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DISCUSSION PAPER SERIES

IZA DP No. 12914

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ISSN: 2365-9793

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ABSTRACT

The Impact of a Minimum Wage Change on the Distribution of Wages and Household Income

We use distributional regression analysis to study the impact of a six percent increase in the Irish minimum wage on the distribution of hourly wages and household income. Wage inequality, measured by the ratio of wages in the 90th and 10th percentiles and the 75th and 25th percentiles, decreased by approximately eight percent and four percent respectively. For young workers, aged under 25, the effects were far greater, with a 24 percent reduction in the ratio of wages in the 90th and 10th percentiles. The results point towards wage spillover effects up to the 30th percentile of the wage distribution. We show that minimum wage workers are spread throughout the household income distribution and are often located in high-income households. Therefore, while we observe strong effects on the wage distribution, the impact of a minimum wage increase on the household income distribution is quite limited.

JEL Classification: J31, J38, K31

Keywords: minimum wage, inequality, wage spillovers, distributional regression

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1. Introduction

Minimum wages are a commonly used policy tool designed to assist low paid workers by providing a binding wage floor. As of 2019, minimum wages were present in 22 EU countries (Eurofound, 2019). In setting minimum wages, policy makers are concerned about the possibility of creating adverse consequences for employment.[1] An extensive, yet often conflicting, body of research has developed over recent decades examining the employment effects associated with increasing minimum wages. While some studies find little to no employment effects (see, e.g., Cengiz et al., 2018; Hoffman, 2016; Schmitt, 2015; Belman et al., 2015; Dolton et al., 2015; Hirsch et al., 2015; Baek and Park, 2016), others find evidence of negative impacts (see, e.g., Neumark et al., 2004; Meer and West, 2015; Sabia et al., 2012; Dickens et al., 2015).[2]

Another strand of minimum wage literature, in which our paper is situated, examines the distributional impacts of minimum wage policies on the wage distribution. A priori, one may expect that minimum wage increases would affect the wage distribution by boosting the wages of low paid workers relative to high paid workers. Quantifying the magnitude of such effects is important in order to inform the policy debate on the merits of minimum wage changes. For the UK, Dickens and Manning (2004a and 2004b) and Dolton et al. (2012) detect modest effects on wage inequality associated with the minimum wage. There is also evidence showing a reduction in wage inequality for the US (Autor et al., 2016; Bauducco and Janiak, 2018; Neumark et al., 2004). Minimum wages have also been found to play a particularly important role during recessions. By providing a binding wage floor, they prevent wage reductions for the lowest paid workers, thereby avoiding large increases in wage inequality during economic downturns (Holton and O'Neill, 2017).[3]

[1] The stated aim of the Irish Low Pay Commission is, "*to set a minimum wage that is fair and sustainable, and when appropriate, is adjusted incrementally, and that, over time, is progressively increased to assist as many low-paid workers as is reasonably practicable without creating significant adverse consequences for employment or competitiveness*".

[2] For Ireland, McGuinness and Redmond (2019) find no evidence of an increased likelihood of job loss, but find evidence of a reduction in hours worked, especially among temporary contract workers.

[3] Cross-country studies by Garnero et al. (2015), Maurizio and Vazquez (2016) and Koeniger et al. (2007) have also found that minimum wages are generally associated with lower wage inequality.

Careful examination of the wage distribution is also important in order to test for the presence of other, less obvious, effects such as wage spillovers. There are various reasons why wage spillovers may occur. It is likely that employees are concerned with their relative standing in the wage distribution and use the wages of their peers as a basis for comparing their own pay (Dube et al., 2019). Therefore, wage increases above the minimum may be required to preserve wage differentials and maintain productivity. An increase in the minimum wage will also raise the relative price of low-skilled labour, which may lead to an increase in demand for higher-skilled workers and hence higher wages for workers already earning above the minimum wage rate (Stewart, 2012). There is conflicting evidence in the existing literature regarding the presence of spillover effects. Butcher et al. (2012), for the UK, find evidence of wage spillovers up to the 25th percentile of the wage distribution, which is 40 percent above the minimum wage. However, Dickens and Manning (2004a and 2004b) and Stewart (2012) find little to no evidence of minimum wage spillovers in the UK. Evidence of wage spillovers have been found for Estonia (Ferraro et al., 2018) and the US (Autor et al., 2016; Bauducco and Janiak, 2018; Neumark et al., 2004).

While there is some consensus that minimum wage policies impact the wage distribution, although the magnitude of the effects vary, the impact on the *income* distribution is less clear-cut, with several studies finding little to no effect. There are a number of reasons for this. Firstly, negative employment effects associated with minimum wage increases can offset hourly wage gains (Caliendo et al., 2017; Churchill and Sabia, 2019). Secondly, minimum wage workers are spread across the household income distribution, often in high income households (Logue and Callan, 2016; MaCurdy, 2015), and these workers are typically not the primary household earner (Maitre et al., 2017). However, there is evidence for the US showing positive effects of minimum wages on family incomes in the bottom two deciles (Dube, 2017).

In this paper, we focus on a minimum wage change that occurred in Ireland in 2016, whereby the minimum hourly rate of pay increased from €8.65 per hour to €9.15 per hour, an increase of approximately six percent. We assess the impact of this change on the wage distribution, by looking at the effect on wage inequality as well as testing for the presence of wage spillovers. Given the disagreement in the existing literature regarding the presence of wage spillovers, as well as differences in the estimated effects on the wage distribution, further evidence is required in this area. Our first contribution is therefore to provide additional evidence in this regard. Our results indicate a four percentage point (or 40 percent) reduction in the number of workers earning on or below the new minimum wage rate. We also detect wage spillover effects that extend to the 30th percentile of the wage distribution. Wage inequality, measured by the ratio of workers' wages in the 90th and 10th percentiles (the P90/P10 ratio) and the 75th and 25th percentiles (the P75/P25 ratio), decrease by approximately eight percent and four percent respectively. We also go beyond average population statistics by examining separate subsets of employees: males only, females only, and young employees (aged under 25). While the effects for males and females are similar to the overall estimates, the effects for young workers are much larger, with a 24 percent reduction in the P90/P10 ratio following the minimum wage increase.

While much of the previous literature focuses on the wage distribution only, our second contribution is to also present evidence on the impact on the household income distribution. Our results indicate that the minimum wage increase had very little impact on the gross household income distribution. We explore potential reasons for this. We find that minimum wage workers, rather than being heavily concentrated in low income households, are spread throughout the income distribution, often in high income households. Furthermore, minimum wage workers are typically not the primary earner within households. These factors will limit the effects of a minimum wage increase on household income.

Finally, we make a methodological contribution, as we are the first to use distributional regression techniques to evaluate the effect of a minimum wage increase on wages and household income.[4] Our methodology involves constructing counterfactual distributions that can be compared to the actual wage and income distributions following the minimum wage change.[5] This allows us to separate the minimum wage effect from compositional changes in the population over time. The method is particularly suitbable to the case of Ireland. Unlike

[4] In related work, Bargain et al. (2019) use distributional regression to examine the change in the gender wage gap following the introduction of a minimum wage in Ireland and the UK.

[5] See Chernozhukov et al. (2013) for a detailed discussion on distributional regression. An alternative way to model distributions in a flexible way would be to use quantile regressions. However, there is evidence that distributional regression generally provides a better fit to wage distributions than quantile regression (Rothe and Wied, 2013; Van Kerm et al., 2016).

most other European countries, which define a minimum wage in terms of a monthly rate, the minimum wage in Ireland is set at a specific hourly rate.[6] This helps us to infer causality when looking at the wage distribution. If the change in the wage distributions over two time periods is causally related to the minimum wage change, then the effect should be clearly present at the new minimum wage rate. This is exactly what our analysis reveals. When focusing on the household income distribution, inferring causality is not as straightforward as there is no precise income level within the income distribution where we would expect to observe the strongest effects. However, note that our distributional regression approach controls for compositional changes pre- and post-minimum wage change. Therefore, provided the minimum wage was the only policy change over the two time periods, we can be reasonably confident that any perceived effects are attributable to this policy.

The remainder of the paper is structured as follows. In Section 2 we describe the data used for the analysis, present some summary statistics, and provide a brief discussion of the policy background relating to the minimum wage in Ireland. In Section 3 we outline the distributional regression methodology and in Section 4 we present our results. Section 5 concludes.

2. Data and Policy Background

2.1 Data and Descriptive Statistics

The data used in our analysis comes from the Survey of Income and Living Conditions (SILC) Research Microdata File, provided by the Central Statistics Office (CSO) in Ireland. SILC collects information on income and living conditions by means of household interviews which take place on a continuous weekly basis throughout the year. Participation in the survey is voluntary for the selected survey respondents. The overall response rate in 2015 was 60 percent and the sample size was 13,793 individuals. The overall response rate in 2016 was 58 percent and the sample size was 13,186 individuals. There were 3,899 employees in 2015 and 3,641 employees in 2016. Hourly wages are calculated by dividing gross monthly employee

[6] In this regard, our methodology is also suitable for the UK and the US which also specific an hourly rate.

earnings by the self-reported usual hours of work. Income information, for the most part, comes from administrative records linked to the individual's tax number (PPSN).[7]

In addition to studying hourly wages, we also examine the impact of the minimum wage on household income using two measures. The first is gross monthly household employment income, which adds together the monthly wages of all employees within the household. This is equivalised using the modified OECD scale.[8] Given that we are evaluating the impact of a wage policy, it is useful to restrict the analysis to employment income, as one would expect the income effects to manifest through changes in household wages. For our second measure, we use data on total gross household income. In addition to employee income, this includes income from benefits (e.g., unemployment, sickness, disability) as well as income from other sources, such as rental property, interest or dividends. The income reference period is the 12 months immediately prior to the date of the interview. Given that interviews are conducted continuously throughout the year, the income reference period for 2016 spans from January 2015 to December 2016.[9] Therefore, a drawback of this measure is that annual income contains a mix of 2015 (pre-policy change) and 2016 (post-policy change) incomes, depending on the date of interview, whereas the first measure, of employment income, relates only to 2016.

Table 1 below presents summary statistics of employees in Ireland for 2015 and 2016. The median wage increased from €16.17 in 2015 to €16.85 in 2016. Educational attainment of Irish employees is high, with just under half of workers having tertiary education. The average age of employees is approximately 41 years and the majority of workers have permanent contracts (87%) and are in full-time employment (82%). Irish nationals account for approximately 87% of the workforce. There is some variation over time in the characteristics of employees, with a slight increase in age, educational attainment, full-time employment and the percentage of male workers in 2016. There was a slight decrease in the number of Irish nationals in employment and the percentage of workers with permanent contracts. Our distributional regression analysis will separate any compositional effects on the wage

[7] Information on the precise number of respondents whose income comes from administrative records is not disclosed by the CSO.
[8] The first adult is assigned a weight of 1, other adults are assigned a weight of 0.5 and children (under 14 years of age) are assigned a weight of 0.3.
[9] For example, the income reference period for a household surveyed in June 2016 will be from June 2015 to June 2016. The reference period for a household surveyed in December 2016 will be January to December 2016.

distribution, due to changes in the characteristics of employees, from the impact of the minimum wage change.

Table 1: Summary statistics – wages, household income and employee demographics

	2015	**2016**
Median hourly wage	16.17	16.85
Age (years)	41.24	41.58
Tertiary Education (%)	47.3	49.4
Permanent job (%)	87.5	87.0
Full-time (%)	80.9	82.1
Irish (%)	87.1	86.7
Male (%)	47.5	48.4
Observations	3899	3641

Source: Survey of Income and Living Conditions (SILC)

Table 2 shows the percentage of employees earning €9.15 per hour or less in 2015 and 2016. We show this for the overall population of workers, as well as separately for three groups: males, females and young people (age 25 or less). The increase in the minimum wage, from €8.65 to €9.15 in January 2016, coincided with a sharp reduction in the incidence of workers earing €9.15 per hour or less. This went from 11.13 percent in 2015 to 6.48 percent in 2016. The results by gender show the percentage of males and females in this wage range is roughly similar, with the incidence of low wage employment being slightly higher for females. Both groups experienced similar reductions in the incidence of low paid employment over the two time periods. The incidence among young workers is higher. In 2015, 35 percent of young workers (aged 25 or under) earned €9.15 per hour or less, compared to 25 percent in 2016. These descriptive statistics indicate that the 2016 increase in the minimum wage appears to have boosted the hourly wage of a substantial number of low wage employees.

Table 2: Percentage of employees earning on or below €9.15 per hour

	2015	**2016**
All employees	11.13 (n=3899)	6.48 (n=3641)
Males	10.25 (n=1853)	6.36 (n=1761)
Females	11.93 (n=2046)	6.60 (n=1880)
Young workers (aged 25 or less)	35.10 (n=416)	24.55 (n=387)

Source: Survey of Income and Living Conditions (SILC)

2.2 Policy Background

A minimum wage was first introduced in Ireland in April 2000 at a rate of €5.58 per hour.[10] Several increases occurred in subsequent years, so that by July 2007 the minimum wage stood at €8.65 per hour. From 2008 onwards, Ireland experienced a prolonged economic downturn, during which time the minimum wage did not increase. In 2015, against the backdrop of an economic recovery, the Irish Low Pay Commission was established and tasked with providing yearly recommendations to the Irish Government concerning the appropriate rate for the Irish minimum wage. Following this, the minimum wage was increased on 1st January 2016, from €8.65 per hour to €9.15 per hour, an increase of approximately six percent.

Sub-minimum rates, expressed as a percentage of the full rate, exist for employees under 18 years of age (70 percent), employees in their first year of employment (80 percent), employees in their second year of employment (90 percent) and employees in structured training during working hours (75, 80 or 90 percent, depending on level of progression).[11] However, the incidence of this type of employment is very low. Of all individuals on or below minimum wage, approximately 90 percent earn the minimum wage, with just 10 percent on sub-minimum rates (Redmond and McGuinness, 2018).[12] For the purpose of our analysis,

[10] Or £4.40 in Irish pounds.
[11] See www.lowpaycommission.ie for details on sub-minimum rates, including what qualifies as "structured training". As of 2019, the training rates were abolished so that sub-minimum rates are now solely based on age.
[12] In quarter 2 of 2016, a question was added to Ireland's Labour Force Survey (LFS) to identify minimum wage and sub-minimum wage employees. While Redmond and McGuinness (2018) use this to calculate the incidence of this type of employment, no actual wage data is present in the LFS. Therefore, this dataset cannot be used for distributional analysis.

when we refer to minimum wage workers, we mean employees earning the minimum wage or less.

3. Methodology

We use distributional regression (DR) to analyse the impacts of a minimum wage increase. DR is a flexible approach to modelling wage distributions.[13] It is theoretically similar to the more commonly used Quantile Regression (QR) technique (Koenker et al., 2013). However, unlike QR, inference using DR is not affected by the bunching of data around the minimum wage. It is difficult for QR to accurately model incidents of bunching as their location within the quantile cannot be accurately gauged. However, if a narrow enough grid is used with DR, a detailed plot of wage distributions, including the location of such bunching, is possible. This is an important advantage of DR when evaluating minimum wages as effects around specific wage levels can be examined and spillover effects easily identified. Additionally, empirical evidence suggests that DR generally provides a better fit to wage distributions than quantile regression (Rothe and Wied, 2013; Van Kerm et al., 2016).

More formally, let W_t denote the hourly wages and X_t the human capital characteristics for population *t,* where *t*=15 refers to the population of employees in 2015, i.e. before the minimum wage increase, and *t*=16 refers to 2016 (post-minimum wage increase). The characteristics X_t include age, gender, education, nationality, permanent / temporary work status and full-time / part-time status. The conditional distribution functions describing the stochastic assignment of wages to workers with characteristics *x* are given by $F_{W_{15}|X_{15}}(w|x)$ and $F_{W_{16}|X_{16}}(w|x)$ for the years 2015 and 2016 respectively. The observed distribution functions for 2015 and 2016, respectively, are $F_{W(15|15)}$ and $F_{W(16|16)}$. The counterfactual distribution, which describes the wages that would have prevailed in 2016 had employees been paid according to the 2015 wage schedule, is $F_{W(15|16)}$. Note that while this counterfactual distribution is not directly observable, it is obtained by integrating the conditional distribution of wages in 2015 with respect to the distribution of employee characteristics in 2016 as follows,

[13] See Chernozhukov et al. (2013) for a detailed discussion of distributional regression techniques.

$$F_{W(15|16)}(w) = \int_{\chi_{16}} F_{W_{15}|X_{15}(w|x)} dF_{X_{16}}(x) \quad (1)$$

As noted by Chernozhukov et al. (2013), equation (1) is well defined if the support of characteristics in the 2015 population, χ_{15}, includes the support of characteristics in the 2016 population, χ_{16}. As we are simply comparing two populations of employees in the same country separated by just one year, and given the characteristics appear relatively stable over time (see Table 1), this is not a strong assumption.

In practical terms, our analysis involves running a series of probit models at each point of the wage distribution in 2015 (pre-minimum wage change). The dependent variable is binary and takes the value of *1* if an individual has an hourly wage below w_i, and *0* otherwise, where w_i takes the value of each point of the wage distribution sequentially. The models are used to predict the probability that an individual has a wage below w_i. Taking the mean predicted probabilities across all individuals at each wage interval, w_i, gives us an estimate of the marginal wage distributions. The model coefficients for 2015 are then applied to individuals in the 2016 data to construct a counterfactual wage distribution, which is an estimate of what the wage distribution in 2016 would have looked like if workers were paid according to the 2015 wage schedule. In our baseline analysis, *w* is increased at 50 cent intervals for all hourly wages in the €5 to €40 range.[14] We choose 50 cent intervals as support can be limited in the tails of the distribution, especially when we look at subsamples of minimum wage workers, such as males, females and young people. However, we verify the robustness of our baseline estimates by increasing *w* at 10 cent intervals for the full sample.

We carry out a decomposition, similar in nature to standard Oaxaca (1973) and Blinder (1973) decomposition techniques, on the observed wage distributions as follows,

$$F_{W(16|16)} - F_{W(15|15)} = \left[F_{W(16|16)} - F_{W(15|16)}\right] + \left[F_{W(15|16)} - F_{W(15|15)}\right] \quad (2)$$

[14] We exclude hourly wages above €40 per hour, which amounts to approximately the top 5 percent of hourly wages. The support in the upper tail beyond this point is limited which prevents us carrying out meaningful analysis with distributional regression techniques in this range.

Equation (2) decomposes the difference in the observed wage distribution into a price effect and a composition effect. The price effect, which is the first term in square parentheses on the right hand side of equation (2), identifies the effect of the increase in the minimum wage on the wage distribution by subtracting the counterfactual distribution from the actual distribution observed in 2016. For clarity, we refer to this price effect as a “minimum wage effect” later in the text. The second term in square parentheses is the composition effect. This captures the change in the distribution that is related to changes in the structure of the workforce.[15] This is obtained by subtracting the 2015 distribution from the counterfactual distribution.

Our methodology allows us to measure the impact of the 2016 minimum wage change on wage inequality in Ireland. This is done by comparing the counterfactual P90/P10 and P75/P25 ratios to the actual 2016 statistics. A fall in these ratios, as a result of the minimum wage change, would be consistent with a fall in wage inequality. We also identify the precise wage range that was affected by the minimum wage change in a statistically significant way, thereby identifying the extent to which low-paid workers were affected. As well as capturing the effect on minimum wage workers, it also highlights any wage spillovers that may have occurred for workers earning above the minimum wage. In addition to applying this methodology to the full sample of employees, we also restrict our analysis to three subsamples: males, females and young workers (aged 25 years and under) as previous research has shown heterogeneous effects of minimum wages for certain groups within the population.

To investigate the effect of the increase in the minimum wage on income inequality, we use the DR method outlined above to model gross equivalised household income before and after the increase in the minimum wage. Explanatory variables in the model include characteristics of the household head (age, age squared, education, marital status, a dummy for Irish nationality and labour market status) as well as an indicator for the number of other earners in the household and the number of weekly labour hours provided by the household. Using the coefficients from the model of gross income before the minimum wage increase, we

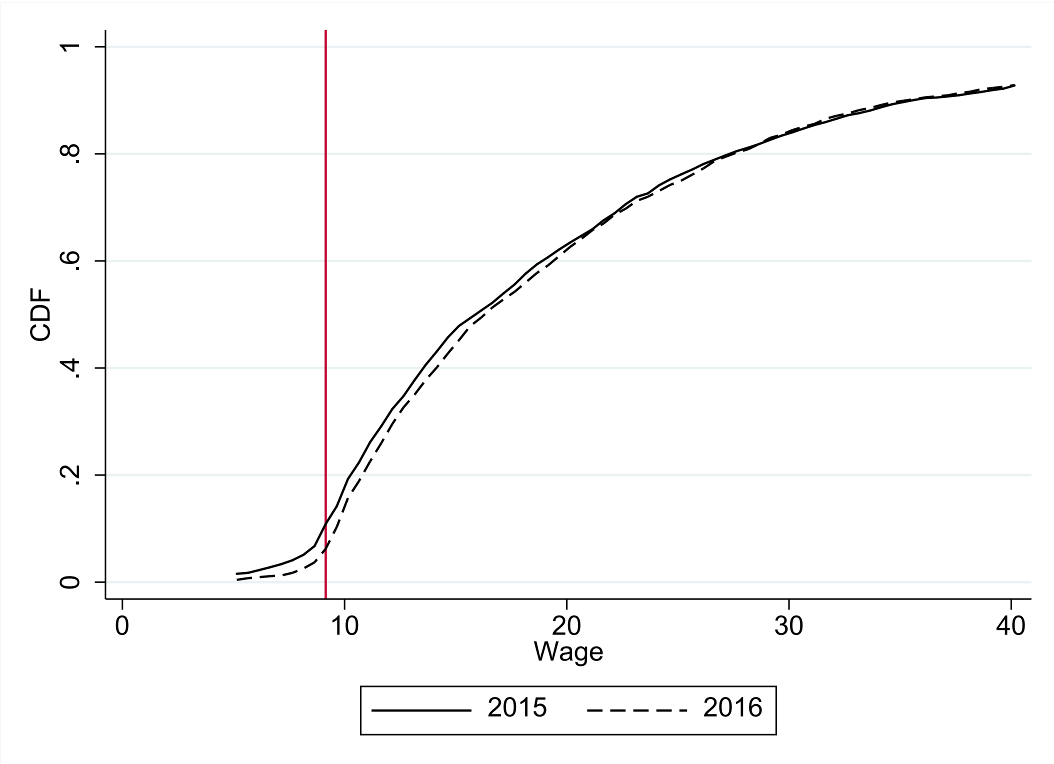
[15] Note that this could include any changes to the structure of the labour supply due to the increase in the minimum wage.

predict the distribution of gross income in the absence of a minimum wage change. The difference between the counterfactual distribution and the actual 2016 distribution gives the effect of the minimum wage increase on gross household income.

4. Results

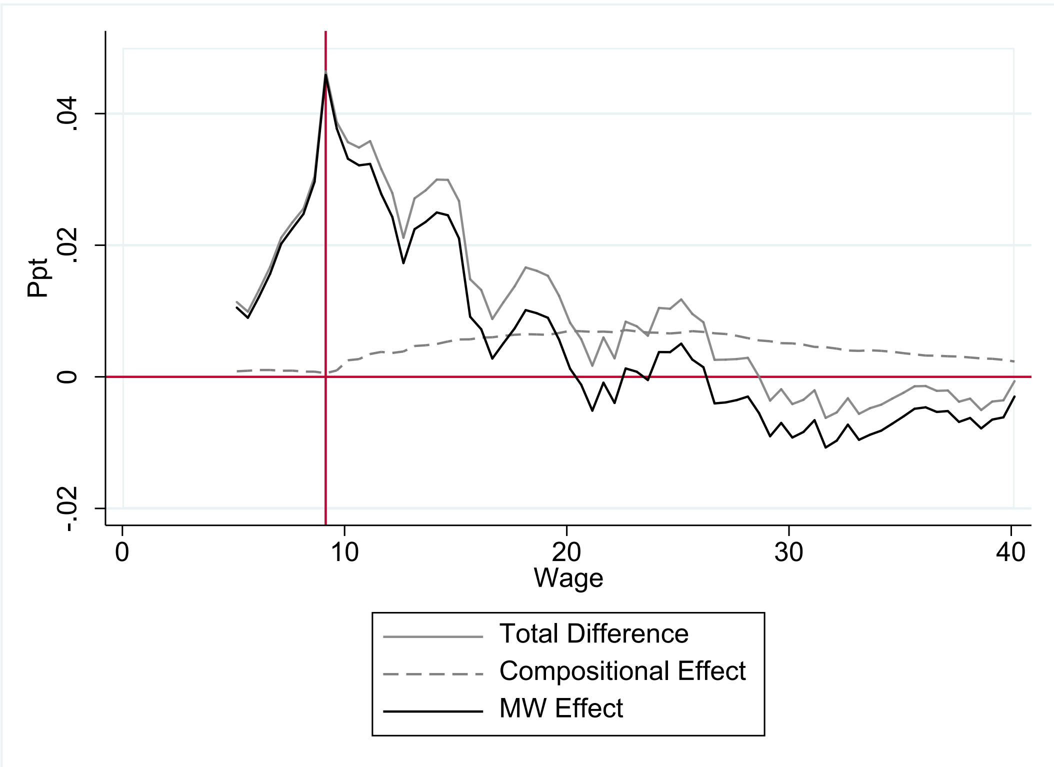
We begin by plotting the 2015 (pre-minimum wage increase) and 2016 (post-minimum wage increase) wage CDFs. The difference between the distributions is greatest in the region of the new 2016 minimum wage, of €9.15 per hour, represented by the vertical line. The fact that the 2016 wage distribution lies below the counterfactual distribution indicates that there are fewer low-paid workers in 2016 compared to 2015.

Figure 2: 2015 and 2016 Hourly Wage Distributions



Our distributional regression decomposition allows us to evaluate how much, if any, of the difference between the 2015 and 2016 CDFs is due to the minimum wage increase, as opposed to compositional changes in the labour force. Figure 3 graphically shows the decomposition described by Equation (2). The vertical difference between the 2015 and 2016 CDFs is shown across the hourly wage range by the “Total Difference” line. This difference is decomposed into the proportion of the gap that is attributable to the minimum wage change, the "MW Effect" line, and the proportion that is attributable to a compositional change, i.e. changes to the education, age, gender, nationality or contract profiles of workers in 2016 compared to 2015 (the "Composition Effect" line). We see that at the lower end of the wage distribution, virtually all of the gap between the 2015 and 2016 CDFs is attributable to the minimum wage change. Moreover, the effect is greatest as precisely the new minimum wage rate of €9.15 per hour, as indicated by the vertical line. As we move higher up the wage distribution, the total difference between the 2015 and 2016 distributions becomes smaller, while at the same time, the compositional effect becomes more important.

Figure 3: Price and Composition Effects of the Minimum Wage Change



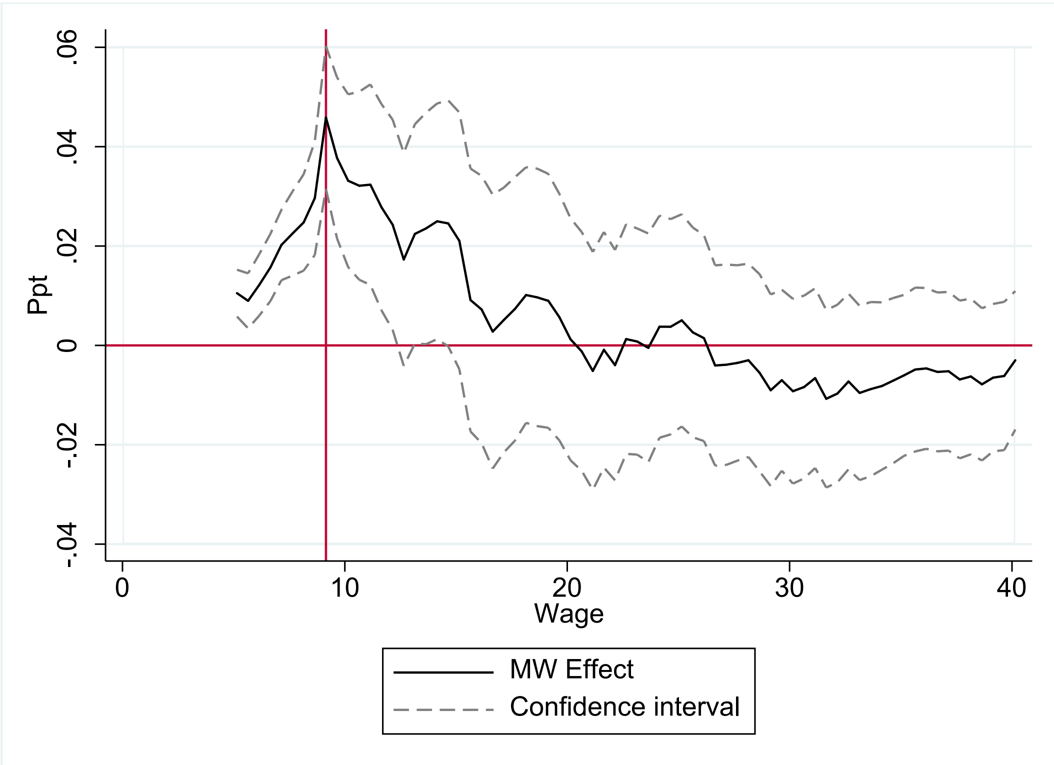
In order to evaluate statistical significance, we generate standard errors using a bootstrapping procedure and plot the *MW Effect* along with fitted 95 percent confidence intervals in Figure 4.[16] Taken together, Figures 2-4 indicate that in the absence of a minimum wage change, approximately 10 percent of workers in 2016 would have earned on or below €9.15 per hour.

[16] As a robustness test, we estimate the model using 10 cent intervals instead of 50 cent intervals. The results are unchanged (see Appendix Table A1).

However, following the minimum wage change, approximately 6 percent of workers had an hourly wage in this range. Therefore, the minimum wage change is associated with a four percentage point reduction in the number of workers earning on or below €9.15 per hour (which corresponds to the peak which occurs just above 0.04 in Figures 3 and 4).

Figure 4 also points towards wage spillover effects, as we observe a statistically significant minimum wage effect up to €12.15 per hour, or the 30th percentile of the wage distribution. This type of wage spillover effect is consistent with the findings of Autor et al. (2016) and Neumark et al. (2004) for the US. However, it stands in contrast to Dickens and Manning (2004a and 2004b) who find no wage spillover effects associated with the UK minimum wage. It is important to note that some of the spillover effects that we detect in our analysis could relate to measurement error when it comes to calculating the hourly wage rate. However, given that we observe a statistically significant impact as far as the 30th percentile of the wage distribution, this points to evidence of genuine wage spillovers.[17]

Figure 4: Minimum Wage Effect and Confidence Intervals



[17] The potential for measurement error is limited given the earnings data, for the most part, comes from administrative data sources. However, hours worked is self-reported, which could generate measurement error.

To measure the impact of the minimum wage change on wage inequality, we report the ratio of the 75th to 25th percentiles (P75/P25) and the 90th to 10th percentiles (P90/P10) of the wage distribution. The results are shown in Table 3. In 2016, the P75/P25 was 2.17, indicating that the hourly wage of those in the 75th percentile was 2.17 times greater than those in the 25th percentile. The P75/P25 from our counterfactual distribution was higher at 2.25. Therefore, inequality fell by just under four percent following the 2016 NMW increase. Our P90/P10 estimate in 2016 was 3.68, versus 3.98 for the counterfactual distribution, indicating that the minimum wage was associated with a reduction in P90/P10 wage inequality of almost eight percent. We also show the average hourly wage of workers in the wage range where a statistically significant minimum wage effect was detected, i.e., €5.65 to €12.15. The average hourly wage in 2016 of workers in this wage range was €10.33 per hour. In the absence of a minimum wage increase, our estimated counterfactual distribution reveals that the average hourly wage in this wage range would have been €10.07 per hour.[18] Therefore, the increase in the minimum wage was associated with an increase of almost three percent in the average hourly wage of low paid employees.

Table 3: Impacts of 2016 NMW Change on Wage Inequality (All Employees)

Full Sample	**2016**	**Counterfactual**	**Difference (%)**
P90 / P10	3.68	3.98	-7.5%
P75 / P25	2.17	2.25	-3.6%
Average wage in range €5.65-€12.15	10.33	10.07	2.6%
Observations	3,641	3,641	

Source: Survey of Income and Living Conditions. The last column shows the percentage difference between the counterfactual and the 2016 figures.

To verify the robustness of our results, we carry out placebo tests by implementing our distributional regression technique on two sets of previous year pairings (2013 to 2014 and 2014 to 2015), during which time no minimum wage change occurred. As shown in Appendix

[18] When comparing the average wages from two distributions in a specific range, the slope of the CDFs as well as their relative position (which one lies above / below the other) can affect the averages. However, in our case, while the actual lies below the counterfactual in this range, the slopes of the two CDFs are similar. Therefore, comparing averages within this range allows us to get a useful estimate of the effect on wages.

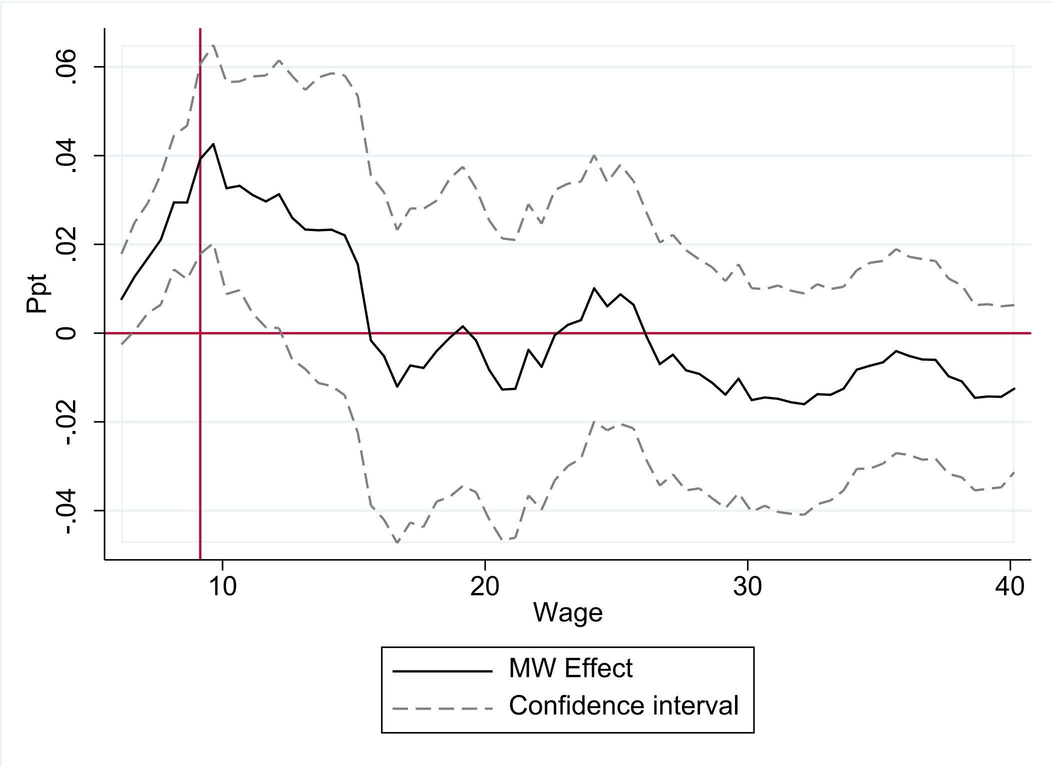
Table A2, we detect no comparable wage effects for the placebo years. The observed price effect is close to zero across the wage distribution in both years. The price effect is not statistically significant, apart from a negative effect, at approximately €14 in the wage distribution in 2015. Importantly, no economically or statistically significant effects are present around the level of the minimum wage in either year. The placebo tests indicate that the wage distribution effects observed in 2016 were not occurring in previous years where no minimum wage change occurred, thereby supporting the view that the observed wage effects in 2016 are related to the minimum wage change.[19]

4.1 The effect of the minimum wage change by gender

We carry out the same analysis, this time focusing on male and female employees separately. Figure 5 shows the effect of the minimum wage on the male wage distribution. As with the full sample of employees, the effect is greatest around the new minimum wage of €9.15 per hour and indicates that the minimum wage change led to a 4 percentage point reduction in the number of workers earning on or below €9.15 per hour. We observe wage spillovers for male employees as far up as €12.15 per hour, or the 27th percentile of the wage distribution. The minimum wage change was associated with a reduction of approximately 12 percent in P90/P10 male wage inequality and five percent in P75/P25 inequality (Table 4). In 2016, the average male wage in the affected wage range was €10.44 per hour, whereas in the absence of a minimum wage change, this would have been 2.7 percent lower, at €10.17 per hour.

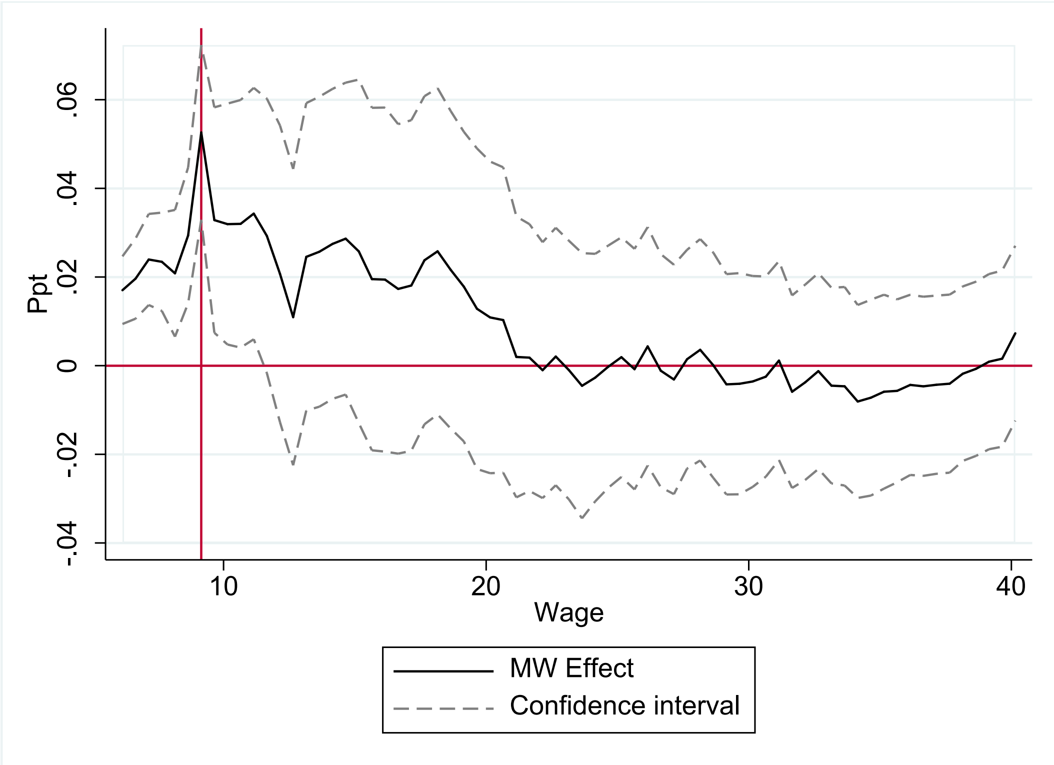
[19] If the negative effects observed in the 2014-2015 period were part of a general, continuing trend, then our 2016 estimates would actually understate the effect of the 2016 minimum wage increase.

Figure 5: Minimum Wage Effect (Males Only)



The effect of the 2016 minimum wage change for females is broadly similar to that for males. Figure 6 shows the effect of the change in the minimum wage on the female wage distribution. The wage effect is slightly larger than that for males, with a reduction of approximately five percentage points in the number of women earning on or below €9.15 per hour. There was a reduction in female P90/P10 and P75/P25 wage inequality of 7 percent and 4.5 percent respectively (Table 4). The affected wage range goes to €11.65 per hour, or the 28th percentile. Average female wages in this range in 2016 was €10.08 per hour. Our analysis indicates that it would have been €9.92 per hour (1.6 percent lower) in the absence of a minimum wage change.

Figure 6: Minimum Wage Effect (Females Only)



Notes: The red line indicates the 2016 minimum wage (€9.15).

Table 4: Impacts of 2016 NMW Change on Wage Inequality by Gender

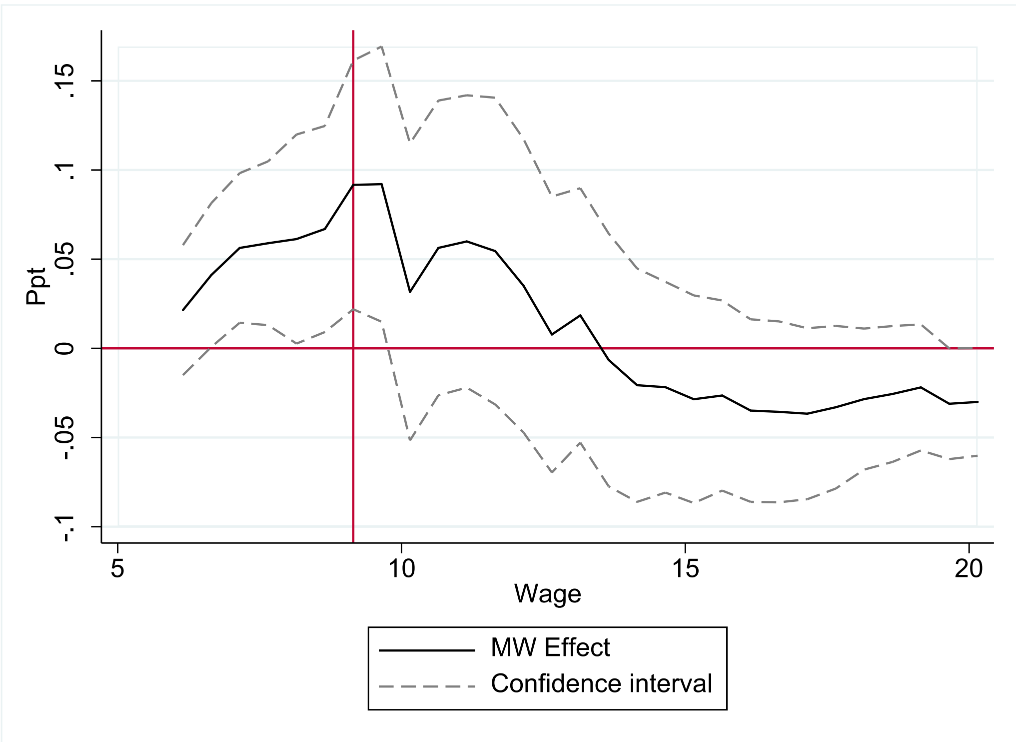
	2016	Counterfactual	Difference (%)
Males			
P90 / P10	3.71	4.20	-11.7%
P75 / P25	2.18	2.29	-4.8%
Average wage in range €6.65-€12.15	10.44	10.17	2.7%
Females			
P90 / P10	3.59	3.86	-7.0%
P75 / P25	2.14	2.24	-4.5%
Average wage in range €6.15-€11.65	10.08	9.92	1.6%

Source: Survey of Income and Living Conditions. The last column shows the percentage difference between the counterfactual and the 2016 figures.

4.2 Young Workers

Previous research has shown that young employees account for a significant share of minimum wage workers in Ireland (Maitre et al., 2017). We investigate the effect of the minimum wage change on the wage distribution of young employees, defined as those aged 25 years or less. Figure 7 shows the estimated effect of the change in the minimum wage across the wage distribution for young workers. Note that younger workers typically earn less than older workers and, as such, the wage distribution extends to €20 per hour.[20] As before, the estimated effect is greatest around the 2016 minimum wage of €9.15 per hour. However, the magnitude of the effect, in percentage point terms, is higher. Among young workers, the 2016 increase in the minimum wage is associated with a nine percentage point reduction in employees earning on or below €9.15 per hour. The impacted wage range extends to €9.65 per hour, or the 32nd percentile. The minimum wage increase was associated with a reduction in P90/P10 and P75/P25 wage inequality of 24 percent and four percent respectively, and an increase of 2.5 percent in the average wages of workers in the impacted wage range.

Figure 7: Minimum Wage Effect (Young Employees Only)



Notes: The red line indicates the 2016 minimum wage (€9.15).

[20] Those above €20 per hour represent the top five percent of young earners.

Table 5: Measures of Inequality and Average Wages of Low Paid Workers (Young Workers Only)

Young workers (Under 25 years of age)	2016	Counterfactual	Difference (%)
P90 / P10	1.87	2.46	-24.0%
P75 / P25	1.37	1.43	-4.2%
Average wage in range €6.65-€9.65	8.95	8.73	2.5%

Source: Survey of Income and Living Conditions. The last column shows the percentage difference between the counterfactual and the 2016 figures.

4.3 The effect of the minimum wage change on gross income inequality

We investigate the effect of the 2016 minimum wage increase on the income distribution using our two measures of household income: monthly gross household employment income and total gross yearly household income. The former measure combines the monthly wages of all employees within the household, while the latter includes all sources of income as well as benefits and transfers. Figure 8 indicates that the 2016 minimum wage increase had little effect on the income distribution, using either measure of income. The price effect oscillates around zero and is not statistically significant at any point of the annual equivalised gross income distribution (ranging from €3,000 to €100,000 per annum). The price effect is also close to zero for most of the monthly gross employment income distribution (ranging from €0 to €5,000 per month) although a small, positive and marginally statistically significant effect is observed in the region just below €1000 per month.

In Figure 9, we plot the distribution of annual household income in Ireland. In the left panel, we condition on minimum wage workers only, while the right panel shows all workers. Rather than being heavily concentrated in low income households, we see that minimum wage workers are spread across the income distribution. They are often located at the top end of the income distribution, with 12 percent in households with income of €100,000 per year or more.[21] This dispersion of minimum wage workers across the household income distribution, combined with the low numbers of minimum wage employees generally and the fact that

[21] The distribution of minimum wage workers extends to €114,000, or the 93rd percentile. We cannot show bins above this point due to reporting restrictions by the Central Statistics Office around small sample sizes.

they are typically not primary earners (Maitre et al., 2017), can help explain why we detect no strong impact on the household income distribution.

An additional factor relates to employment effects of the minimum wage. If the minimum wage increase is associated with a reduction in hours worked of low paid employees, then minimum wage changes can affect the hourly wage distribution without impacting income. This is the finding of Caliendo et al. (2017) for Germany. This may also play a role for Ireland, as McGuinness and Redmond (2019) find that the 2016 minimum wage increase in Ireland was associated with a reduction in the hours worked of minimum wage employees of approximately 0.5 hours per week.

Figure 8: Effect of Minimum Wage Increase on Household Income

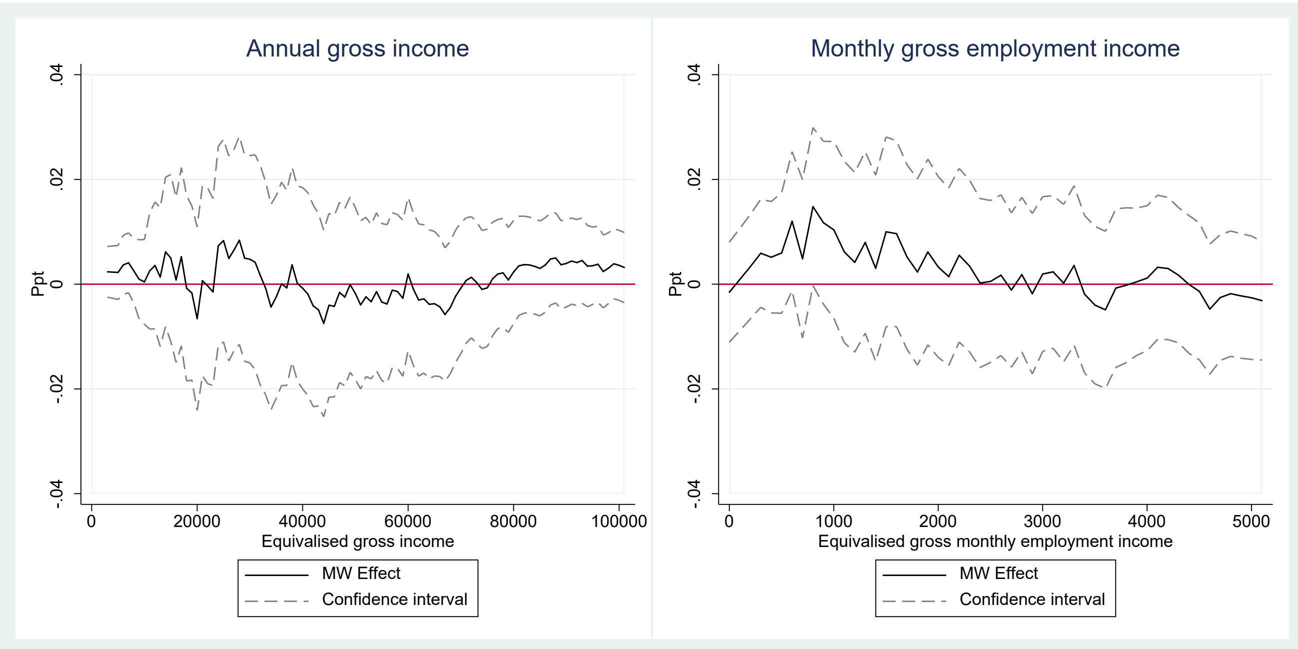
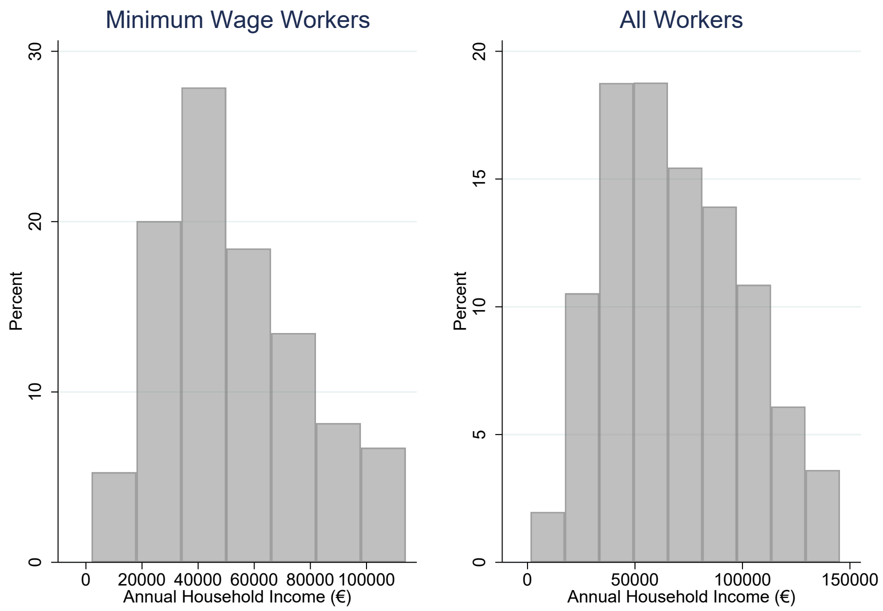


Figure 9: Distribution of Total Yearly Household Income (2015 and 2016)



Notes: The distribution of yearly gross household income is shown for minimum wage employees and all workers. The minimum wage group are defined as those earning €9.15 per hour or less.

5. Conclusion

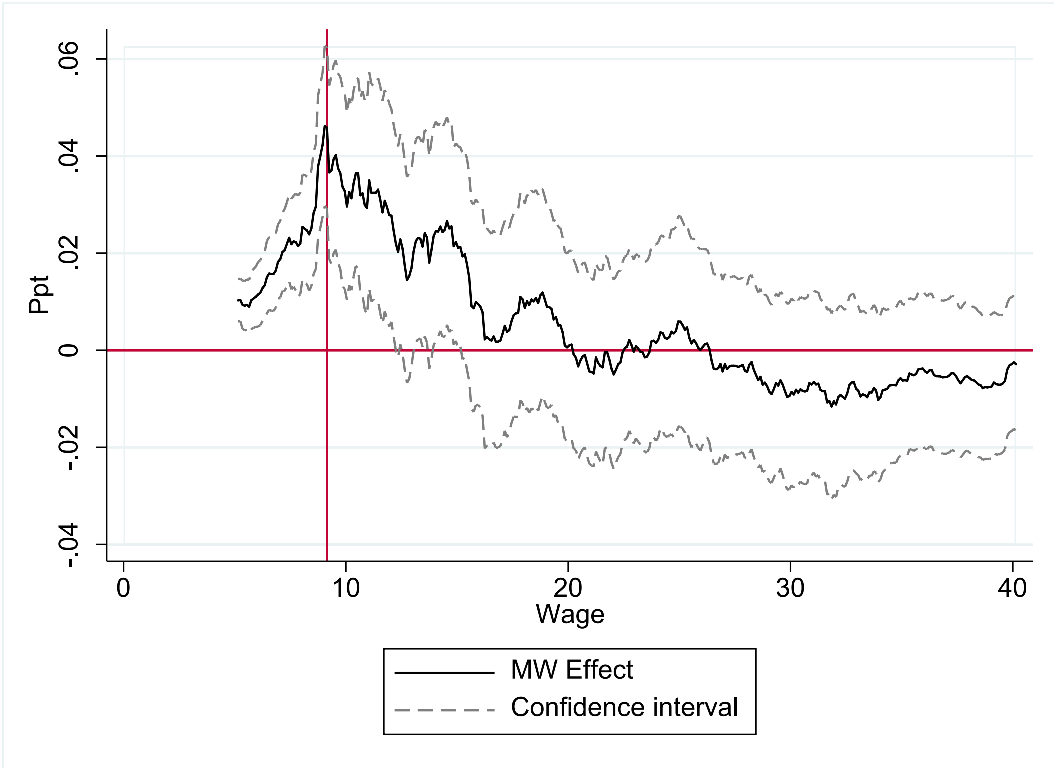
Minimum wage policies aim to ensure fair pay for low paid workers with low bargaining power. While there is some agreement in the international literature that minimum wages affect the wage distribution, the magnitude of the effect is not clear. Moreover, there is disagreement as to whether minimum wages generate wage spillovers by increasing the wages of those earning in excess of the minimum rate. Evidence on potential heterogeneous impacts for certain subsets of employees is also lacking. In this paper, we contribute to the evidence base in this area by examining a minimum wage increase that occurred in Ireland in 2016. Our results indicate that the minimum wage was effective at increasing the wages of low-paid workers and in reducing hourly wage inequality. In the absence of a minimum wage change, approximately 10 percent of workers in 2016 would have earned on or below €9.15 per hour (the 2016 minimum wage rate). However, following the minimum wage change, approximately 6 percent of workers had an hourly wage in this range. With regard to hourly wage inequality, the 2016 minimum wage increase was associated with a reduction of approximately eight percent in the P90/P10 ratio and approximately four percent in the P75/P25 ratio. For young workers, aged 25 years or less, the effects were much greater, with a 24 percent reduction in the P90/P10 ratio. While the impact of the minimum wage is most heavily concentrated in the immediate area of the rate change, we find evidence of wage spillover effects to workers earning in excess of the new minimum wage. These spillovers extend to the 30^{th} percentile of the hourly wage distribution.

While much of the existing work tends to focus on the wage distribution only, we also examine the household income distribution. Our results show that the increase in the minimum wage had very little effect on the household income distribution. Rather than being heavily concentrated among low income households, we show that minimum wage workers are spread throughout the household income distribution, often in high income households. As such, its effectiveness as a policy tool for tackling household poverty is likely to be limited.

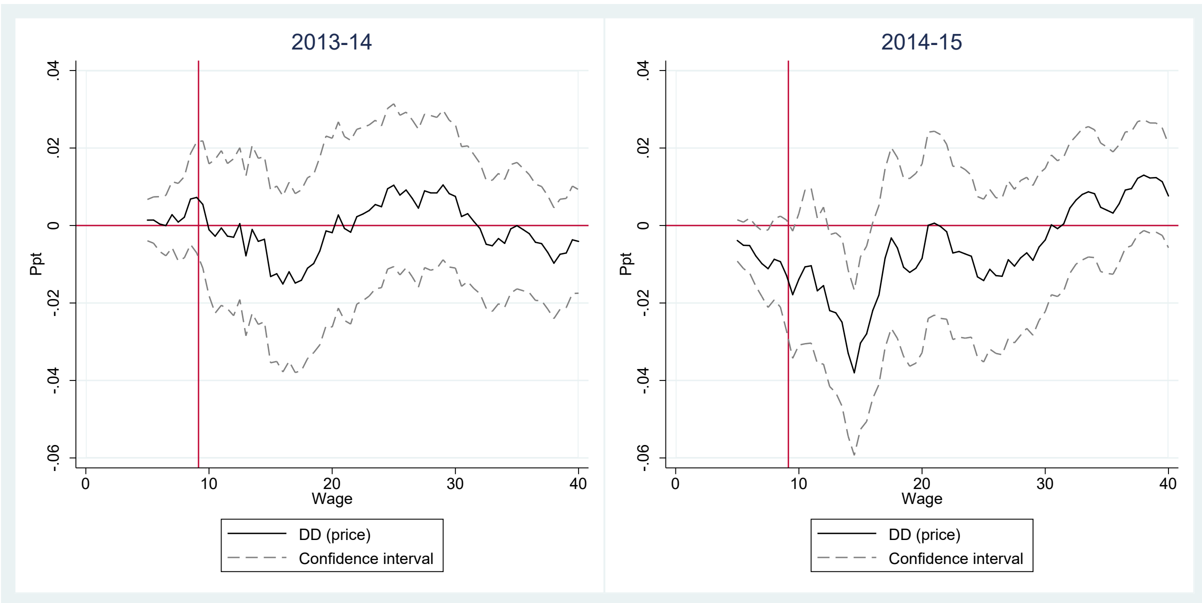
Finally, our paper makes a modest methodological contribution by applying distributional regression techniques to evaluate the impact of a minimum wage change on wage inequality and household income. The approach is particularly well suited to countries which specify an hourly, as opposed to a monthly, minimum wage. In such a setting, distributional regression allows for a greater degree of confidence in identifying causal effects of the minimum wage change on the wage distribution. In this regard, our approach seems well suited to other settings, such as the US and the UK.

Appendix

Appendix Table A1: MW Effect with narrow band (10 cents)



Appendix Table A2: Placebo Analysis



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