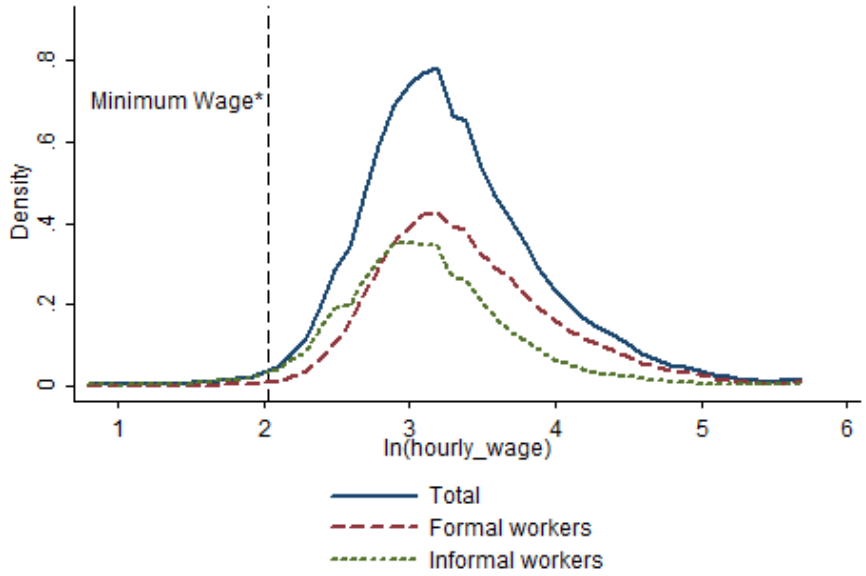
In spite of this data limitation, we are able to accomplish the two objectives of the paper: to evaluate the impact at the bottom of the distribution and to investigate the presence of spillover effects. Moreover, ENOE has the fundamental advantage of including the informal labour market. Restricting the analysis to formal workers, by using data from social security services, for instance, would provide an incomplete and possibly biased analysis of the Mexican labour market.

Finally, Figure 1 plots the kernel density estimates[8] of the real log-hourly wages for treated Zone B (self-employed workers are not included). The earnings distribution is also decomposed into the weighted sum of the densities of formal and informal workers.

The dotted vertical line expresses the minimum wage considering a workday of 8 hours. So, the first issue to emphasize is that in the Mexican labour market there are actually workers with earnings below the minimum wage, in both formal and informal labour markets. Secondly, as expected, informal workers are grouped in lower levels of remunerations in comparison to the formal counterpart.

[8]Epanechnikov kernel using the optimal cross validation bandwidth (Silverman, 1986) computed by the following calculation: $h = 0.9\min(\sigma, IQR/1.349)n^{-1/5}$. Where σ is the standard deviation of the log hourly real wages and IQR denotes the interquartile range. Self-employed workers are not included in the analysis, and the data *winsorizes* the extreme 0.2 percentiles of the wage distribution by assigning the 0.02 and 99.8 percentile value to the respective quantiles.

Figure 1
Wage distribution density estimates by formality condition, Zone B
(pooled sample, 2012-2013)



* Average minimum wage weighted by active labour market population by zones.

Appendix A presents some descriptive analysis on earnings' mean and variance trends and their relationship with the minimum wage setting. It also analyses as the evolution of some selected wage gaps to provide an additional description of the earnings distribution in the Mexican labour market.

4.1 The intervention and pre-treatment trends

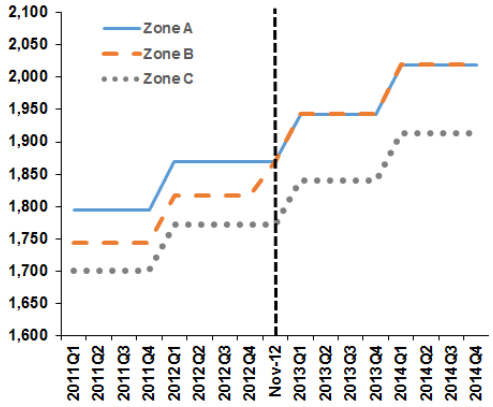
On November 26, 2012 the Council of Representatives of the National Council on Minimum Wages in Mexico announced an agreement between government, employers' organisations, and workers representatives to incorporate Zone B into Zone A. One day after the announcement, the legislation came into force. There were no expectations for this policy change, so it is not necessary to model anticipated responses by the labour market.

Panel (a) of Figure 2 shows the monthly minimum wages for the three different zones. In monetary terms, the increase observed in the former Zone B was $53.00 MXN, which represents a 2.9% rise. Panel (b) of Figure 2 shows the geographical distribution of the minimum wage zones valid until November 26, 2012. The minimum wage increase potentially affected 10.21% of the active labour market population in Mexico. As we can observe, the classification is not regional, it depends on the economic development of each municipality. For instance, all the municipalities in 21 out of 32 states belonged to Zone C. But, there are also cases where a single state can have municipalities classified in the three different wages zones, as Sonora in the northwest, and Tamaulipas and Veracruz in the east of Mexico.

In the absence of a randomized treatment allocation, an essential assumption to implement

Figure 2

The intervention and minimum wage zones



Source: own calculations with data retrieved from ENOE.

(a) Monthly minimum wage by zones (current Mexican pesos, 2010-2014)

Source: Own elaboration with information from CONASAMI.

(b) Geographical distribution of minimum wages zones until 2012

differences in differences estimations is that control and treatment groups have the same behavior before the intervention. That is, it is necessary to show the existence of parallel trends of the dependent variables in the pre-treatment period.

For our distributional analysis, in which the impact of the minimum wage intervention is evaluated at different points of the distribution, graphical inspection of wages at the means is not enough, so Figure 3 displays the graphical analysis of real hourly wage trends for different earnings deciles. Graphs show that there are not considerable differences in the period prior to the Zone's B minimum wage harmonization for any of the quantiles analysed. The distance between Zone B and control zones A and C remains practically constant for the period before the intervention (illustrated by the vertical dotted line).

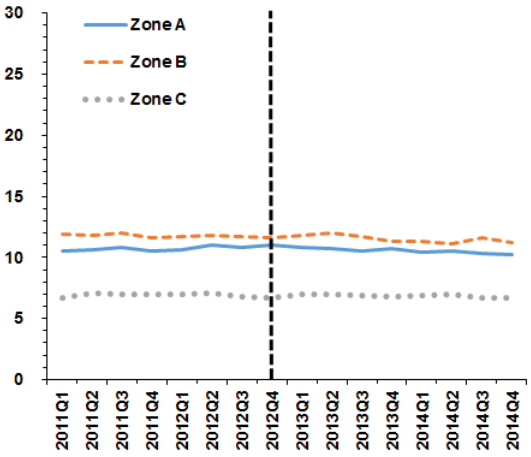
Anyway, it is possible to appreciate differences in wage trends only after the intervention for percentiles 75^{th} and 90^{th}. For the rest of centiles it is not possible to recognize differences in wages, which suggest that the treatment effects in the bottom part of the distribution should be small. The results presented in Section 6.1 corroborates this.

This descriptive analysis suggests that the implementation of differences in differences procedures is valid. Robustness exercises in Section 6.2 formally demonstrate that there are no differences between minimum wage zones before the intervention, which corroborates this descriptive visual inspection.

Figure 3

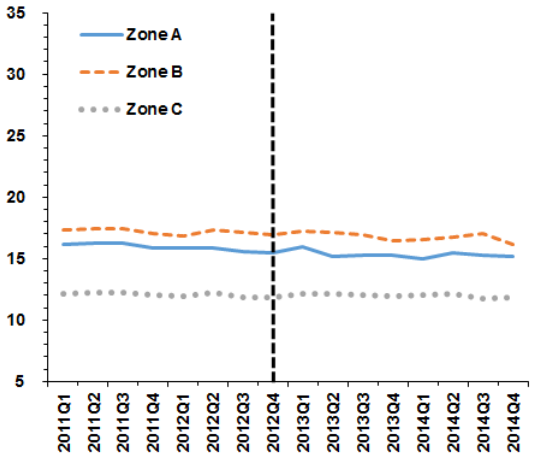
Real hourly wage trends by percentile and wage zones

(Mexican pesos of 1F December 2010)



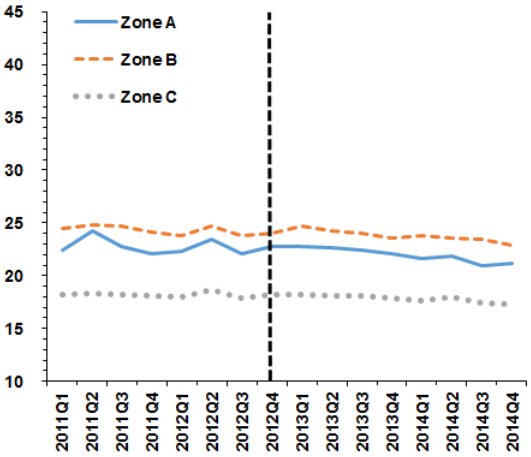
Source: own calculations with data retreived from ENOE.

(a) 10th percentile



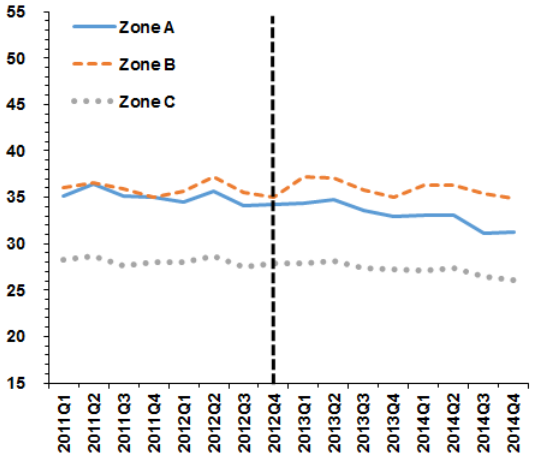
Source: own calculations with data retreived from ENOE.

(b) 25th percentile



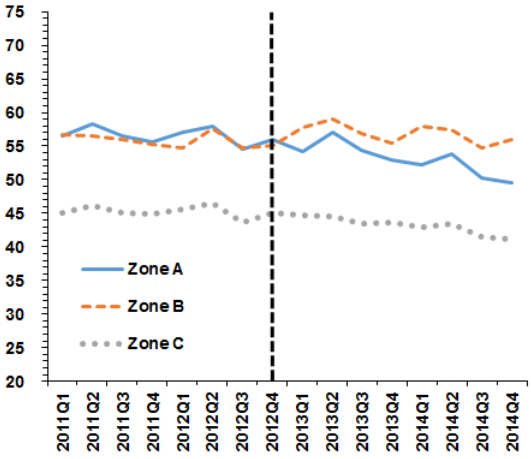
Source: own calculations with data retreived from ENOE.

(c) 50th percentile



Source: own calculations with data retreived from ENOE.

(d) 75th percentile



Source: own calculations with data retreived from ENOE.

(e) 90th percentile

5 Methodology

5.1 Unconditional quantile regression

Conditional quantile regression (CQR), developed by Koenker and Bassett (1978), became a useful empirical tool to characterize the full distribution of a certain outcome conditioned on a set of covariates. Nevertheless, the interpretation of the estimated parameters in a evaluation program setting is complicated; the coefficients do not translate to the relevant policy questions that are linked to the covariates, they do not summarize the causal effect of a treatment (Borah and Basu, 2013; Frolich et al., 2010).[9] This subsection describes the method recently proposed by Firpo et al. (2009), which allows us to evaluate how a marginal change in one variable —in this case, the minimum wage variation in Zone B— affects the entire wage distribution, keeping the distribution of the rest of covariates constant.

Formally, the aim is to estimate the effect of the minimum wage intervention, denoted as mw, on the τ^{th} quantile of the earnings unconditional distribution, $F_Y(y)$. In the OLS regression framework, the parameter δ is interpreted as the impact on the conditional mean: $\delta = d\mu(\text{mw})/d\text{mw} = \text{E}(Y|\text{mw}=1) - \text{E}(Y|\text{mw}=0)$.[10] In contrast, the coefficient δ_τ^{CQR} from conditional quantile regression analysis is generally different from the corresponding partial effect: $\delta_\tau^{CQR} = F_Y^{-1}(\tau|D=1) - F_Y^{-1}(\tau|D=0) \neq dq_\tau(\text{mw})/d\text{mw}$.

The reason of the inequality is simple, conditional and unconditional distributions are not necessarily the same. Following an example in Borah and Basu (2013), the set of workers at the 5$^{\text{th}}$ percentile of the unconditional earnings distribution of Y may not be the same as the workers at the 5$^{\text{th}}$ percentile of the conditional distribution of $Y|\text{mw}$.

Under this context, Firpo et al. (2009) developed a procedure to obtain directly the marginal effects in quantile regression. They showed that the *unconditional quantile partial effect* can be obtained by running an OLS regression of the recentered influence function (RIF) of the unconditional quantile on the explanatory variables.

The influence function, $\text{IF}(Y;v;F_Y)$, of a distributional statistic $v(F_Y)$ represents the influence of a single observation on that distributional statistic, for instance, variance, quantiles, or the Gini coefficient. For the τ^{th} quantile, the influence function corresponds to: $\text{IF}(Y;q_\tau,F_Y) = \tau - \mathbb{1}\{Y \leq q_\tau\})/f_Y(q_\tau)$. The recentered influence function is obtained just by adding back the statistic $v(F_Y)$ to the influence function, in this case the τ^{th} quantile: $\text{RIF}(Y;q_\tau,F_Y) = q_\tau + IF(Y;q_\tau,F_Y)$.

Firpo, Fortin and Lemieux demonstrated that the average derivative of the conditional expectation of the RIF, $\text{E}[\text{RIF}(Y;q_\tau,F_Y)|X] = m_v(X)$, corresponds to the marginal effect on the

[9] Differences in differences estimates using Conditional Quantile Regressions are reported in Appendix B. Even though it is not possible to interpret the coefficients as a marginal treatment effects, it is worth emphasizing that the general conclusions of our results in terms of the magnitude of the effects at different points of the distribution do not change.

[10] mw = 1 denotes treatment, that is, it identifies those workers performing labour activities in some municipality of Zone B after 26 November 2012; mw = 0 indicates absence of treatment.

unconditional quantile of a small location shift in the distribution of covariates, holding everything else constant. Therefore, the RIF regression model can be viewed as an unconditional quantile regression.

Hence, to implement the unconditional quantile regression the first step is to estimate the recentered influence function, which is used as dependent variable:

$$\text{RIF}(Y;q_\tau,F_Y) = q_\tau + \tau - \mathbb{1}\{Y \leq q_\tau\})/f_Y(q_\tau) \tag{1}$$

To do so, it is necessary to compute each of its components: the sample quantile q_τ, a dummy variable $\mathbb{1}\{Y \leq q_\tau\}$ indicating whether the outcome variable is below q_τ, and the density $f_Y(q_\tau)$ at the point q_τ by Kernel procedures, or other non-parametric methods. Finally, this new dependent variable is regressed on the set of covariates.

Thus, a RIF-regression is similar to a standard regression, with the only difference that the dependent variable is replaced by its recentered influence function of the quantile of interest τ. The main advantage of the method is that the distribution function is *locally* inverted (Fortin et al., 2011); the binary variable $\mathbb{1}\{Y \leq q_\tau\}$ is actually divided by the density of the marginal distribution $f_Y(q_\tau)$. This allows us to estimate locally what is the minimum wage effect at any specific point τ of the distribution.

The following subsection details the difference in differences specifications to estimate the effect of the 2012 minimum wage increase at different percentiles of the earnings distribution.

5.2 The model. Difference in differences specification

To estimate the effect of an increase in minimum wage zone B on real hourly earnings $\ln(w_i)$ at different percentiles of the distribution, we use two difference in differences equations, which change depending on the zone used as a control group. In equation (2a) the control group consists of the untreated zones A and C. For equation (2b) only Zone C is part of the control group; to avoid losing all the observations from Zone A, the dummy variable *ZoneA* is included as a regressor.

$$\begin{aligned}\text{RIF}(Y;q_\tau,F_Y) = {} & \beta_{0,\tau} + \delta_{1,\tau} ZoneB_i * Period2_i + \delta_{2,\tau} Period2_i + \delta_{3,\tau} t + \delta_{4,\tau} ER \\ & + \beta_{1,\tau} ZoneB_i + \sum_{k=2}^{k} \beta_{k,\tau} X_{ki} + e_{i,\tau}\end{aligned} \tag{2a}$$

$$\begin{aligned}\text{RIF}(Y;q_\tau,F_Y) = {} & \beta_{0,\tau} + \delta_{1,\tau} ZoneB_i * Period2_i + \delta_{2,\tau} Period2_i + \delta_{3,\tau} t + \delta_{4,\tau} ER \\ & + \delta_{5,\tau} ZoneA_i * Period2_i + \beta_{1,\tau} ZoneB_i + \beta_{2,\tau} ZoneA_i + \sum_{k=3}^{k} \beta_{k,\tau} X_{ki} + e_{i,\tau}\end{aligned} \tag{2b}$$

$$\text{where } \tau = (0.10, 0.11, ..., 0.90)$$

$\delta_{1,\tau}$ is our parameter of interest. It expresses the marginal effect of the minimum wage increase in Zone B on the real hourly wage for the centile τ. *Period*2 is a dummy variable for identifying the post-treatment period to capture the 'shift effect' of the intervention. *ZoneB* and *ZoneA* are also indicator variables to differentiate from wages zones. By the inclusion of the interaction $ZoneA_i * Period2_i$ in equation (2b), the purpose is not to estimate the effect on Zone A; it is only included for completeness given that *ZoneA* is added as an independent variable in the model.[11]

The specifications also include a quarterly common linear trend (t) in order to capture the macroeconomic factors not considered in the model at the individual level. To control for the labour market conditions at the state level, state employment rate (ER) is also added in the equations (constructed as the percentage of employed workers over the active population by state).[12] Finally, X_{ki} is a vector of sociodemographic variables, including age, squared age, gender, schooling level, an indicator variable of rural municipalities, and interactions of schooling level with rurality and gender. An indicator variable for identifying informal workers is also included for the pooled sample analysis (Figure 4 and Panel (a) of Table 2).

For the quantile regression analysis is not necessary to implement sample section bias correction. Since the purpose is to estimate the effect on the earnings distribution, there is no reason to consider the inactive labour market population in the analysis. By definition this sector does not have labour activities and therefore does not perceive earnings.

6 Results. The impact on earnings distribution

This section describes the estimates of the implementation of the innovative method developed by Firpo et al. (2009), which by the use of the recentered influence function estimates directly the marginal treatment effects on the quantiles of the distribution.

The first subsection presents our core results for equations (2a) and (2b), analysing separately the effect on formal and informal workers. Subsection 6.2 presents some falsification tests. We use a different period of time (2011Q1-2012Q4) in which there were no changes to the real minimum wage, but we introduce an artificial treatment in 2012 to check the robustness of the model, as well as the validity of the use of the intervention as a natural experiment. The last subsection discusses the main policy implications of our results, emphasizing the inequality effects.

[11] In all cases, the parameter $\delta_{5,\tau}$ for equation (2b) is not statistically different from zero.

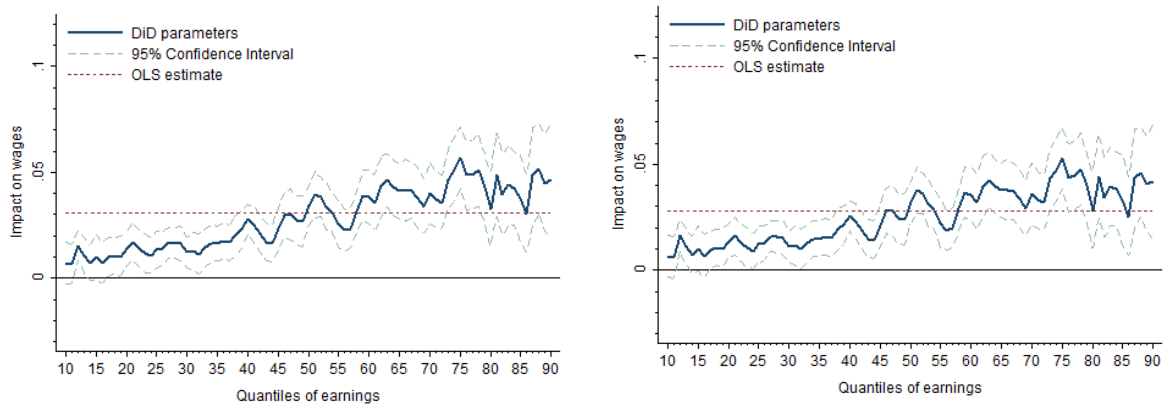
[12] We cannot reject the null hypotheses of the exogeinity of employment rate in the wage equation after the implementation of the Durbin-Hu-Hausman test. Examples of the use of aggregate employment rates as a control variable in wage equations are Mroz (1987) and Autor et al. (2016).

6.1 Main results

Throughout this subsection and the following one, for both equations (2a) and (2b) we present graphically the unconditional partial effects of the parameter of interest, $\delta_{1,\tau}$ (including its 95% confidence interval), for each of the 10th to the 90th percentile of the real hourly wage distribution. Table 2 presents the estimated parameters of interest, as well as their associated standard errors across different percentiles. In all cases, standard errors were obtained by bootstrap methods.

Figure 4 shows the RIF regression coefficients for the pooled sample including formal and informal waged workers. The first aspect to highlight is the fact that the intervention has a positive, although weak effect on the lowest deciles of the distribution. For percentiles 10th, 11th, 14th, 15th, and 16th the effect is not statistically significant, at least at the 5% level. For those below the 20th percentile, the effect on earnings is significant with a magnitude of around 1%. Even though the impact is small, there exists evidence of significant and positive effects at the bottom of the distribution. This implies that a 2.9% rise in the minimum wage for Zone B is enough to increase real wages by 1% for the labour force at the bottom of the distribution, which means an elasticity (ε) of 0.34.

Figure 4
Unconditional quantile regressions on earnings distribution.
Pooled sample, formal and informal workers



(a) Equation (2a) **(b)** Equation (2b)

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are informal workers, state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.

Secondly, it worth emphasizing that the intervention increased wages on the entire distribution of earnings. This implies that the 2012 minimum wage change affected the whole labour market earnings distribution, not only the lowest centiles. The shortcoming of this policy intervention is that the effect is stronger for the upper percentiles of the distribution. For the median of the distribution, the impact is 3.4% ($\varepsilon \approx 1.13$), while for the top quartile the effect reaches the highest level, increasing real hourly wages by around 5.6% —see Table 2, Panel (a). Its

implied elasticity is 1.93, which means that for every 1% minimum wage increase, real wages for the 75th percentile increased by 1.93%, which is almost twice the minimum wage change.

Moreover, considering that absolute wages for workers at the top of the earnings distribution are by definition higher, the increase on wages for the wealthiest workers is many times greater than the impact on workers at the bottom of the distribution. As a consequence of the Zone's B minimum wage increase wage dispersion increased.

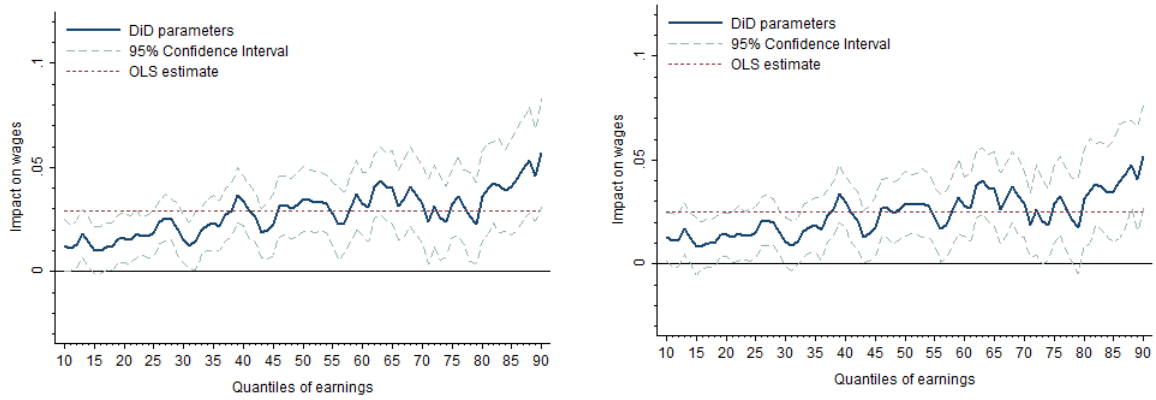
Thus, even though the intervention fulfills the primary goal of any minimum wage legislation, which is to improve the wage conditions for the lowest waged workers, it does not seem to be a successful policy in terms of reducing inequality. Section 6.3 discusses in more detail the policy implications of the intervention.

In order to investigate the different impact between formal and informal labour markets, our subsequent analyses separate workers by formality condition.

For the formal workers' earnings distribution, Figure 5 (and Panel (b) of Table 2) shows that the impact along the distribution is similar to that for the pooled sample. There is evidence of a positive impact on the workers with the lowest level of earnings, but minimum wage effects are stronger at the top of the earnings distribution.

Figure 5

Unconditional quantile regressions on formal workers earnings distribution



(a) Equation (2a) **(b)** Equation (2b)

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.

The impact for the lowest centiles of the distribution are slightly higher with respect to the pooled sample: for the bottom decile the estimated effect is 1.3% ($\varepsilon \approx 0.45$), while for the 25th percentile is around 1.6% ($\varepsilon \approx 0.58$). The sizes of the coefficients become higher as we move to the right of the distribution; the impact on the 50th distribution is around 3.2% ($\varepsilon \approx 1.09$), and the strongest effect is observed at the 90th percentile with an estimated impact greater than 5% ($\varepsilon \approx 1.87$). This corroborates that the wage dispersion in the formal labour market is also increased by the minimum wage intervention.

Table 2

The impact on the hourly earnings distribution for selected percentiles (τ)

Dependent variable:	RIF[ln(*hourly_wage*); q_τ, F_Y]											
	Pooled OLS		τ =0.1		τ =0.25		τ =0.50		τ =0.75		τ =0.90	
(a) Pooled sample, formal and informal workers *												
Equation (2a)												
ZoneB*Period2	0.0305***	(0.00439)	0.0070	(0.00443)	0.0135***	(0.00417)	0.0339***	(0.00573)	0.0562***	(0.00844)	0.0459***	(0.01200)
Equation (2b)												
ZoneB*Period2	0.0277***	(0.00443)	0.0062	(0.00451)	0.0121***	(0.00423)	0.0317***	(0.00577)	0.0521***	(0.00849)	0.0412***	(0.01207)
Observations	767,006		767,006		767,006		767,006		767,006		767,006	
(b) Formal workers												
Equation (2a)												
ZoneB*Period2	0.0291***	(0.00543)	0.0128**	(0.00643)	0.0184***	(0.00564)	0.0346***	(0.00758)	0.0338***	(0.00955)	0.0566***	(0.01272)
Equation (2b)												
ZoneB*Period2	0.0251***	(0.00550)	0.0132**	(0.00655)	0.0154***	(0.00571)	0.0289***	(0.00765)	0.0297***	(0.00965)	0.0516***	(0.01285)
Observations	405,217		405,217		405,217		405,217		405,217		405,217	
(c) Informal workers												
Equation (2a)												
ZoneB*Period2	0.0268***	(0.00728)	0.0292***	(0.00781)	0.0043	(0.00781)	0.0150**	(0.00694)	0.0341***	(0.01155)	0.0413**	(0.01842)
Equation (2b)												
ZoneB*Period2	0.0256***	(0.00731)	0.0294***	(0.00789)	0.0032	(0.00788)	0.0141**	(0.00698)	0.0339***	(0.01159)	0.0386**	(0.01846)
Observations	361,789		361,789		361,789		361,789		361,789		361,789	

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are: state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender.

Bootstrapped standard errors in parentheses, 100 repetitions. Statistical significance: *** p<0.01, ** p<0.05, * p<0.1.

* An indicator variable for identifying informal workers is also included for the pooled sample regression.

It is worth highlighting that these estimates confirm that minimum wages are truly in force in the formal labour market. A common argument against minimum wage increases in Mexico, is that the target group performs the labour activities out of the formal labour market. If minimum wages are not enforced in the informal sector, minimum wage policies could not affect the lowest income workers. Our results demonstrate that there is a positive, although small, impact on the lowest quantiles of the distribution.

The magnitude of the estimated impacts reveals the relevance of the institutional wage setting. The fact that the Zone's B intervention took place before the 'de-indexation reform' of 2016 can explain the size of the effect beyond the 20^{th} percentile, in which minimum wages were an important determinant of wage setting in the whole labour market, not only for the lowest earnings sector.

Unfortunately, it is not possible to construct a counterfactual to estimate the distributional effects of the minimum wage reform in the presence of the 'de-indexation reform' to distinguish between the 'pure' minimum wage effect on the lowest deciles, and the spillover effects at the top of the distribution.

Nonetheless, our results corroborate the findings in previous literature in two ways. They confirm that minimum wage affects several occupational wages, not only the lower end of the distribution (Grossman, 1983; Lee, 1999; Lemos, 2009; Autor et al., 2016). And also that minimum wage in Mexico has a role of a reference rate for wage and price setting (Fairris et al., 2008; Bosch and Manacorda, 2010; Castellanos et al., 2004; Kaplan and Pérez-Arce, 2006).

It is important to emphasize that even though the previous literature recognizes the existence of the minimum wage spillover effects, there is no prior evidence of minimum wage effects on the top percentiles of the earnings distribution. But, neither is there previous international experience on indexing prices and remunerations to the value of the minimum wage.

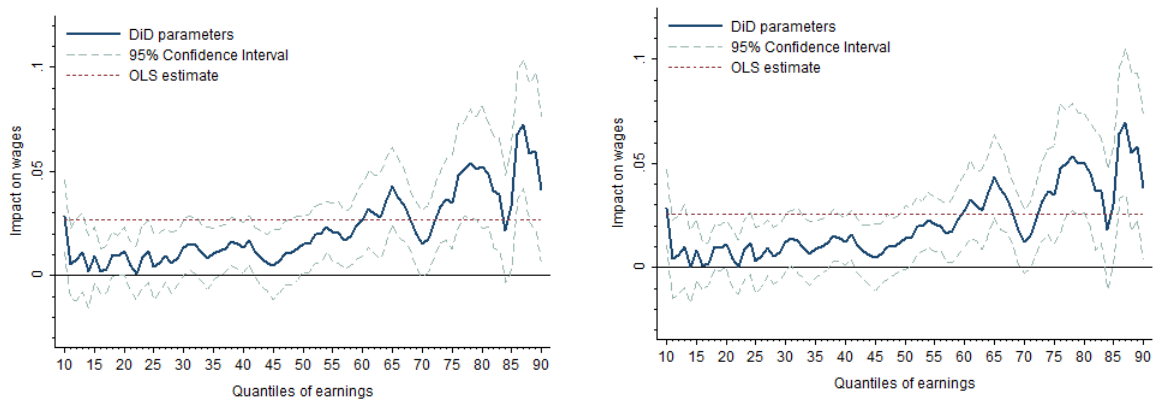
With respect to the distribution of earnings in the informal labour market, the pattern of the effect is different. Figure 6 shows that there are only some isolated significant effects below the 50^{th} percentile, but the RIF regression shows that the intervention increased real wages in the informal sector for workers with earnings above the median, even more strongly than in the formal sector. The impact, for example, for the 86^{th} percentile is around 7%, which implies an elasticity of 2.4.

It is not surprising that our model does not find a significant impact at the bottom of the distribution in the informal labour market. The activities performed by this specific segment of the labour force are related to household activities and small family business. So, there is no a formal labour market for these informal jobs. That is, the lack of statistically significant effects for the lowest percentiles of the distribution is explained by the absence of a reference rate of remunerations in that segment of the formal market.

In contrast, for higher levels of remuneration, heterogeneous workers —in terms of skills and qualifications— choose between formal and informal markets. On this issue, Maloney and Mendez (2004) state that although minimum wage is not enforced by law in this sector, it ap-

Figure 6

Unconditional quantile regressions on informal workers earnings distribution



(a) Equation (2a) **(b)** Equation (2b)

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.

pears to operate as a benchmark for 'fair' remuneration.[13] There is a pressure from informal workers to obtain the same increases than those observed in the formal labour market. Therefore, the incentives on the highest quantiles are different; the results can confirm the hypotheses that an increase of wages in the formal labour market affect the opportunity cost for high waged informal workers of remaining employed under informal conditions. In response, informal employers increase wages for these workers to retain them even by stronger magnitudes than in the formal labour market counterpart.

Our results also corroborate previous findings by Khamis (2013), who argues that minimum wages may have stronger wage effects on the informal labour market. The mechanism behind this phenomena could be a compensation for the lack of formal benefits. That is, increases to the minimum wage would also generate (under formality conditions) an increase of the labour costs for the employers, as higher social security contributions. Given that informal employers are not paying for these extra costs, they may tend to compensate directly the monetary remunerations of their workers.

In all cases, there are no significant differences between the estimates generated by equations (2a) and (2b). This implies that the use of Zone A and Zone C, or only Zone C as a control group does not affect the conclusions reached. As a consequence, it also confirms the validity to the difference and differences procedures.

Thus, the unconditional quantile regression analysis proves that the minimum wage rise actually improved real wages for the targeted workers, even if the increase is only 2.9% in nominal terms. Simultaneously, it corroborates the presence of income-increasing spillover ef-

[13] Other studies argue that informal employers may comply the minimum wage regulations even though they do not comply other formal labour market arrangements as social security contributions (Marshall, 2004; Kristensen and Cunningham, 2006).

fects suggesting that the institutional setting of the minimum wage as a reference price can have negative repercussions on the labour market, specifically on the increase of earnings dispersion.

6.2 Robustness checks: falsification test

In this section we report tests on whether the Zone B minimum wage increase in 2012 was a valid natural experiment for identifying the effects of minimum wages on the earnings distribution. By the use of a simulated intervention, the central objective is to validate the difference in differences specifications, as well as the control groups used. In addition, this exercise provides some clarification regarding the estimated spillover effects for the percentiles at the upper end of the wage distribution.

Given that minimum wages policies are by definition focused on improving earnings for workers at the lower end of the wage distribution, a valid concern with respect to the estimates presented in the previous section is the magnitude of the difference in differences parameters for the upper end of the wage distribution. Earnings inequality has increased during the last three decades (OECD, 2015). So, the possibility exists that macroeconomic factors, not included in the model, are actually driving the increase in wages for the top earners, and not necessarily the 2012 minimum wage intervention.

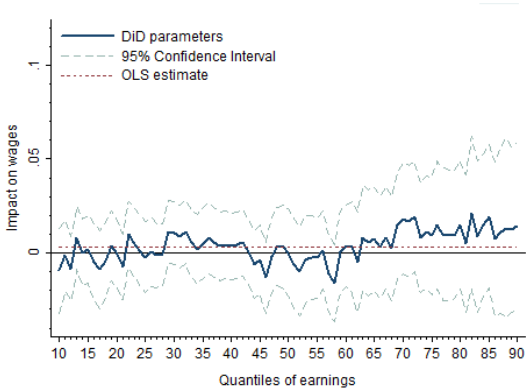
If this is the case, we would observe positive and significant effects even in absence of the intervention. We use a specification similar to Autor (2003), in which a placebo treatment is introduced in the difference in differences model. To do so, we restrict the sample to 2011 and 2012, and a treatment is artificially defined for Zone B in the period 2012Q1-2012Q4 when no policy change actually took place. All the individuals interviewed after the actual intervention on 26 November 2012 are therefore excluded from the sample in this simulated intervention. We use exactly the same specifications described by equation (2) to estimate the marginal treatment effects (by the re-centered influence function) on the percentiles from the 10^{th} to the 90^{th} centile of the real hourly wage distribution.

Figure 7 shows the unconditional quantile regressions for the falsification test. Following the structure of our main results, we replicate the model for the pooled sample, for formal workers and, finally, for informal workers. These results are reported in panels (a), (b) and (c), respectively. The results are compelling. In all cases, the simulated intervention difference in difference parameters are not statistically different from zero.

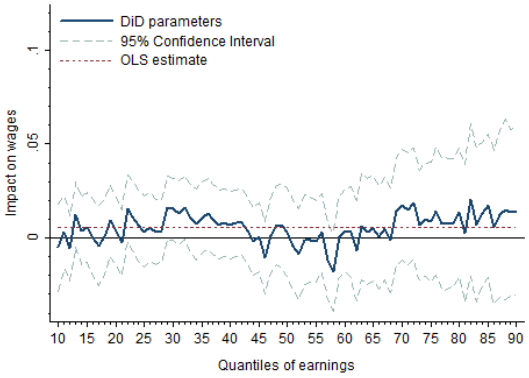
It is reassuring that there were no significant effects when there was no actual intervention. This corroborates the finding that the 2012 Zone B minimum wage intervention can be effectively used as a natural experiment to evaluate the impact on the real earnings distribution. With respect to the model, it also confirms that the implementation of difference in differences models allows us to identify the treatment effect.

Figure 7
Falsification Test

(a) Pooled sample, formal and informal workers *

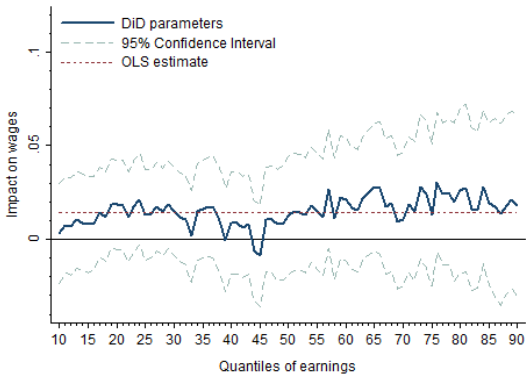


Equation (2a)

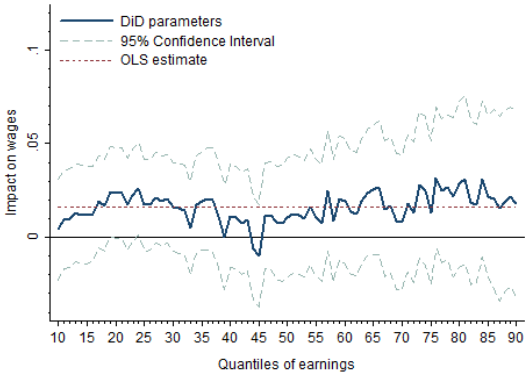


Equation (2b)

(b) Formal workers

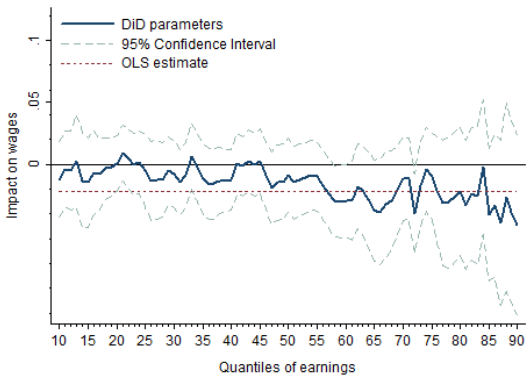


Equation (2a)

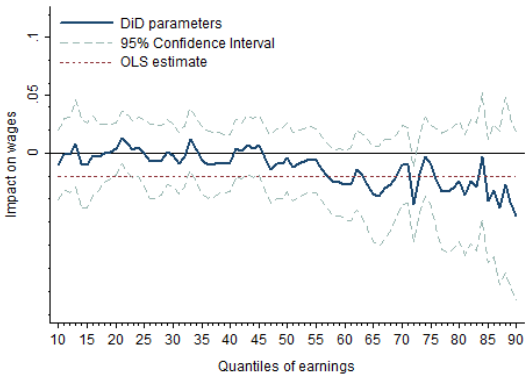


Equation (2b)

(c) Informal workers



Equation (2a)



Equation (2b)

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.
* An indicator variable for identifying informal workers is also included for the pooled sample regression.

Moreover, the simulated intervention shows no evidence of differentiated parameters throughout the earnings distribution. This implies that the estimated effects for workers at the top of the distribution, for the actual intervention, are purely a consequence of the 2012 minimum wage change. Even though the magnitude of the effect at the top end of the wage distribution is greater than the 2.9% change in the Zone B minimum wage, we argue that it is a result of the 'reference' role of the minimum wage in the Mexican labour market. Therefore, the analysis in this subsection also allows us to conclude that the findings for the top earning centiles do not constitute spurious effects.

Some additional robustness checks, with some changes to the econometric specification are reported in Appendix C. On the one hand, given that the minimum wage reform came into force in November 2012 and the period of analysis from goes from 2012Q1 to 2013Q4, it implies that December 2012 and December 2013 are included in the post-treatment period. If there are seasonal fluctuations on earnings, which is possible, this can affect our estimates. Figure C.1 reports the difference in differences regressions excluding December in both years. The coefficients are not statistically different from those reported in figures 4 to 6 and Table 2.

On the other hand, with respect to the sociodemographic control variables included in the model, *age* is commonly included in wage equations, but in our case it could introduce an undesired shift effect. As ENOE follows the same individual up to five quarters, it is possible that some individuals —not all of them— have a shift by one or even two years in age. This depends on the specific date of the interviews (if individuals completed the five quarterly waves) generating an artificial shift effect on the age of some workers, which potentially can affect our estimates. To check this, we run two additional specifications. First, we simply omit *age* from the unconditional quantile regressions (parameters reported in Figure C.2). And second, we keep constant the initial age of all the individuals in the sample to avoid missing this important variable (parameters reported in Figure C.3). In all cases, including also the analysis for the formal and informal labour markets, the results and the conclusions are not affected significantly.[14]

6.3 Policy implications

It is important to emphasize that the purpose of Zone's B 2012 minimum wage increase was not to reduce poverty or inequality. The minimum wage intervention was implemented as an administrative change, aiming to adjust the level of remunerations in two out of three zones according to their convergence in terms of economic development. Furthermore, the magnitude of the increase seems insufficient for a public policy oriented at combating poverty. For this reason, the purpose of our analysis is not to evaluate the impact on poverty or inequality measures.

[14] Some other robustness exercises, not reported in the text were: real monthly earnings as a dependent variable, the inclusion of self-employed workers an extension of the period of analysis from 2011Q1 to 2014Q4, and the inclusion of the economic sector as a regressor. In any case our general conclusions were affected significantly.

Nevertheless, the use of the intervention as a natural experiment provides fundamental information on how the Mexican labour market responds to minimum wage changes. The evaluation of the wage effects on the poorest workers, as well as the recognition of spillover effects on jobs with levels of remuneration already above the minimum wage, represent a guideline for further reforms with the explicit objective of increasing the living standards of the lowest income workers.

The estimates presented in this paper demonstrate that the 2012 minimum wage rise increased real wages on the whole earnings distribution. For the lowest percentiles of the distribution, the impact is only present for formal workers, but the minimum wage reform is still accomplishing its central objective: to increase real remunerations for those workers with the lowest level of earnings in the formal, covered sector. The shortcoming of the policy intervention is that the increase on real earnings is stronger on the segment of the workforce with the highest level of remunerations.

We can implement a simple exercise to illustrate the likely inequality implications of the lighthouse effect: if we apply the estimated coefficients to every log-earning percentile mean, the interquartile range would have increased by 0.014 log points. This means that the wage differential between percentiles 75^{th} and 25^{th} increased by around 1.4% as a consequence of the intervention.[15]

Thus, if the purpose of the minimum wage increase was only to raise real wages for the poorest sector of the labour market, the 2012 intervention may be considered successful. But if reducing inequality is part of the objectives of the policy makers, the message from our research is clear, given the conditions of the Mexican labour market in 2012, the policy change benefited top-income workers to a greater extent, thus increasing wage dispersion.

We cannot forget that the legal context of the labour market has also changed. The 2016 'de-indexation' reform was not a coincidence. Indeed, it was a result of the recognition of the likely consequences of the use of the minimum wage as a reference rate. It represents the first step towards a stronger minimum wage reform. So far, it is not possible to determine if the 'de-indexation' reform was enough to avoid the spillover effects on workers earning above the minimum wage.

7 Conclusions

The implementation of unconditional quantile regressions in this paper shows that Zone B minimum wage increase had a positive impact on the lowest deciles of the real earnings distribution. It suggests that the minimum wage regulations are actually binding, specifically on the formal labour market, and moreover, that increases to the minimum wage have a positive effect on the

[15]Exercise restricted to the earnings distribution of the treated Zone B for 2012Q3, just before the policy change.

poorest workers.

Exploring the impact on workers with earnings above the minimum wage, we find strong statistical evidence of important spillover effects on the whole distribution of earnings. Nevertheless, the effect exhibits the lowest magnitudes precisely at the bottom percentiles of the distribution. Therefore, the policy intervention can be considered successful in terms of increasing real earnings for workers with the lowest level of wages, but not in terms of the distributional effects.

Independently of whether the workers are formally or informally employed, the model suggests that real wages increased by a higher proportion at the top percentiles. This implies that the 2012 minimum wage intervention increased the dispersion of wages. Previous empirical studies have recognized the existence of minimum wage spillover effects, but not in the magnitude of our estimates, nor on the top of the distribution. There are two important differences with respect these prior estimates. On the one hand, the data source does not include richest people in the labour market, so we do not observe actual top-income workers. And more importantly, to our knowledge there is no previous international experience in a wage setting in which the minimum wage is used as a reference rate to determine other remunerations.

Related to this, previous literature has contended that the institutional wage setting in Mexico, specifically the role of the minimum wage as a reference rate, could be responsible for this spillover effects. Even though this institutional setting has been legally modified by the 'de-indexation' reform of 2016, so far we do not have enough elements to evaluate if the spillover effects are entirely generated by the 'nummeraire' role of minimum wages. Meanwhile, it is essential to consider the likely distributional repercussions in the implementation of future labour market policies.

New legislation, with stronger changes on the minimum wage is expected to be passed at the end of 2017. This would represent a suitable source of variation to test the minimum wage effects on the labour market once the 'de-indexation reform' has been implemented. Moreover it would also represent an opportunity to test for the robustness of the estimates presented in this paper, but in presence of deeper variations in the minimum wage level.

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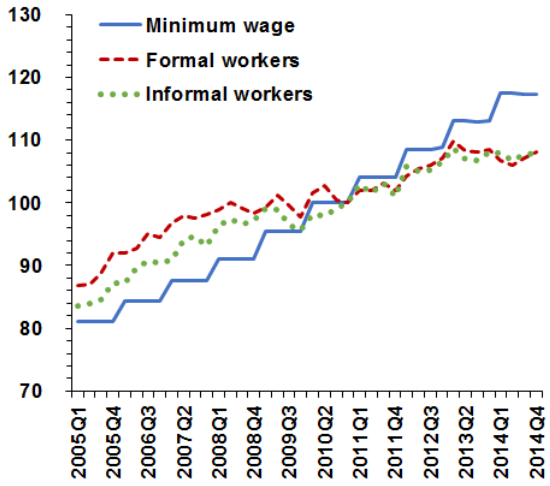
Appendix A Descriptive statistics on real earnings and wage dispersion

Following the argument in Section 3, if minimum wage has the role of a reference rate or 'nummeraire', it should be an important determinant of the whole wage setting process in the Mexican labour market. Figure A.1 presents the path followed by the minimum wage and average earnings in nominal terms. The solid blue line corresponds to the average minimum wage, weighted by the active labour market population by zone, while the dotted lines show the mean earnings by formality condition. We graph nominal earnings instead of presenting real earnings to capture more closely the wage setting dynamics. The reference period for the index number is 2010Q4, which corresponds to the base period for the construction of the National Price Index by INEGI.

Figure A.1
Nominal minimum wage and mean earnings by formality condition
(Index 2010Q4=100, 2005Q1-2014Q4)



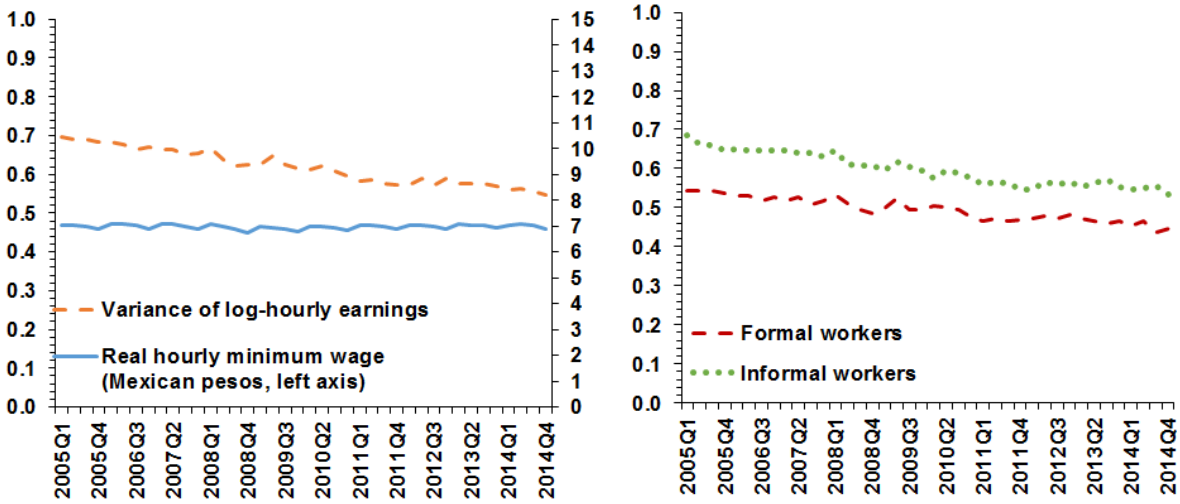
Notes: nominal minimum wage is a weighted average by active labour market population by zone. Earnings population values using expansion factors in ENOE.

Although nominal minimum wage exhibits a higher growth rate, the annual increases to the minimum wage (at the beginning of every year) are usually accompanied by similar raises in the average level of earnings. The graph illustrates that there is a common variation between average earnings and minimum wage, and more importantly, not only in the formal labour market. Indeed, the correlation index of the mean earnings in the formal and informal sectors, with respect to the minimum wage level are 0.94 and 0.96, respectively. It is also interesting to note that there is convergence in the variation (not in absolute If we look at the relationship between wage dispersion and real minimum wage, panel (a) of Figure A.2 shows that from 2005 to 2014, the variance for the log-hourly earnings has decreased by 0.15 log points. In contrast, the real hourly minimum wage (considering an 8-hour workday) has remained unchanged for the same period. This makes sense, the annual increases to the nominal minimum wage aim

precisely at adjusting the lost by inflation in the previous year, so the purpose is to keep constant its purchasing power. So, the observed decline in the earnings dispersion does not seem to be related to the minimum wage policy.

Panel (b) of Figure A.2 analyses by separately wage dispersion for the formal and informal labour markets. As expected, the log-hourly variance for informal workers is higher (by around 0.1 log points), but formal and informal sectors respond in a similar way to exogenous shocks. terms) of average earnings between formal and informal sectors.

Figure A.2
Wage dispersion and real minimum wage
(2005Q1-2014Q4)



(a) Variance for real log-hourly earnings and real minimum wage

(b) Variance for real log-hourly earnings by formality condition

Notes: nominal minimum wage is a weighted average by active labour market population by zone. Earnings population values using expansion factors in ENOE.

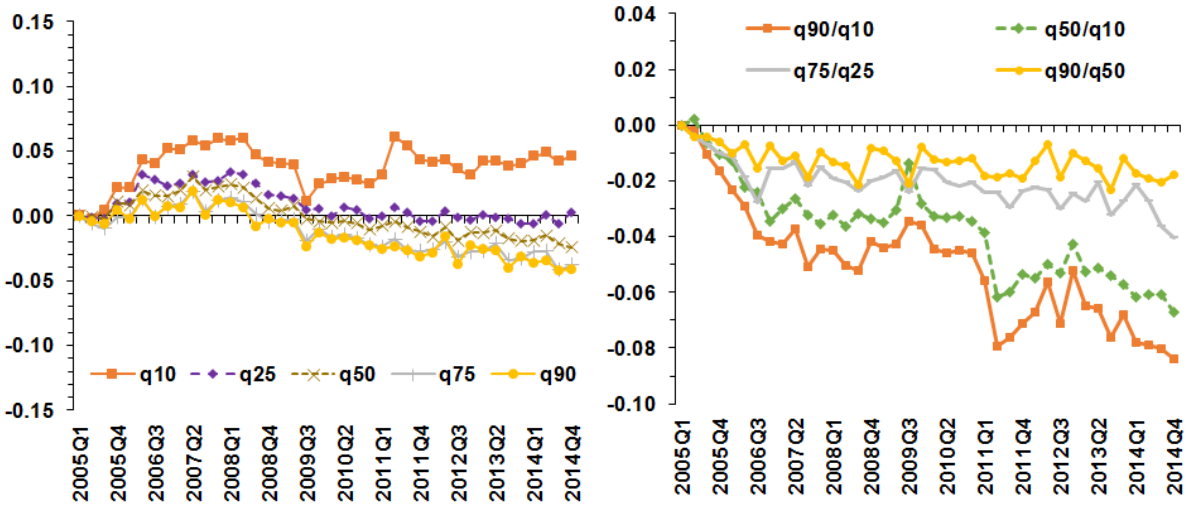
Thus, figures A.1 and A.2 suggest that there is a close relationship between minimum wages and wage setting in the formal and informal labour market, but minimum wage does not seem to be responsible for the reduction in the wage dispersion between 2005 and 2014.

In order to analyse in depth the earnings distribution for the same period, panel (a) of Figure A.3 describes the evolution of the mean earnings quantiles for some selected percentiles. Following a similar analysis in Engbom and Moser (2017), real log-hourly wage percentiles are normalised to zero in the initial period, which in our case corresponds to 2005Q1. From 2005 to 2008 there is a generalized increase in real wages, but after the financial crises in 2008 there is a negative trend for which only the 10th percentile was able to recover. The 25th percentile exhibits practically the same level in 2014Q4 to that observed 2005Q1, but the rest of the percentiles had an important decrease, including the median of the distribution.

With the objective of having an additional measure of wage dispersion, but at different points of the distribution, panel (b) of Figure A.3 depicts percentile ratios —also normalised to zero in 2005Q1. In all cases, the wage gap within percentiles decreased. But, there was a

more important decline for the ratio q50/q10. In absolute terms, it decreased by 0.1 log points, while for the interquartile range (q75/q25) the decline observed was by 0.05 log points, and 0.02 points for the ratio q90/q50.

Figure A.3
Real earnings by percentiles
(2005Q1-2014Q4)



(a) Normalised real log-hourly wage percentiles (2005Q1=0)

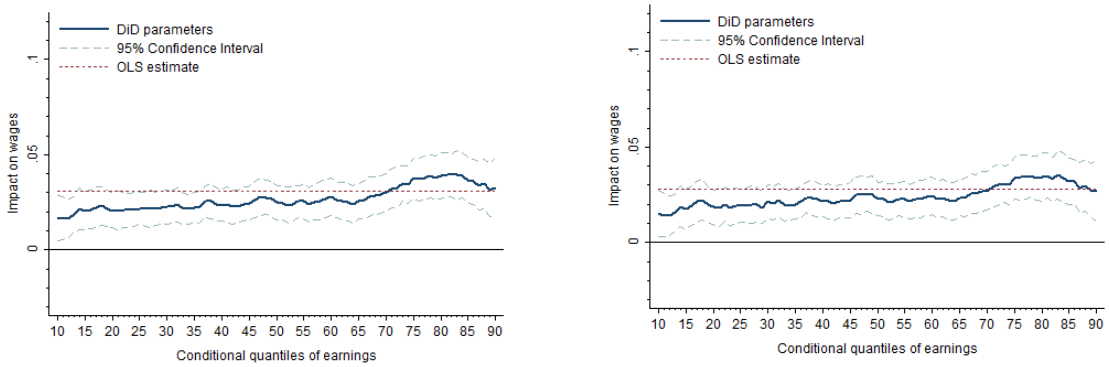
(b) Normalised percentile ratios (2005Q1=0)

Notes: earnings population values using expansion factors in ENOE.

Appendix B Conditional Quantile Regressions

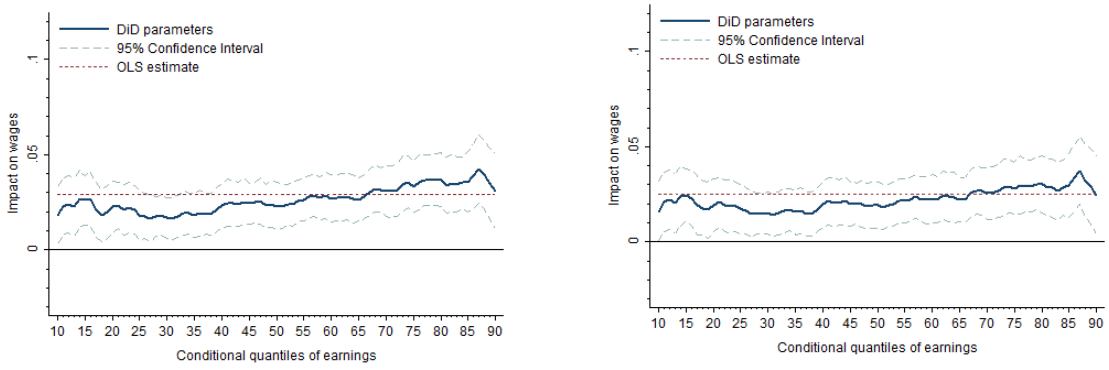
Figure B.1
Conditional Quantile Regressions

(a) Pooled sample, formal and informal workers *



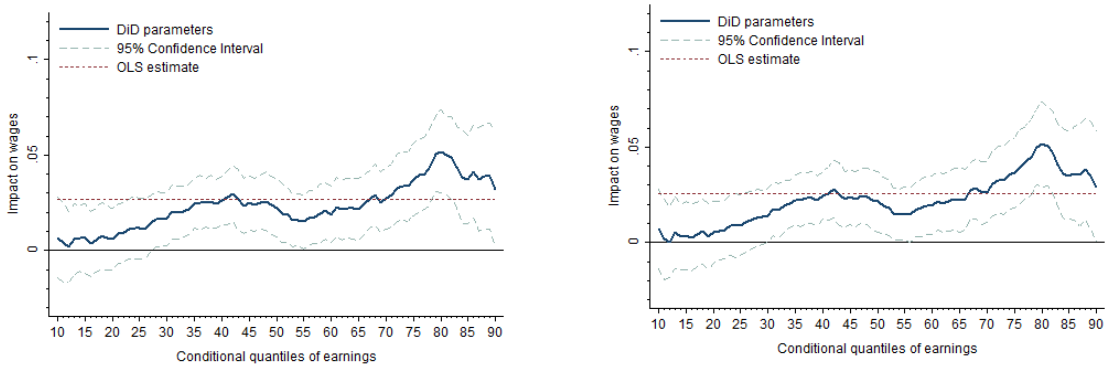
Equation (2a) Equation (2b)

(b) Formal workers



Equation (2a) Equation (2b)

(c) Informal workers



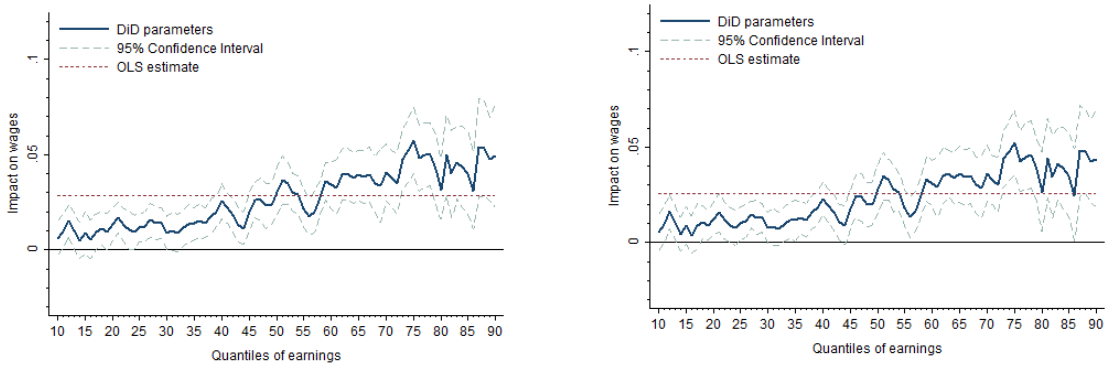
Equation (2a) Equation (2b)

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.
* An indicator variable for identifying informal workers is also included for the pooled sample regression.

Appendix C Additional robustness checks

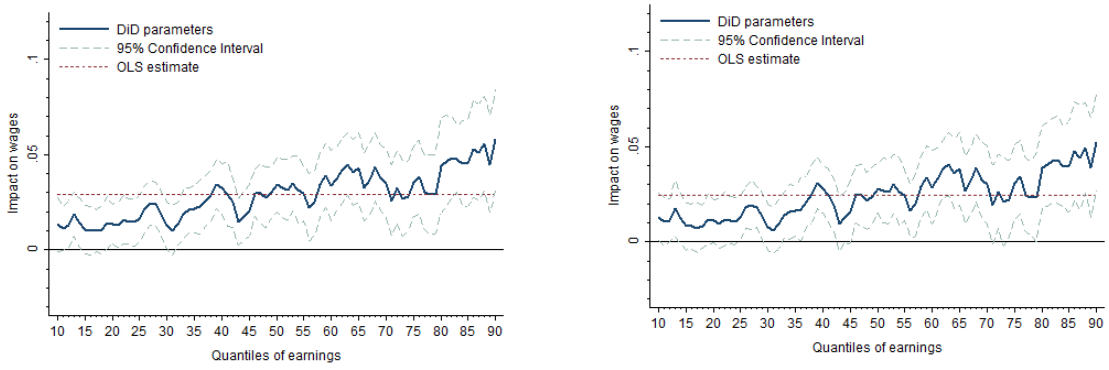
Figure C.1
Excluding observations from December 2012 and 2013

(a) Pooled sample, formal and informal workers *



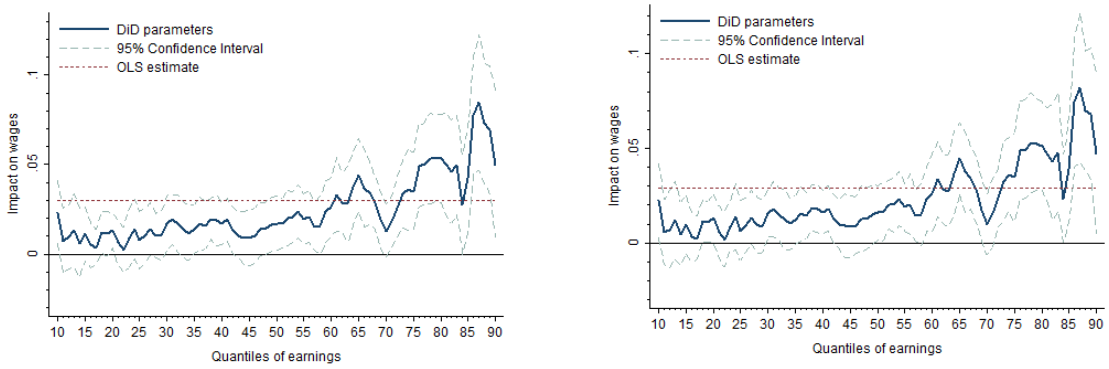
Equation (2a) Equation (2b)

(b) Formal workers



Equation (2a) Equation (2b)

(c) Informal workers



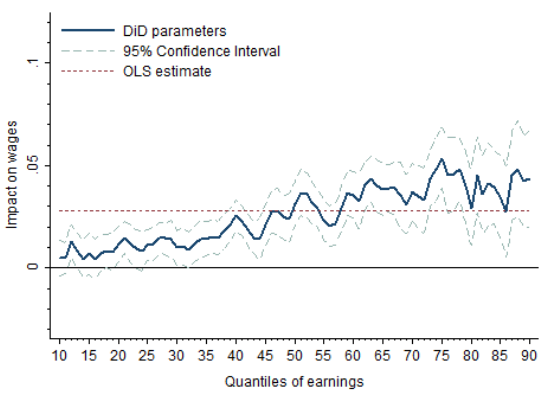
Equation (2a) Equation (2b)

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.
* An indicator variable for identifying informal workers is also included for the pooled sample regression.

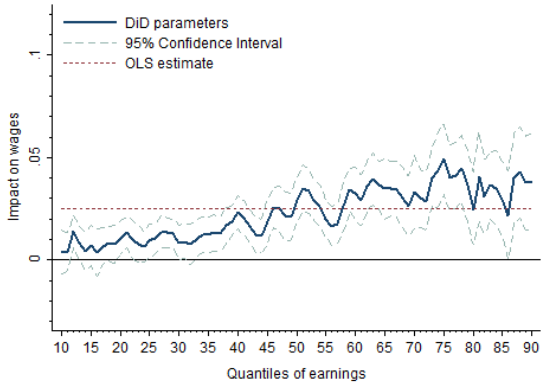
Figure C.2

Excluding *Age* as a control variable

(a) Pooled sample, formal and informal workers *

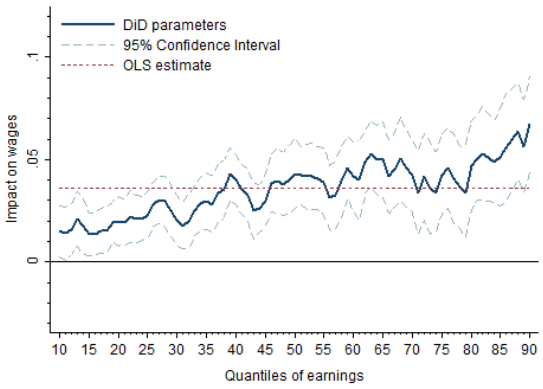


Equation (2a)

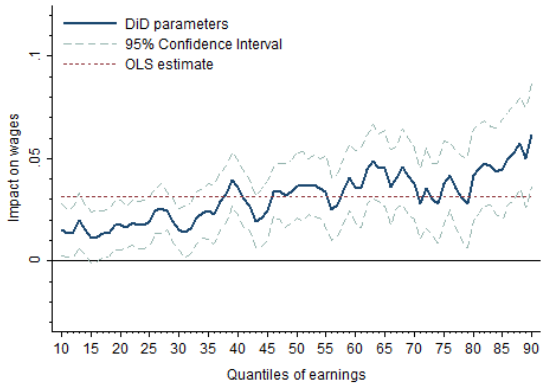


Equation (2b)

(b) Formal workers

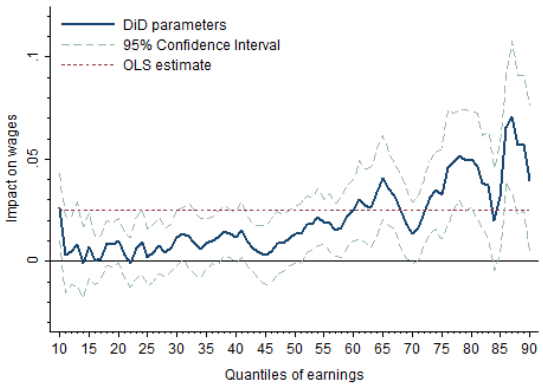


Equation (2a)

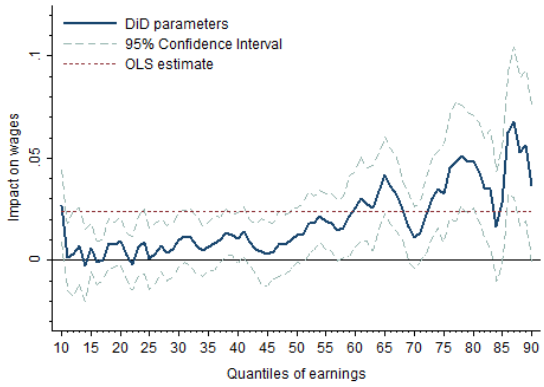


Equation (2b)

(c) Informal workers



Equation (2a)



Equation (2b)

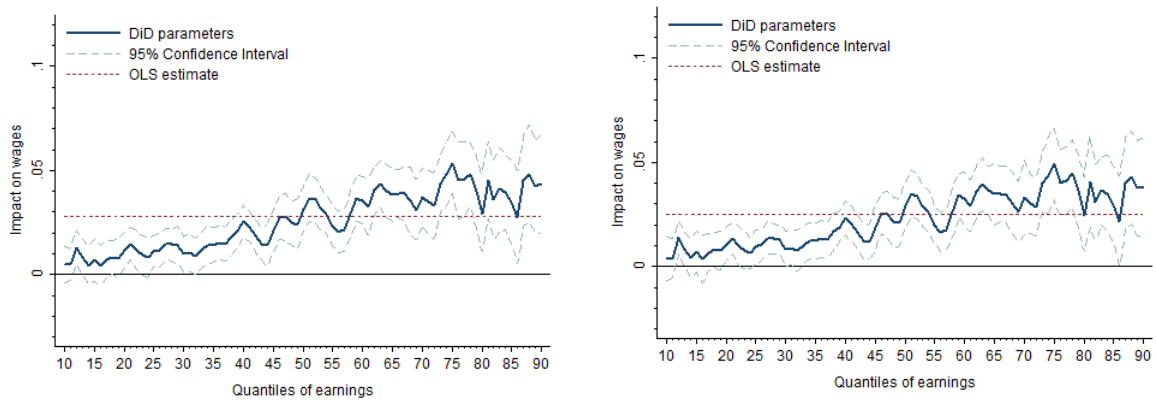
Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.

* An indicator variable for identifying informal workers is also included for the pooled sample regression.

Figure C.3

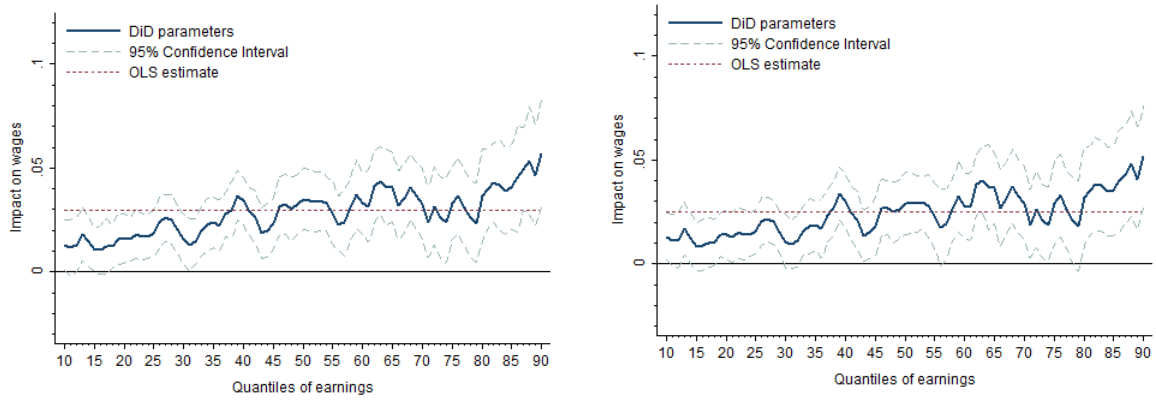
Keeping *Age* constant in time

(a) Pooled sample, formal and informal workers *



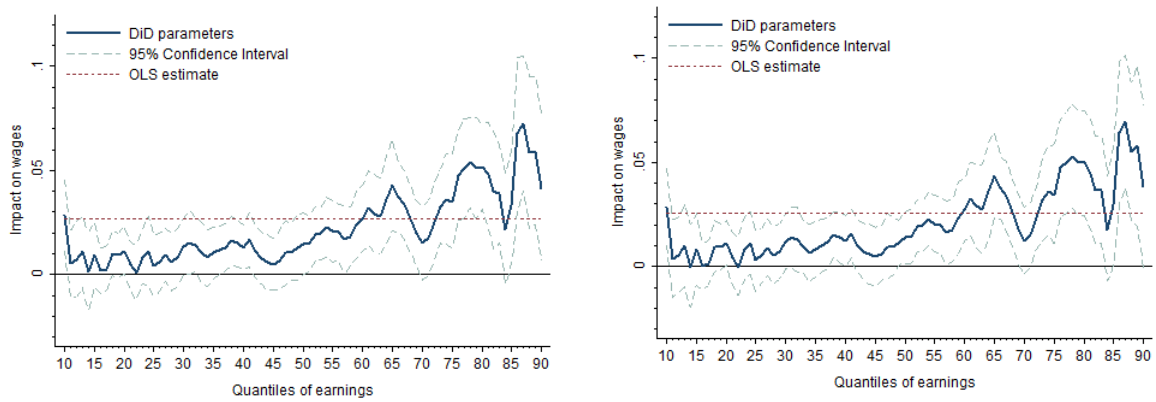
Equation (2a) Equation (2b)

(b) Formal workers



Equation (2a) Equation (2b)

(c) Informal workers



Equation (2a) Equation (2b)

Notes: Self employed workers and observations with non-reported wages are excluded from the analysis. The set of covariates included are state employment rate, gender, age, squared age, schooling level, rural, and interactions of schooling level with rural and gender. Standard errors are obtained by bootstrapping, 100 repetitions.
* An indicator variable for identifying informal workers is also included for the pooled sample regression.