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The effects of minimum wage on unemployment for OECD countries: a dynamic fixed effects panel threshold model perspective

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ABSTRACT

The purpose of this paper is to shed new light on the incidence of the minimum wage on the unemployment rate on 33 OECD countries during 1980–2020 period applying a dynamic fixed effects panel threshold model. Controlling for the usual macro-economic and demographic factors, the best model estimates a minimum wage threshold of 9.1667. Specifically, the higher the minimum wage the lower the unemployment rate, however the marginal effect is larger above the threshold value. A single-threshold model is identified for 25–74, secondary and long-term unemployment. The possibility of a double-threshold model is rule out for all the unemployment indicators.

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1. Introduction

Nowadays there is more pressure to apply minimum wages almost everywhere. According to several international institutions such as the IMF, OECD, World Bank or ILO, an appropriate level of a statutory minimum wage is able to generate an increment in labour force participation at the margin avoiding adverse effects on demand which translate into a net positive impact on the labour market (ILO, 2012). In the same line, OECD (2018) ensure that as long as minimum wages are well designed and moderate, unfavorable employment impact can be avoided. A clear recommendation of increasing minimum wage is also proposed by IMF (2014) for the United States due to their low levels. Increasingly, more countries around the world support the idea of introducing minimum wage such as Hong Kong in 2011 or Germany in 2015.

The minimum wage is also considered as a crucial social welfare policy with the purpose of combating poverty in society. In fact, according to Waltman (2008), it is a labour market regulation in terms of design and operation. In particular, the minimum wage legislation forces the employers to focus on cost minimisation. Card and

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Krueger (1995) emphasise that the employer reduce low-paid employment and they replaced it by skilled labor and machinery which are not conditioned by the minimum wage.

According to the Goal 8 of the new 2030 Agenda for Sustainable Development, the International Labour Organization (ILO) has developed an agenda in which productive employment and decent work are key factors to reach fair globalisation and less poverty. To that aim, it focuses on job creation, rights at work, social protection and social dialogue.

There is a vast literature related with the employment effects of minimum wages raises (see for instance, Aaronson et al., 2008; Andrews & Kasy, 2019; Chletsos & Giotis, 2015; Belman & Wolfson, 2014; Leonard et al., 2014; Lynn & Boone, 2015; or Reich et al., 2016). Along literature there are excellent surveys about this relationship: Wolfson and Belman (2019), Neumark (2019), Doucouliagos and Stanley (2009), Neumark and Wascher (2010), Schmitt (2015), among others.

Apart from the no consensus on the sign and size of the employment effects by minimum wages increases, the literature does not reach an agreement about the margins of adjustment to minimum wage. Specifically, many studies have examined whether the minimum wage affects consumers through higher prices (Aaronson & French, 2007; Lemos, 2008; MaCurdy, 2015) or the consequences are paid by firms due to lower profits (Allegretto & Reich, 2018; Draca et al., 2011; Hau et al., 2016; Kim & Jang, 2019; Riley & Bondibene, 2017; among others).

In this paper, I try to shed new light on the incidence of the minimum wage on the unemployment rate on 33 OECD countries during 1980–2020 period applying a non-linear perspective. In particular, I apply the dynamic fixed effects panel threshold model. I also contribute to the scant literature on the incidence on alternative indicators in the labor market based on the unemployment rate. Concretely, several indicators are used: total unemployment, long-term unemployment, below upper secondary, upper secondary-non tertiary, tertiary unemployment, 15–24 and 25 and over unemployment.

The paper is organised as follows. Section 2 offers the most important theoretical views on this relationship and focuses on the main empirical studies along the literature review. Section 3 presents the data used and Section 4 explains the econometric methodology. Moreover, Section 5 provides the corresponding empirical results and concluding remarks and policy implications are provided in Section 6.

2. Literature review

The competitive market model or the simple supply-demand model put forward that a scenario characterised by a competitive labour market with homogenous workers and complete coverage in which the minimum wage is above the market wage level increases in minimum wages reduce the quantity of labour demanded (Brown, 1999; Flinn, 2010; Neumark & Nizalova, 2007; Powell, 2015). One of the first researchers of this school of thought was the study proposed by Stigler (1946). Assuming that the wage is set according to the marginal product, he establishes that those employees whose marginal product is below the minimum wage will be laid off. The reduction

in employment depends on the ability of firms to substitute other factors of production and this is equal to the percentage wage increase multiplied by the elasticity of demand, meaning that for a demand for labor relatively inelastic, the negative effects on employment will not be severe (Edagbami, 2006). Other studies, such as Neumark and Wascher (1992), Burkhauser et al. (2000), Neumark and Wascher (2006) reach the same conclusion: increases in minimum wages translate into more unemployment. Theoretically, minimum wages should cut down the labor demand because substitution and output effects work in the same direction. Moreover, economists who only understand wages as cost of production, it is expected that employers reduce hiring (Fang & Lin, 2015; Jia, 2014). There are many studies which support an important and significant association between minimum wage and employment in panels (see for instance, Burkhauser et al., 2000; Sabia, 2009; Thompson, 2009, among others). However, authors such as Addison et al. (2012) or Allegretto et al. (2011) highlight that this negative relationship can disappear with the inclusion of jurisdiction-specific linear trends or region-year interactions. In particular, these analyses maintain that the adverse impact on employment for teens and low skilled workers is due to the unobserved spatial heterogeneity, since minimum wage amendments are more prone to be implemented in areas with more severe economic shocks. In the same line, authors such as Kahn-Lang and Lang (2020) or Borusyak and Jaravel (2017) offer evidence in which the minimum wage elasticities tend to be quite sensitive to the model component since state-specific time trends are problematic in difference-in-differences approaches.

On the contrary, an opposite view to the competitive market model was developed Card (1992), Katz and Krueger (1992), Card and Krueger (1994, 1995) and Clark (1998). The modern liberal perspective is based on the argument that minimum wage contributes to higher labour productivity by improving the skills of workers. Therefore, the result is a positive relationship between minimum wage and employment. Some advocates of this perspective argue that the neoclassical view is based on an abstract theoretical logic and does not rely upon systematic empirical analysis.

This approach is built on the basis that labour market model is a monopsony in which the imposition of the minimum wage can act to match marginal cost to average cost by rendering a certain portion of monopsonist's supply and marginal cost of labor coincident (Benjamin et al., 2002; Edagbami, 2006). Therefore, this situation leads to an increment in the employment rate (this is only true if transactions wage is less than the competitive equilibrium wage). In a monopsony model, firms behave with ongoing vacancies. In this view, an increment in the minimum wage forces low-wage firms to act as high-wage firms which are characterised by few vacant positions and low labour turnover rates. Henceforth, these firms try to fill their vacancies as soon as possible. For this reason, the modern liberal perspective argues that higher levels of minimum wage can suppose higher employment rates, because monopsony can reverse the negative impact on employment. Apart from the argument of upwards-sloping labor supply schedule as a consequence of the employer's monopsonistic hiring behaviour, the job-search model in which employees make comparisons of wages posted by several firms is another strand to justify the positive relationship between minimum

wages and employment (Burdett & Mortensen, 1989; Card & Krueger, 1994). In more recent studies, Azar et al. (2019) or Neumark and Wascher (1992) argue that it can be generated positive employment effects of the minimum wage in cases such as local labor markets with highly-concentrated low-wage labor markets.

Besides, the Keynesian vision inside the modern liberal perspective points out the necessity of consider not only the supply side but also the demand side to correctly analyse the employment effect of increases in minimum wages. In particular, Keynes recognises that higher unemployment rates are more likely to happen with increments in real wages, especially in recession periods. The reason is based on the fact that companies suffer a lower profitability and this situation can generate an erosion in production terms and more dismissals of workers. Nevertheless, he highlights that firms are able to compensate these adverse effects increasing production and productivity. This argument is reinforced by other authors such as Bender and Theodossiou (1999), Apergis and Theodosiou (2008), Dube et al. (2010) Jardim et al. (2017), among others. Therefore, the demand side acquire significant relevance to justify why is not always true that increases in minimum wages conduct to higher unemployment levels. If employers are more prone to hire more productive employees, hence people are more able to continue their formation and training. It leads to a higher productivity in general, meaning that an improvement in the firms´ success, the employers are more incentive to hire more individuals and therefore reducing unemployment rate. In the same line, Cooke (2005), Han and Wei (2005) and Zhang (2007) argue that higher labor cost is able to induce employers to move up the value-added chain and at the same time promote managerial efficiency and invest in productivity thanks to improving technology. Concretely, not only the adverse effect on employment of a raise in the minimum wage can be mitigated, but also it could increase capital-induced employment and profitability. The argument is the following: firms which pay lower than marginal product, they are able to manage their inventory better and they can invest more in capital, boosting productivity gains substituting previous workers by migrants or increasing prices (Mayneris et al., 2018; Wye & Bahri, 2021; Xu et al., 2015).

Summarising, according to Wye and Bahri (2021) the direct relationship between minimum wage and employment can be argued through the firms´ pricing strategy, passing the cost burden to consumers, reducing labour turnover, hiring more skilled workers, reducing hours worked, raising labor productivity, among others.

According to the international empirical evidence there is no consensus. In fact, Doucouliagos and Stanley (2009), applying a meta-analysis study show high evidence of publication bias of the negative effects of the minimum wage since larger standard errors. For instance, a negative relationship between minimum wage and employment is detected in Brown et al. (1982). In particular, an increment of 10% in the minimum wage erodes youth employment by 1–3% in the United States (USA). A very similar estimations were offered by Neumark and Wascher (1992), in which the same increment in the minimum wage implies a drop in teens and young adults employment rate of 1–2% and 1.5–2%, respectively.

Applying panel data techniques with a synthetic control estimator, Powell (2015) estimates important employment reductions (concretely, an elasticity of −0.44)

associated with higher minimum wages suggesting that the additive fixed effect models are offering estimates biased towards zero. In a more recent study, Paun et al. (2021) find a negative impact of minimum wage on total employment and on sensitive categories (youth, female workers and elderly) for 22 European countries during the period 1999–2016. Applying a complementary study to meta-analyses of the employment effects of minimum wages, Neumark and Shirley (2021) conclude that for 70 papers, the 79.2% of the estimated employment elasticities are negative, more specifically, the 53.8% are negative and significant at 10% level and the 46.2% at 5% level or better. This negative impact is stronger for teens and young adults and for less-educated workers.

Among studies which argue that high minimum wage can generate a financial burden for employers in the sense that it can force them to significantly reduce the number of jobs for low-skilled workers and at the end it translates into lower employment, we can find Brown (1999), Neumark and Wascher (2006), Neumark and Nizalova (2007), among others.

According to the competitive labor markets and time series models, the imposition of a binding wage floor, e. g. minimum wage, has usually involved a reduction in employment for young and less-skilled workers. Nevertheless, quasi-experimental models considering longitudinal and cross-sectional data do not support the negative employment effects in the United States and in the OECD countries. No evidence of adverse effect on youth workers is detected immediately following the reform in the minimum wages in New Zealand, but some weak impact of employment loss is identified for this country by 2003 (Hyslop & Stillman, 2007).

The supporters of implementing minimum wages focus on the fact that higher wages in low-paid workers may contribute to higher motivation in their jobs promoting positive effects (see for instance, Dickens et al., 1999; Dube et al., 2010); Jardim et al., 2017; Metcalf, 2008).

There are several authors which conclude that the impact of minimum wage increases on employment is minimal or non-existent. For instance, Metcalf (2008) or Schmitt (2013) hold up that this outcome is due to the impact on hours rather than workers or due to employer wage schemes and labor market frictions. Moreover, this study points out that it can be because of productivity improvements or by the tax credit system, prices raises and profits cutting. Besides, foreign direct investment can be seen as an instrument to smooth or mitigate the impact on the employment (Alam & Shah, 2013; Coniglio et al., 2015).

Some of these studies which have identified impact very close to zero have been criticised due to the fact that they rely on small and temporary shocks for identification (see for instance, Aaronson et al., 2018; Sorkin, 2015) or because they focus on the short-term responses not reflecting the adjustment costs (Chetty et al., 2011). In order to overcome these issues, Harasztosi and Lindner (2019) examine Hungary, characterised by large and persistent raise in the minimum wage and applying a partial equilibrium model, they found that around 30,000 of 290,000 lost their job, while the remaining undergone a 60% increase in their wages. This increment in the labor cost was absorbed by higher output prices suggesting that the incidence of higher minimum wages fell mainly on consumers.

Several meta-analysis for United Kingdom show no impact on employment after controlling for publication bias (see for instance de Linde Leonard et al., 2014 or Hafner et al., 2017). Some authors such as Rebitzer and Taylor (1995), Van Den Berg (2003), Flinn (2010) or Dube et al. (2016) argue the near-zero effect due to labor market frictions. In fact, many authors who have emphasised the relevance of controlling for unobserved time trending heterogeneity within states do not find significant employment effects (Rybczynski & Sen, 2018). In the same line, Güven et al. (2011) justify the non-impact on employment due to the result of non-cointegration and non-causality between these two variables for Turkey during 1969–2008. Specifically, they emphasise that minimum wages should be above average wages to perceive a negative impact on employment. No significant disemployment effects are detected by Cengiz et al. (2019) since it is true that higher minimum wages lead to jobs destruction, concretely those which pay below the new minimum wage, however it is clearly outweighed with higher employment associated with slightly higher wages. Nevertheless, studies such as Portugal and Cardoso (2006), O'Neill et al. (2006) or Hyslop and Stillman (2007, 2011) do not have found any impact on employment considering large changes in minimum wages in which they are relatively high.

Results very heterogeneous are detected by Neumark (2001) for several regions in China. In particular, for state-owned firms in the East, a positive impact on employment is identified to monopsonistic pattern. However, regions are characterised by slower growing, adverse employment effects isolated. Nonetheless, for prosperous and growing Easter region no negative impact is underscored.

Analysing 17 OECD economies during 1975–2000, Neumark and Wascher (2004) show elasticities ranging from −0.19 to −0.31 for teenagers and −0.15 to −0.28 for youths. This negative impact is reinforced by their dynamic specification. However, active labor market policies and employment protection outweigh disemployment effects. In the same line, Addison and Ozturk (2012) identify adverse employment impact among adult females and participation rates due to raises in minimum wages. Noticeable is the fact that policymakers need to know how to behave with minimum wages in periods of recessions. For this reason, Dolton and Bondibene (2012) pay attention to these phases along 1971–2009 period for 33 OECD and Europe countries. They find a significantly negative relationship on youth employment, but less significant disemployment effects for adults. In a more recent study, a positive significant effect on employment and labor force participation rate is obtained by Chletsos and Giotis (2015) for teenagers, young adults and youth except for 55–64 years old.

In more recent studies, the non-linearities have been considered. Concretely, Christl et al. (2018) argue that the relationship between minimum wage and employment is not linear. For these authors, raises in minimum wage can positively contribute to employment up to certain point and higher levels can dominate the negative effects on the positive ones. Nonlinearities in the minimum wagés effects are also detected in Clemens and Strain (2018) being consistent with standard labor models, since up to certain point minimum wage increases suppose a reduction over 1 percentage point for low-skilled workers, however for higher raises even positive effects are detected. An inverted U-shape link between minimum wages and employment is

detected for 31 Chinese provinces between 2004 and 2015 suggesting a maximum threshold value for minimum wage (Wye & Bahri, 2021).

3. Data

In this analysis I consider 33 OECD countries during 1980–2020 period: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Luxembourg, Mexico, Netherlands, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States, Chile, Estonia, Israel, Lithuania, Latvia, Slovenia.

The annual real minimum wage was extracted from the World Bank's World Development Indicators as 2020 USD constant prices. Additionally, following Bayrak and Tatli (2018), Heimberger et al. (2017), Folawewo and Adeboje (2017), Baah-Boateng (2013), among others, I consider several control macroeconomic factors which explain the behavior of unemployment rate such as: initial unemployment rate, inflation rate (taking the CPI index), the real gross domestic product, population growth rate, productivity, foreign domestic investment (as percentage of the GDP) and public debt (as percentage of the GDP) extracted from the OECD database and the World Bank's World Development Indicators.

As far as I know, only a few studies have underscored the relevance of considering the economic downturn as an important factor to capture the employment impact of minimum wages (Chletsos & Giotis, 2015; Dolton & Bondibene, 2012). In fact, Dube et al. (2010) highlight that economic expansion may enhance employment creation, rather than economic recession in which there is an exacerbation of the unemployment raise through the substitution effect. For this reason, I use the GDP in order to reflect the economic cycle.

It is important to mention that many studies have focuses on employment effects on teens, however according to Manning (2021), this group has experienced an important decline in the share of total employment. In particular, he points out that this age group only represent 2% of the total hours worked in 2019. Additionally, he highlights that in 1979 almost one in three minimum wage workers was a teen rather than nowadays that is one in ten. Since the 20–24 group of minimum wage workers is over twice as large as the teen group, I pay attention to the impact of minimum wage on unemployment for a more extended age group to capture this trend. For this reason, I consider the following age groups: the 15–24 and the 25–74 unemployment rates.

Appendix A offers some graphics as a more descriptive analysis about the behavior among minimum wages and different categories of the unemployment rate for the OECD countries analysed in this study

4. Econometric methodology

Following Christl et al. (2018), Clemens and Strain (2018) and Wye and Bahri (2021), the possibility of a nonlinearity relationship between minimum wage and unemployment rate is analysed in this section for 33 OECD countries during 1980–2020 period.

The purpose of this study is to provide more empirical evidence about the existence of an asymmetric impact of minimum wage on unemployment rate. To that aim, I apply a dynamic panel threshold model in which the specific threshold is determined endogeneously, controlling for the most common explanatory factors which have been consistently identified as the main drivers of unemployment in the literature.

Heterogeneity is a very frequent characteristic in panel data. It is very common that each country is different and therefore it can explain that a structural relationship varies across economies. Usually, the classical fixed and random effect models capture the heterogeneity only in the intercepts. Nevertheless, the dynamic fixed-effect panel threshold model goes beyond capturing the jumping character or the so-called structural break in the relationship between these two variables (minimum wage and unemployment rate).

The single-threshold model can be expressed in the following form:

$$y_{it} = \alpha_i + X_{it}(q_{it} < \tau)\delta_1 + X_{it}(q_{it} \geq \tau)\delta_2 + e_{it} \tag{1}$$

in which α_i are the country−specific intercepts, q_{it} is the threshold variable and τ is the threshold parameter. The variables are expressed in logarithms to analyse elasticities.

Instead of searching in the whole sample, this procedure restricts the range within the interval $(\underline{\tau}, \overline{\tau})$, which are quantiles of q_{it}. The corresponding $\tau's$ estimator is achieved when the residual sum of squares (RSS) is minimised as follows, based on a subset of the threshold variable (q_{it}):

$$\hat{\tau} = \operatorname{argmin} S_1(\tau) \tag{2}$$

It is well known the nuisance parameter problem associated when the threshold parameter is unknown due to the fact that estimation and inference is more complex because the τ estimator's distribution is nonstandard. Hansen (1999) solves this concern proving that $\hat{\tau}$ is a consistent estimator for τ.

Given the purpose of analysing whether it is a threshold value from which the impact on unemployment may be different in each regime, I implement the following test. In the null hypothesis, the linear model is reflected rather than in the alternative hypothesis in which the single-threshold model is captured as follows:

$$H_0 : \delta_1 = \delta_2 \;\; H_1 : \;\; \delta_1 \neq \delta_2 \tag{3}$$

and the corresponding F statistic is computed as:

$$F_1 = \frac{(S_0 - S_1)}{\hat{\sigma}^2} \tag{4}$$

in which S_0 corresponds to the RSS of the linear model. The associated critical values for the F statistics are constructed based on boostrap method to guarantee the significance of threshold.

In addition to that, I also consider the feasibility of presenting multiple-threshold models. To carry out this possibility, I apply this procedure sequentially. Specifically, I introduce another test in which the null hypothesis is associated with a single-threshold model and the alternative hypothesis is the double-threshold model which can be developed as follows:

$$y_{it} = \alpha_i + X_{it}(q_{it} < \tau_1)\delta_1 + X_{it}(\tau_1 \leq q_{it} < \tau_2)\delta_2 + X_{it}(q_{it} \geq \tau_2)\delta_3 + e_{it} \tag{5}$$

where τ_1 *and* τ_2 are the two threshold values and δ_1, δ_2 *and* δ_3 capture the three impacts for each regime.

The way to proceed is very easy. First, it is crucial to estimate the threshold estimator τ_1 linked to the single-threshold model and the second stage is to compute the associated RSS ($S_1\ (\hat{\gamma}_1)$). Thereafter, the next step is related to work out the second threshold and its confidence interval:

$$\hat{\tau}_2^r = argmin\{S_2^r(\tau_2)\} \tag{6}$$

$$S_2^r = S\{\min(\hat{\tau}_1, \tau_2)\max(\hat{\tau}_1, \tau_2)\} \tag{7}$$

$$LR_2^R(\tau_2) = \frac{\{S_2^r(\tau_2 - S_2^r(\hat{\tau}_2^r)\}}{\hat{\sigma}_{22}^2} \tag{8}$$

Finally, to compute the F statistic is:

$$F_2 = \frac{\{S_1(\hat{\tau}_1) - S_2^r(\hat{\tau}_2)\}}{\hat{\sigma}_{22}^2} \tag{9}$$

The procedure is recursively, henceforth in case a double-threshold model is identified, the following step would be testing whether a triple-threshold model exists.

I perform Monte Carlo simulations in order to study the size of the threshold-effect test and the coverage rate of the threshold estimator. The boostrap iteration number is set to 300 for the single-threshold model and the iteration number of Monte Carlo simulation is set to 500.

5. Empirical results

Table 1 shows the results of the dynamic fixed effect panel threshold model for 33 OECD countries during 1980–2020 period.[1] In the upper part of the table, it can be seen the corresponding estimated minimum wage threshold and the corresponding 95% confidence interval. From model *a* to *h*, it has been considered several explanatory variables as the main drivers of unemployment rate recognised along the empirical literature. The minimum wage threshold ranges from 9.1667 to 9.1912 considering these alternative models. According to the usual criteria for model selection, the best model corresponds to model *h*. Focusing on this specification, the estimated minimum wage threshold is 9.1667 which is statistically significant at the 5%

Table 1. Results of minimum wage and its impact on total unemployment.

	Model a	Model b	Model c	Model d	Model e	Model f	Model h
Threshold estimates ($\hat{\tau}$)	9.1667	9.1667	9.1667	9.1667	9.1912	9.1667	9.1667
Significance of threshold *p*-value	0.0040	0.0010	0.0060	0.0130	0.0100	0.0430	0.0270
95% confidence interval	[9.1302, 9.1764]	[9.1302, 9.1764]	[9.1302, 9.1764]	[9.1345, 9.1764]	[9.1414, 9.1938]	[9.1345, 9.1764]	[9.1345, 9.1745]
Impact of threshold variable on unemployment rate:							
$\hat{\delta}_1$	−0.4735***	−0.4665***	−0.5348***	−0.4131***	−0.3927***	−0.6869***	−0.6581***
	(0.0798)	(0.0806)	(0.0987)	(0.0930)	(0.0928)	(0.0912)	(0.0907)
$\hat{\delta}_2$	−0.5308***	−0.5240***	−0.5920***	−0.4669***	−0.4469***	−0.7296***	−0.7019***
	(0.0762)	(0.0773)	(0.0960)	(0.0915)	(0.0902)	(0.0874)	(0.0879)
Impact of control variables on unemployment rate:							
$\text{Unemployment}_{t-1}$	0.5666***	0.5627***	0.5778***	0.6142***	0.6401***	0.6418***	0.6461***
	(0.0724)	(0.0723)	(0.0748)	(0.0680)	(0.0679)	(0.0630)	(0.0629)
Inflation	−0.0333***	−0.0335***	−0.0330***	−0.0289***	−0.0288***	−0.0260***	−0.0259***
	(0.0040)	(0.0040)	(0.0040)	(0.0038)	(0.0038)	(0.0034)	(0.0034)
GDP		−0.1125*	−0.1365**	−0.1468**	−0.1467**	−0.1486**	−0.1398***
		(0.0689)	(0.0502)	(0.0256)	(0.0256)	(0.0245)	(0.0081)
Population			___	−0.2945***	−0.2940***	−0.1310***	−0.1319***
				(0.0351)	(0.0353)	(0.0371)	(0.0360)
Productivity			0.0045	0.0004	−0.0009	−0.0006	−0.0018
			(0.0036)	(0.0038)	(0.0030)	(0.0028)	(0.0030)
FDI					−0.0023**	___	−0.0020**
					(0.0012)		(0.0008)
Debt						0.0063***	0.0064***
						(0.0010)	(0.0008)
Constant	6.9208***	7.2861***	7.2600***	6.4756***	5.9008***	7.6025***	8.6340***
	(0.7259)	(0.6970)	(0.9652)	(0.8869)	(0.7265)	(0.6974)	(0.7967)
N	500	500	500	500	500	500	500
R^2 within	0.3630	0.3245	0.3806	0.4596	0.4547	0.4896	0.5586
R^2 between	0.1043	0.1114	0.0930	0.1630	0.1549	0.1513	0.2425
R^2 overall	0.0378	0.0530	0.0586	0.0964	0.0999	0.1164	0.1160

Notes: In the ordinary brackets below the parameter estimates are the corresponding *z*-statistics, computed using White (1980)'s heteroskedasticity-robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1% respectively.
Source: OECD database and the World Bank's Development Indicators.

level and the 95% confidence interval is [9.1345, 9.1745]. The corresponding regime-dependent coefficient is displayed in the middle part of Table 1.

Specifically, $\hat{\delta}_1$, and $\hat{\delta}_2$ represent the marginal effects of the minimum wage on unemployment rate when the minimum wage is below and above the estimated threshold value, respectively. Concretely, the higher the minimum wage the lower the unemployment rate; however, the intensity is different if we compare below and above its threshold. In other words, when the minimum wage is below its threshold (9.1667), raises in minimum wage lead to a reduction in total unemployment rate ($\hat{\delta}_1 = -0.6581$), nonetheless the shortfall in this indicator is significantly higher ($\hat{\delta}_2 = -0.7018$) when this value is above its threshold. It can be seen that these estimated parameters statistically differ looking at the significance of the thresholds *p*-values in Table 1. Besides, these marginal effects are statistically significant at 1% significance level and the marginal effect is stronger above the threshold value. Therefore, there is evidence of a non-linear relationship between minimum wages and unemployment rate. In particular, there exists a negative relationship between these two variables, nevertheless the elasticity is higher above the economy achieve this estimated threshold.

Finally, the coefficients of the control variables are presented in the lower part of this table. The explanatory factors offer the expected signs. On the one hand, the previous unemployment rate is one of the most important and significant factors to explain the behavior of the actual one. The higher the initial unemployment, the higher the unemployment rate in the present. A positive relationship is also detected between unemployment rate and public debt.[2]

On the other hand, the results are in line with the Phillips curve in which the nexus between inflation rate and unemployment rate is inverse. Trying to capture the business cycle in the analysis between unemployment and minimum wage, the GDP is included (Chletsos & Giotis, 2015; Dube et al., 2010; Dolton & Bondibene, 2012). The higher the economic performance, the lower will be the total unemployment rate. In the same vein, the population growth significantly erodes the total unemployment rate. Many authors, such as Card and Krueger (1995), Cooke (2005), Zhang (2007), Apergis and Theodosiou (2008) or Jardim et al. (2017), have emphasised that the implications of minimum wages raises into an improvement in productivity. The results obtained in these estimations reveal that more productivity contribute to reduce unemployment rate. Furthermore, a negative and significant relationship is pointed out between foreign direct investment and unemployment rate (similar results are supported by Dritsakis & Stamatiou, 2018; Johnny et al., 2018; Tegep et al., 2019; among others).

In order to distinguish whether there is an asymmetric behavior in the presence of raises in minimum wages on the long-term unemployment or between young and adult unemployment or depending on the education level unemployment, Table 2 offers the results of the dynamic fixed effects panel threshold model. On the one hand, it can be concluded that we do not have enough statistical evidence to reject the null hypothesis of linear model for 15–24 unemployment rate,[3] for below secondary and tertiary unemployment rate. On the contrary, a single-threshold model is identified for 25–74 unemployment rate, secondary unemployment and for the long-term unemployment. Focusing on the latter group, it can be seen that an expansion

Table 2. Results of minimum wage and its impact on long-term unemployment, unemployment by age (youth and adult), and unemployment by education level.

	Long-term unemployment	[15–24] unemployment	[25–74] unemployment	Below Secondary unemployment	Secondary unemployment	Tertiary unemployment
Threshold estimates ($\hat{\tau}$)	9.4308	9.1063	9.1667	8.7271	9.1667	9.1560
Significance of threshold *p*-value	0.0660	0.1350	0.0380	0.3740	0.0450	0.2800
95% Confidence interval	[9.4206, 9.4310]	[9.1019, 9.1081]	[9.1345, 9.1764]	[8.6952, 8.7289]	[9.1390, 9.1764]	[9.1208, 9.1628]
Impact of threshold variable on unemployment rate:						
$\hat{\delta}_1$	−0.3900***	−0.4888***	−0.6734***	−0.9274***	−0.6838***	−0.6459***
	(0.0720)	(0.0952)	(0.0925)	(0.1007)	(0.1034)	(0.1008)
$\hat{\delta}_2$	−0.4137***	−0.5255***	−0.7178***	−0.8935***	−0.7310***	−0.6777***
	(0.0710)	(0.0922)	(0.0899)	(0.0965)	(0.1005)	(0.0976)
Impact of control variables on unemployment rate:						
$\text{Unemployment}_{t-1}$	0.6023***	0.5896***	0.6338***	0.6327***	0.6298***	0.5346***
	(0.0608)	(0.0615)	(0.0624)	(0.0677)	(0.0665)	(0.0632)
Inflation	−0.0099***	−0.0211***	−0.0269***	−0.0222***	−0.0293***	−0.0322***
	(0.0029)	(0.0035)	(0.0036)	(0.0037)	(0.0040)	(0.0038)
GDP	−0.1436**	−0.1563***	−0.1496***	−0.1369***	−0.1402***	−0.1468***
	(0.0256)	(0.0039)	(0.0028)	(0.0036)	(0.0047)	(0.0040)
Population	−0.0997***	−0.1368***	−0.1295***	−0.1259***	−0.0960**	−0.0229
	(0.0320)	(0.0359)	(0.0366)	(0.0388)	(0.0409)	(0.0391)
Productivity	−0.0035	0.0030	−0.0006	−0.0004	0.0015	0.0044
	(0.0029)	(0.0028)	(0.0029)	(0.0032)	(0.0032)	(0.0031)
FDI	−0.0002	−0.0018**	−0.0020**	−0.0018**	−0.0024**	−0.0018*
	(0.0007)	(0.0009)	(0.0010)	(0.0011)	(0.0009)	(0.0010)
Debt	0.0044***	0.0057***	0.0069***	0.0098***	0.0082***	0.0075***
	(0.0006)	(0.0008)	(0.0008)	(0.0007)	(0.0008)	(0.0007)
Constant	6.9684***	7.3236***	8.1974***	10.3695***	8.1863***	7.1196***
	(0.6165)	(0.7922)	(0.7896)	(0.8310)	(0.8544)	(0.8329)
N	480	500	500	480	480	500
R^2 within	0.4721	0.4768	0.5510	0.5369	0.5412	0.4650
R^2 between	0.1227	0.1227	0.2863	0.1900	0.1591	0.1364
R^2 overall	0.1186	0.1896	0.1367	0.1697	0.2173	0.0917

Notes: In the ordinary brackets below the parameter estimates are the corresponding *z*-statistics, computed using White (1980)'s heteroskedasticity-robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1% respectively.
Source: OECD database and the World Bank's Development Indicators.

Table 3. Multiple-threshold models of each explanatory variable and its impact on unemployment.

Minimum wage and its impact on total unemployment							
Threshold estimator (level = 95):							
Model		Threshold		Lower		Upper	
Th_1		9.1667		9.1345		9.1745	
Th_21		9.1667		9.1345		9.1745	
Th_22		9.5227		9.5000		9.5279	
Threshold-effect test:							
Threshold	RSS	MSE	F-stat	Prob	Crit10	Crit5	Crit1
Single	22.4633	0.0468	50.23	0.0270	38.0437	44.5115	56.8163
Double	21.5603	0.0449	20.10	0.5080	34.7678	42.6691	57.4896
Minimum wage and its impact on long-term unemployment							
Threshold estimator (level = 95):							
Model		Threshold		Lower		Upper	
Th_1		9.4308		9.4206		9.4310	
Th_21		9.4308		9.4206		9.4310	
Th_22		9.7403		9.7250		9.7530	
Threshold-effect test:							
Threshold	RSS	MSE	F-stat	Prob	Crit10	Crit5	Crit1
Single	15.3753	0.0334	32.24	0.0660	28.9893	33.9733	48.0394
Double	14.6385	0.0318	23.16	0.2620	30.9378	36.4292	50.2348
Minimum wage and its impact on 25–74 unemployment							
Threshold estimator (level = 95):							
Model		Threshold		Lower		Upper	
Th_1		9.1667		9.1345		9.1764	
Th_21		9.1667		9.1345		9.1764	
Th_22		9.5227		9.5000		9.5279	
Threshold-effect test:							
Threshold	RSS	MSE	F-stat	Prob	Crit10	Crit5	Crit1
Single	23.4930	0.0489	48.18	0.0380	37.0215	42.8696	57.6346
Double	22.6944	0.0473	16.89	0.6640	36.0662	42.2288	58.6571
Minimum wage and its impact on secondary unemployment							
Threshold estimator (level = 95):							
Model		Threshold		Lower		Upper	
Th_1		9.1667		9.1390		9.1764	
Th_21		9.1667		9.1390		9.1764	
Th_22		10.1050		10.0924		10.1067	
Threshold-effect test:							
Threshold	RSS	MSE	F-stat	Prob	Crit10	Crit5	Crit1
Single	27.9953	0.0609	45.48	0.0450	39.1138	47.0509	62.4618
Double	26.3023	0.0572	29.61	0.1850	34.2137	39.9841	54.9974

Notes: In the threshold-effect test we show the RSS, the mean squared error (MSE), the F statistic (F-stat), the probability value of the F statistic (Prob) and the critical values at 10%, 5% and 1% significance levels (Crit10, Crit5 and Crit1, respectively). Th_21 and Th_22 refers to the two estimators in the double-threshold model. Single considers that the null hypothesis is the linear model and the alternative hypothesis is the single-threshold model and Double captures a single-threshold model in the null hypothesis and a double-threshold model in the alternative hypothesis.
Source: OECD database and the World Bank's Development Indicators.

of the minimum wage supposes a deterioration in each of these indicators. In particular, above their corresponding thresholds the marginal effect is significantly higher. The explanatory variables which have been considered to control for macroeconomic and demographic factors offer the expected signs.

In order to check the stability of these results and given the heterogeneity among countries in the sample, this study also offers the estimated impact on the total unemployment and on the long-term unemployment rate excluding both the highest and the lowest minimum wages countries to ensure the robustness of the results (see the Appendix B).[4] Additionally, splitting the sample before and after 2008 crisis the conclusions are qualitative very similar.[5]

Taking into account these results, I also check the feasibility of testing for a double-threshold model for the measures in which a single-threshold model has been detected. The results are presented in Table 3. In all cases, we are only able to reject the null hypothesis of a linear model being more appropriate the single-threshold model; however, we cannot reject the null hypothesis of single-threshold model (see the *p*-values of 0.5080 for total unemployment, 0.2620 for long-term unemployment, 0.6640 for 25–74 unemployment and 0.1850 for secondary unemployment). Therefore, the possibility of a double-threshold model is rule out for all the unemployment indicators.

6. Concluding remarks

There is a vast literature related with the employment effects of minimum wages raises (see for instance, Aaronson et al., 2008; Andrews & Kasy, 2019; Belman & Wolfson, 2014; Chletsos & Giotis, 2015; Leonard et al., 2014; Lynn & Boone, 2015; or Reich et al., 2016). Nevertheless, there is no consensus on either the sign or the size of the employment effects, not even on the margins of adjustment to minimum wage (see for instance, Clemens & Strain, 2018; Hirsch et al., 2015; Kim & Jang, 2020; Meer & West, 2016; Totty, 2017; among others). Specifically, many studies have examined whether the minimum wage affects consumers through higher prices (Aaronson & French, 2007; Lemos, 2008; MaCurdy, 2015) or the consequences are paid by firms due to lower profits (Allegretto & Reich, 2018; Draca et al., 2011; Hau et al., 2016; Kim & Jang, 2019; Riley & Bondibene, 2017; among others).

In this paper, I try to shed new light on the incidence of the minimum wage on the unemployment rate on 33 OCDE countries during 1980–2020 period applying a non-linear perspective. As far as I know, this is the first time a dynamic fixed effects panel threshold model is applied for these countries, since the classical fixed and random effect models only reflect the heterogeneity in the intercepts while this more recent methodology captures the jumping character or the so-called structural break. This allow us to estimate the threshold from which a different pattern in the minimum wage-unemployment nexus is detected.

I also contribute to the scant literature on the incidence on alternative indicators in the labor market based on the unemployment rate. Moreover, this study also pays attention to analyse the heterogeneity in the estimates of the minimum wage elasticities. Concretely, several indicators are used: total unemployment, long-term unemployment, below upper secondary, upper secondary-non tertiary, tertiary unemployment, 15–24 and 25 and over unemployment.

Controlling for the usual macroeconomic and demographic factors mostly identified as the main drivers of unemployment and according to the usual criteria for

model selection, the best model estimates a minimum wage threshold of 9.1667 which is statistically significant at the 5% level. The results suggest that the higher the minimum wage the lower the unemployment rate, however the intensity is different if we compare below and above its threshold. Concretely, if the minimum wage is below its threshold, raises in minimum wage lead to a reduction in total unemployment rate, nevertheless the shortfall in this indicator is significantly higher when this value is above its threshold. These marginal effects are statistically significant at 1% significance level and the marginal effect is stronger above the threshold value.

In this study, the possibility of an asymmetric behavior in the presence of raises in minimum wages on the long-term unemployment or between young and adult unemployment or depending on the education level unemployment is also analysed. On the one hand, it can be concluded that we do not have enough statistical evidence to reject the null hypothesis of linear model for 15–24 unemployment rate, for below secondary and tertiary unemployment rate. On the contrary, a single-threshold model is identified for 25–74 unemployment rate, secondary unemployment and for the long-term unemployment. Focusing on the latter group, it can be seen that an expansion of the minimum wage supposes a deterioration in each of these indicators. In particular, above their corresponding thresholds the marginal effect is significantly higher.

Taking into account these results, I also check the feasibility of testing for a double-threshold model for the measures in which a single-threshold model has been detected. In all cases, the possibility of a double-threshold model is rule out for all the unemployment indicators.

The results are in line with authors such as Christl et al. (2018), Clemens and Strain (2018) and Wye and Bahri (2021) identifying a non-linear relationship between minimum wage and unemployment indicators. The main policymaking implication deriving from these results is that minimum wage is an effective policy in order to reduce unemployment rate paying attention to the asymmetric pattern offered in this study, since above the estimated thresholds the elasticities are significantly higher. Henceforth, minimum wage can be understood as a key factor in order to promote the access and the use of socioeconomic resources to combat poverty since the unemployment rate is reduced. In order words, raising minimum wages may stimulate stable economic growth due to higher purchasing power to lower social classes (Lester et al., 2013; Sabia & Nielsen, 2012; Waltman, 2008). Therefore, if policymakers seek to make minimum wage policy based on empirical evidence, the dynamic fixed effects panel threshold methodology may help to better understand that the impact is not inconsequential.

Disclosure statement

No potential conflict of interest was reported by the authors.

Notes

1. According to Dube et al. (2010), Allegretto et al. (2011) or Addison et al. (2012), this table offers the estimations including time effects as part of the dynamic fixed effects panel threshold model.

2. This result is in line with Fedeli and Forte (2012) in which the authors show how high public deficits (inclusive of the repayment of interests, particularly if it is accompanied by high public expenditures and taxation) are likely to aggravate unemployment rate during 1981-2009 period for 19 OECD countries, suggesting that non-Keynesian fiscal theories more oriented to reducing too large public spending are needed. In other words, public debt can generate a burden for future generations due to future taxpayer's burden and therefore this situation translates into greater unemployment. According to Buchanan (1978), excessive burden of public debt may be dangerous and an important example was in the 2007-2009 crisis, in which the risk of debt default hit Greece, Italy, Portugal, Ireland and Spain achieving higher unemployment rates.
3. According to Manning (2021), I consider a more extended group, the 15-24 age group.
4. The highest minimum wages countries are: Luxembourg, France, Belgium, Austria and Netherlands. The lowest minimum wages economies are: Latvia, Mexico and Chile.
5. The results are not shown here due to space restrictions but are available from the author upon request.

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References

Aaronson, D., & French, E. (2007). Product market evidence on the employment effects of the minimum wage. *Journal of Labor Economics*, *25*(1), 167–200. https://doi.org/10.1086/508734

Aaronson, D., French, E., & MacDonald, J. (2008). The minimum wage, restaurant prices, and labor market structure. *Journal of Human Resources*, *43*(3), 688–720. https://doi.org/10.1353/jhr.2008.0007

Aaronson, D., French, E., Sorkin, I., & To, T. (2018). Industry dynamics and the minimum wage: A putty-clay approach. *International Economic Review*, *59*(1), 51–84. https://doi.org/10.1111/iere.12262

Addison, J. T., & Ozturk, O. D. (2012). Minimum wages, labor market institutions and female employment: A cross-country analysis. *ILR Review*, *65*(4), 779–809. https://doi.org/10.1177/001979391206500402

Addison, J. T., Blackburn, M. L., & Cotti, C. D. (2012). The effect of minim wages on labour market outcomes: County-level estimates from the restaurant and bar sector. *British Journal of Industrial Relations*, *50*(3), 412–435. https://doi.org/10.1111/j.1467-8543.2010.00819.x

Alam, A., & Shah, Z. A. (2013). Determinants of foreign direct investment in OECD member countries. *Journal of Economic Studies*, *40*(4), 515–527. https://doi.org/10.1108/JES-10-2011-0132

Allegretto, S., & Reich, M. (2018). Are local minimum wages absorbed by price increases? Estimates from internet-based restaurant menus. *ILR Review*, *71*(1), 35–63. https://doi.org/10.1177/0019793917713735

Allegretto, S. A., Dube, A., & Reich, M. (2011). Do minimum wages really reduce teen employment? Accounting for heterogeneity and selectivity in state panel data. *Industrial Relations: A Journal of Economy and Society*, *50*(2), 205–240. https://doi.org/10.1111/j.1468-232X.2011.00634.x

Andrews, I., & Kasy, M. (2019). Identification of and correction for publication bias. *American Economic Review*, *109*(8), 2766–2794. https://doi.org/10.1257/aer.20180310

Apergis, N., & Theodosiou, I, University of Aberdeen & University of Macedonia at Thessaloniki. (2008). The employment-wage relationship: Was Keynes right after all? *American Review of Political Economy*, *6*(1), 40–50. https://doi.org/10.38024/arpe.100

Azar, J., Huet-Vaughn, E., Marinescu, I., Taska, B., & von Wachter, T. (2019). Minimum wage employment effects and labor market concentration. In *NBER Working Paper No. 26101*. National Bureau of Economic Research.

Baah-Boateng, W. (2013). Determinants of unemployment in Ghana. *African Development Review*, *25*(4), 385–399. https://doi.org/10.1111/1467-8268.12037
Bayrak, R., & Tatli, H. (2018). The determinants of youth unemployment: A panel data analysis of OECD countries. *The European Journal of Comparative Economics*, *15*(2), 231–248.
Belman, D., & Wolfson, P. J. (2014). What does the minimum wage do? Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. EQ: Maybe 2013 in text.
Bender, K. A., & Theodossiou, I. (1999). International comparisons of the real wage-employment relationship. *Journal of Post Keynesian Economics*, *21*(4), 621–637. https://doi.org/10.1080/01603477.1999.11490219
Benjamin, D., Gunderson, M., & Riddell, C. W. (2002). *Labour market economics* (5th ed.). McGraw-Hill Ryerson.
Bishop, J. (2018). The effect of minimum wage increases on wages, hours worked and job loss. Bulletin of Reserve Bank of Australia, September 20.
Borusyak, K., & Jaravel, X. (2017). Revisiting event study designs: With an application to the estimation of the marginal propensity to consume. Unpublished manuscript, Harvard University, Boston.
Brown, C. (1999). Minimum wages, employment and the distribution of income. *Handbook of Labor Economics*, *3*, 2101–2163.
Brown, C., Gilroy, C., & Kohen, A. (1982). The effect of the minimum wage on employment and unemployment. *Journal of Economic Literature*, *20*(2), 487–528.
Buchanan, J. M. (1978). *The ethics of debt default, in Deficits* (pp. 361–373) (Buchanan, J. N.-Rowley, & C.-Tollison, R. D. Editor). Basil Blackwell.
Burdett, K., & Mortensen, D. T. (1989). Equilibrium wage differentials and employer size. Center for Mathematical Studies in Economics and Management Science Discussion Paper No. 860. October. Chicago IL: Northwestern University.
Burkhauser, R. V., Couch, K. A., & Wittenburg, D. C. (2000). A reassessment of the new economics of the minimum wage literature with monthly data from the current population survey. *Journal of Labor Economics*, *18*(4), 653–680. https://doi.org/10.1086/209972
Campolieti, M. (2020). Does an increase in the minimum wage decrease employment? A meta-analysis of Canadian studies. *Canadian Public Policy*, *46*(4), 531–564. https://doi.org/10.3138/cpp.2019-070
Card, D. (1992). Do minimum wages reduce employment? A case of study of California, 1987–1989. *Industrial and Labour Relations Review*, *46*(1), 38–54.
Card, D., & Krueger, A. B. (1994). Minimum wages and employment: A case study of the fast-food industry in New Jersey and Pennsylvania. *American Economic Review*, *84*(4), 772–793.
Card, D., & Krueger, A. B. (1995). *Myth and measurement: The new economics of the minimum wage*. Princeton University Press.
Cengiz, D., Dube, A., Lindner, A., & Zipperer, B. (2019). The effect of minimum wages on low-wage jobs. *The Quarterly Journal of Economics*, *134*(3), 1405–1454. https://doi.org/10.1093/qje/qjz014
Chetty, R., Friedman, J. N., Olsen, T., & Pistaferri, L. (2011). Adjustment costs, firm responses and micro vs. macro labor supply elasticities: Evidence from Danish tax records. *The Quarterly Journal of Economics*, *126*(2), 749–804. https://doi.org/10.1093/qje/qjr013
Chletsos, M., & Giotis, G. P. (2015). The impact of minimum wage on employment in an economic downturn using data from 17 OECD countries for the period 1985–2008. MPRA Paper No. 61323.
Christl, M., Koppl-Turyna, M., & Kucsera, D. (2018). Revisiting the employment effects of minimum wages in Europe. *German Economic Review*, *19*(4), 426–465. https://doi.org/10.1111/geer.12135
Clark, B. (1998). *Political economy: A comparative approach* (2nd ed.). Praeger Publishers.
Clemens, J., & Strain, M. (2018). The short-run employment effects of recent minimum wage changes: Evidence from the American Community Survey. *Contemporary Economic Policy*, *36*(4), 711–722. https://doi.org/10.1111/coep.12279

Clemens, J., & Wither, M. (2019). The minimum wage and the Great Recession: Evidence of effects on the employment and income trajectories of low-skilled workers. *Journal of Public Economics*, *170*, 53–67. https://doi.org/10.1016/j.jpubeco.2019.01.004

Coniglio, N. D., Prota, F., & Seric, A. (2015). Foreign direct investment, employment and wages in Sub-Saharan Africa. *Journal of International Development*, *27*(7), 1243–1266. https://doi.org/10.1002/jid.3044

Cooke, F. L. (2005). *HRM, work and employment in China*. Routledge.

de Linde Leonard, M., Stanley, T. D., & Doucouliagos, H. (2014). Does the UK minimum wage reduce employment? A meta-regression analysis. *British Journal of Industrial Relations*, *52*(3), 499–520. https://doi.org/10.1111/bjir.12031

Dickens, R., Machin, S., & Manning, A. (1999). The effects of minimum wages on employment: Theory and evidence from Britain. *Journal of Labor Economics*, *17*(1), 1–22. https://doi.org/10.1086/209911

Dolton, P., & Bondibene, C. R. (2012). The international experience of minimum wages in an economic downturn. *Economic Policy*, *27*(69), 99–142. https://doi.org/10.1111/j.1468-0327.2011.00278.x

Doucouliagos, H., & Stanley, T. D. (2009). Publication selection bias in minimum-wage research? A meta-regression analysis. *British Journal of Industrial Relations*, *47*(2), 406–428. https://doi.org/10.1111/j.1467-8543.2009.00723.x

Draca, M., Machin, S., & Van Reenen, J. (2011). Minimum wages and firm profitability. *American Economic Journal: Applied Economics*, *3*(1), 129–151. https://doi.org/10.1257/app.3.1.129

Dritsakis, N., & Stamatiou, P. (2018). Causal nexus between FDI, exports, unemployment and economic growth for the old European Union members. Evidence from panel data. *International Journal of Economic Sciences*, *VII*(2), 35–56. https://doi.org/10.20472/ES.2018.7.2.002

Dube, A., Lester, T. W., & Reich, M. (2016). Minimum wage shocks, employment flows and labor market frictions. *Journal of Labor Economics*, *34*(3), 663–704. https://doi.org/10.1086/685449

Dube, A., Lester, T. W., & Reich, M. (2010). Minimum wage effects across state borders: Estimates using contiguous counties. *Review of Economics and Statistics*, *92*(4), 945–964. https://doi.org/10.1162/REST_a_00039

Edagbami, O. (2006). *The employment effects of the minimum wage: A review of the literature*. Canadian Policy Research Networks.

Fang, T., & Lin, C. (2015). Minimum wages and employment in China. *IZA Journal of Labor Policy*, *4*(1), 22. https://doi.org/10.1186/s40173-015-0050-9

Fedeli, S., & Forte, F. (2012). Public debt and unemployment growth: The need of new fiscal-monetary rules. Evidence from OECD countries. *Economia Politica*, *29*(3), 409–438.

Flinn, C. J. (2010). *The minimum wage and labour market outcomes*. The MIT Press.

Folawewo, A. O., & Adeboje, O. M. (2017). Macroeconomic determinants of unemployment: Empirical evidence from economic community of West African States. *African Development Review*, *29*(2), 197–210. https://doi.org/10.1111/1467-8268.12250

Güven, A., Mollavelioglu, S., & Dalgic, B. (2011). Does minimum wage increase employment? Evidence from Turkey, 1969–2008. *ODTÜ Gelistirme Dergisi*, *38*, 147–166.

Hafner, M., Taylor, J., Pankowska, P., Stepanek, M., Nataraj, S., & van Stolk, C. (2017). *The impact of the national minimum wage on employment*. Rand Europe.

Han, Z., & Wei, Z. (2005). Minimum wage research based on grey model. *Mathematics in Practice and Theory*, *35*(9), 99–104.

Harasztosi, P., & Lindner, A. (2019). Who pays for the minimum wage? *American Economic Review*, *109*(8), 2693–2727. https://doi.org/10.1257/aer.20171445

Hau, H., Huang, Y., & Wang, G. (2016). Firm response to competitive shocks: Evidence from Chinás minimum wage policy. Swiss Finance Institute Research Paper 16–47.

Heimberger, P., Kapeller, J., & Schütz, B. (2017). The NAIRU determinants: Whatś structural about unemployment in Europe? *Journal of Policy Modeling*, *39*(5), 883–908. https://doi.org/10.1016/j.jpolmod.2017.04.003

Hirsch, B. T., Kaufman, B. E., & Zelenska, T. (2015). Minimum wage channels of adjustment. *Industrial Relations: A Journal of Economy and Society*, *54*(2), 199–239. https://doi.org/10.1111/irel.12091

Hyslop, D., & Stillman, S. (2007). Youth minimum wage reform and the labour market in New Zealand. *Labour Economics*, *14*(2), 201–230. https://doi.org/10.1016/j.labeco.2005.10.001

Hyslop, D., & Stillman, S. (2011). *The impact of the 2008 youth minimum wage reform*. The Department of Labour.

ILO. (2012). Boosting jobs and living standards in G20 countries: A joint report by the ILO, OECD, IMF and the World Bank.

IMF. (2014). Article IV consultation with the United States of America concluding statement of the IMF mission.

Jardim, E., Long, M. C., Plotnick, R., Van Inwegen, E., Vigdor, J., & Wething, H. (2017). Minimum wage increases, wages and low-wage employment: Evidence from Seattle (No. W23532). *National Bureau of Economic Research.*

Jia, P. (2014). Employment and working hour effects of minimum wage increase: Evidence from China. *China & World Economy*, *22*(2), 61–80. https://doi.org/10.1111/j.1749-124X.2014.12062.x

Johnny, N., Timipere, E. T., Krokeme, O., & Markjackson, D. (2018). Impact of foreign direct investment on unemployment in Nigeria (1980–2015). *International Journal of Academic Research in Business and Social Sciences*, *8*(3), 57–69. https://doi.org/10.6007/IJARBSS/v8-i3/3905

Kahn-Lang, A., & Lang, K. (2020). The promise and pitfalls of differences-in-differences: Reflections on 16 and pregnant and other applications. *Journal of Business & Economic Statistics*, *38*(3), 613–620. https://doi.org/10.1080/07350015.2018.1546591

Katz, L. F., & Krueger, A. B. (1992). The effect of the minimum wage on the fast-food industry. *ILR Review*, *46*(1), 6–21. https://doi.org/10.1177/001979399204600102

Kar, B. B., Egri, T., & Aksunger, N. (2019). Minimum wage and employment: A dynamic heterogeneous approach for OECD countries. *Turkish Journal of Islamic Economics*, *6*(2), 80–106. https://doi.org/10.26414/A069

Kim, H. S., & Jang, S. (2020). Does a minimum wage increase endanger restaurant jobs? Examining the role of franchising. *International Journal of Hospitality Management*, *84*, 102325. https://doi.org/10.1016/j.ijhm.2019.102325

Kim, H. S., & Jang, S. (2019). Minimum wage increase and firm productivity: Evidence from the restaurant industry. *Tourism Management*, *71*, 378–388. https://doi.org/10.1016/j.tourman.2018.10.029

Lemos, S. (2004). Minimum wage policy and employment effects: Evidence from Brazil. *Economía*, *5*(1), 219–266. https://doi.org/10.1353/eco.2005.0007

Lemos, S. (2008). A survey of the effects of the minimum wage on prices. *Journal of Economic Surveys*, *22*(1), 187–212. https://doi.org/10.1111/j.1467-6419.2007.00532.x

Lester, W., Madland, D., & Odum, J. (2013). Raising the minimum wage would help, not hurt our economy. Center for American Progress Action Fund. December 3, 2013.

Lynn, M., & Boone, C. (2015). Have minimum wage increase hurt the restaurant industry? The evidence say no! *Cornell Hospitality Report*, *15*(22), 3–13.

MaCurdy, T. (2015). How effective is the minimum wage at supporting the poor? *Journal of Political Economy*, *123*(2), 497–545. https://doi.org/10.1086/679626

Mayneris, F., Poncet, S., & Zhang, T. (2018). Improving or disappearing: Firm-level adjustments to minimum wages in China. *Journal of Development Economics*, *135*, 20–42. https://doi.org/10.1016/j.jdeveco.2018.06.010

Manning, A. (2021). The elusive employment effect of the minimum wage. *Journal of Economic Perspectives*, *35*(1), 3–26. https://doi.org/10.1257/jep.35.1.3

Meer, J., & West, J. (2016). Effects of the minimum wage on employment dynamics. *Journal of Human Resources*, *51*(2), 500–522. https://doi.org/10.3368/jhr.51.2.0414-6298R1

Metcalf, D. (2008). Why has the British national minimum wage had little or no impact on employment? *Journal of Industrial Relations*, *50*(3), 489–512. https://doi.org/10.1177/0022185608090003

Neumark, D. (2019). The econometrics and economics of the employment effects of minimum wages: Getting from known unknowns to known knowns. *German Economic Review*, *20*(3), 293–329. https://doi.org/10.1111/geer.12184

Neumark, D. (2001). The employment effects of minimum wages: Evidence from a pre-specified research design. *Industrial Relations: A Journal of Economy and Society*, *40*(1), 121–144. https://doi.org/10.1111/0019-8676.00199

Neumark, D., & Shirley, P. (2021). Myth or measurement: What does the new minimum wage research say about minimum wages and job loss in the United States? NBER Working Paper No. w28388.

Neumark, D., & Nizalova, O. (2007). Minimum wage effects in the longer run. *Journal of Human Resources*, *XLII*(2), 435–452. https://doi.org/10.3368/jhr.XLII.2.435

Neumark, D., & Wascher, W. (2006). Minimum wages and employment. *Foundations and Trends® in Microeconomics*, *3*(1–2), 1–182. https://doi.org/10.1561/0700000015

Neumark, D., & Wascher, W. (1992). Employment effects of minimum and subminimum wages: Panel data on state minimum wage laws. *ILR Review*, *46*(1), 55–81. https://doi.org/10.1177/001979399204600105

Neumark, D., & Wascher, W. (2004). Minimum wages, labor market institutions and youth employment: A cross national analysis. *ILR Review*, *57*(2), 223–248. https://doi.org/10.1177/001979390405700204

Neumark, D., & Wascher, W. (2010). *Minimum wages*. MIT Press.

OECD. (2018). *Good jobs for all in a changing world of work: The OECD jobs strategy*.

O'Neill, D., Nolan, B., & Williams, J. (2006). Evaluating the introduction of a national minimum wage: Evidence from a new survey of firms in Ireland. *Labour*, *20*(1), 63–90. https://doi.org/10.1111/j.1467-9914.2006.00334.x

Ozdemir, A., Mercan, M., & Erol, H. (2012). Türkiye emek piyasasinda belirlenmifl makro ekonomik degiskenler arasindaki iliskilerin ekonometrik analizi. *TISK Academy/TISK Akademi*, *7*(14), 34–53.

Paun, C. V., Nechita, R., Patruti, A., & Topan, M. V. (2021). The impact of the minimum wage on employment: An EU panel data analysis. *Sustainability*, *13*(16), 9359. https://doi.org/10.3390/su13169359

Portugal, P., & Cardoso, A. R. (2006). Disentangling the minimum wage puzzle: An analysis of worker accessions and separations. *Journal of the European Economic Association*, *4*(5), 988–1013. https://doi.org/10.1162/JEEA.2006.4.5.988

Powell, D. (2015). Synthetic control estimation beyond case studies: Does the minimum wage reduce employment? Working Paper WR1142. RAND Labor & Population.

Rebitzer, J. B., & Taylor, L. J. (1995). The consequences of minimum wage laws: Some new theoretical ideas. *Journal of Public Economics*, *56*(2), 245–255. https://doi.org/10.1016/0047-2727(93)01411-3

Reich, M., Montialoux, C., Allegretto, S., Jacobs, K., Bernhardt, A., & Thomason, S. (2016). *The effects of a $15 minimum wage by 2019 in San Jose and Santa Clara county*. University of California.

Riley, R., & Bondibene, C. R. (2017). Raising the standards: Minimum wages and firm productivity. *Labour Economics*, *44*, 27–50. https://doi.org/10.1016/j.labeco.2016.11.010

Rybczynski, K., & Sen, A. (2018). Employment effects of the minimum wage: Panel data evidence from Canadian provinces. *Contemporary Economic Policy*, *36*(1), 116–135. https://doi.org/10.1111/coep.12241

Sabia, J. (2009). Identifying minim wage effects in state panels: Evidence from the current population survey. *Industrial Relations: A Journal of Economy and Society*, *48*(2), 311–328. https://doi.org/10.1111/j.1468-232X.2009.00559.x

Sabia, J., & Nielsen, R. (2012). Can raising the minimum wage reduce poverty and hardship? Employment Policies Institute (EPI), April.

Schmitt, J. (2013). *Why does the minimum wage have no discernible effect on employment?* Center for Economic and Policy Research (CEPR).

Schmitt, J. (2015). Explaining the small employment effects of the minimum wage in the United States. *Industrial Relations: A Journal of Economy and Society*, *54*(4), 547–581. https://doi.org/10.1111/irel.12106

Sorkin, I. (2015). Are there long-run effects of the minimum wage? *Review of Economic Dynamics*, *18*(2), 306–333. https://doi.org/10.1016/j.red.2014.05.003

Stigler, G. J. (1946). The economics of minimum wage legislation. *The American Economic Review*, *36*(3), 358–365.

Tegep, J., Suratman, E., & Indra, S. (2019). The failure of foreign direct investment to explain unemployment rate and the mediating role of economic growth and minimum wage. *International Journal of Economics and Financial*, *9*(2), 154–161.

Thompson, J. P. (2009). Using local labor market data to reexamine the employment effects of the minimum wage. *ILR Review*, *62*(3), 343–366. https://doi.org/10.1177/001979390906200305

Totty, E. (2017). The effect of minimum wages on employment: A factor model approach. *Economic Inquiry*, *55*(4), 1712–1737. https://doi.org/10.1111/ecin.12472

Van Den Berg, G. J. (2003). Multiple equilibria and minimum wages in labor markets with informational frictions and heterogeneous production technologies. *International Economic Review*, *44*(4), 1337–1357. https://doi.org/10.1111/1468-2354.t01-1-00112

Waltman, J. L. (2008). *Minimum wage policy in Great Britain and the United States*. Algora Publishing.

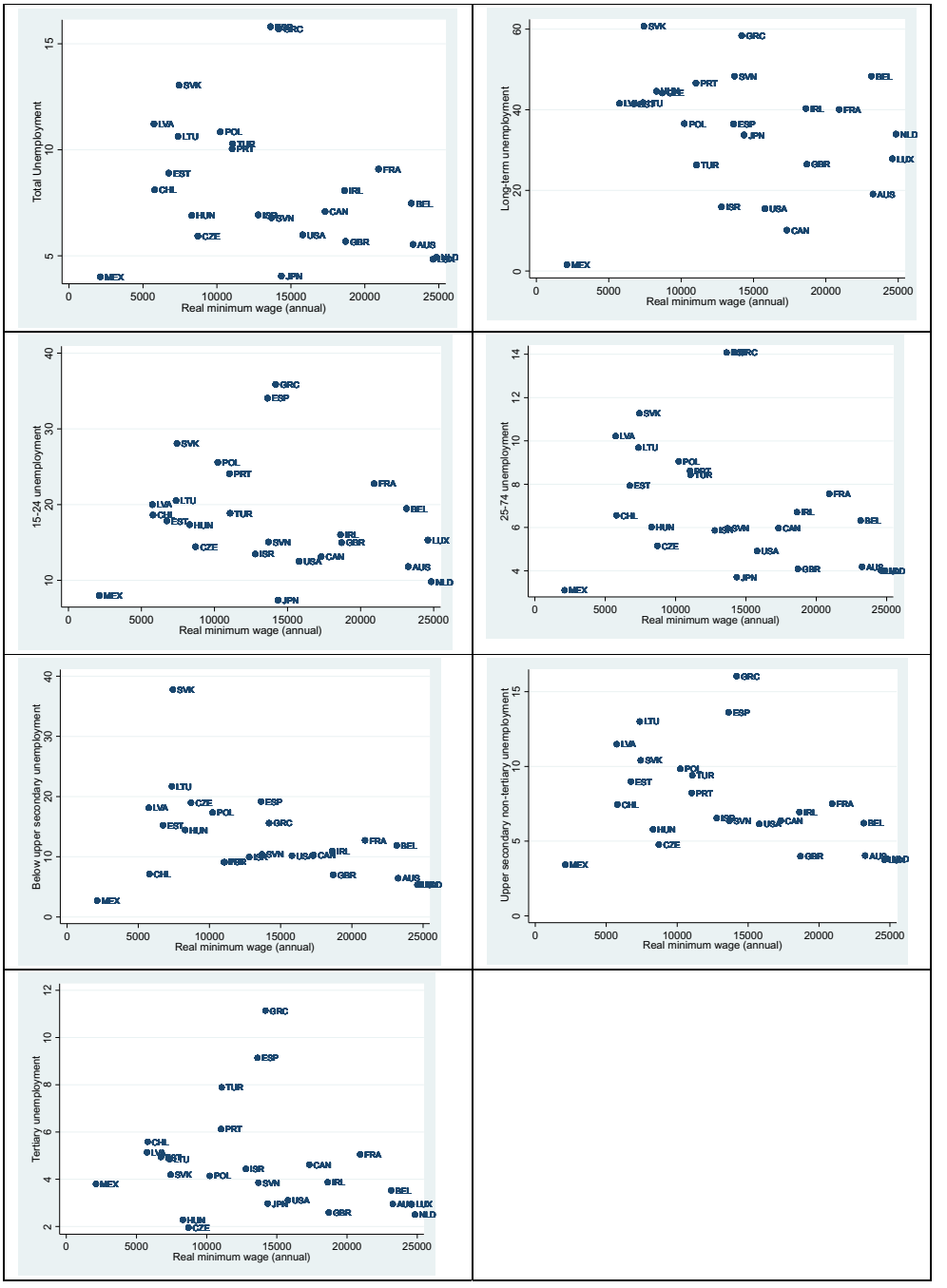
Wolfson, P., & Belman, D. (2019). 15 years of research on US employment and the minimum wage. *LABOUR*, *33*(4), 488–506. https://doi.org/10.1111/labr.12162

Wye, C.-K., & Bahri, E. N. A. (2021). How does employment respond to minimum wage adjustment in China? *The Economic and Labour Relations Review*, *32*(1), 90–114. https://doi.org/10.1177/1035304620970838

Xu, Z., Chen, Y., & Li, M. (2015). Are Chinese workers paid the correct wages? Measuring wage underpayment in the Chinese industrial sector, 2005–2010. *Review of Radical Political Economics*, *47*(3), 446–459. https://doi.org/10.1177/0486613414542780

Zhang, Z. (2007). Will the minimum wage law reduce the employment of rural workers? *Finance and Economics Science*, *10*, 103–110.

Appendix A. Descriptive analysis of different unemployment rates and minimum wages across the OECD countries.



Appendix B. Robustness check excluding the highest and the lowest minimum wages countries for the total and the long-term unemployment

	Total unemployment	Total unemployment excluding highest minimum wages	Total unemployment excluding lowest minimum wages	Long-term unemployment	Long-term unemployment excluding highest minimum wages	Long-term unemployment excluding lowest minimum wages
Threshold estimates ($\hat{\tau}$)	9.1667	9.1667	9.1667	9.4308	9.4308	9.4308
Significance of threshold *p*-value	0.0270	0.0600	0.0490	0.0660	0.0500	0.0316
95% confidence interval	[9.1345, 9.1745]	[9.1364, 9.1764]	[9.1345, 9.1745]	[9.4206, 9.4310]	[9.4206, 9.4314]	[9.4206, 9.4311]
Impact of threshold variable on unemployment rate:						
$\hat{\delta}_1$	−0.6581***	−0.6472***	−0.7064***	−0.3900***	−0.3380***	−0.6820***
	(0.0907)	(0.0963)	(0.1150)	(0.0720)	(0.0846)	(0.0812)
$\hat{\delta}_2$	−0.7019***	−0.6900***	−0.7555***	−0.4137***	−0.3721***	−0.7576***
	(0.0879)	(0.0907)	(0.1204)	(0.0710)	(0.0836)	(0.0810)
Impact of control variables on unemployment rate:						
$\text{Unemployment}_{t-1}$	0.6461***	0.6982***	0.6611***	0.6023***	0.6093***	0.5737***
	(0.0629)	(0.0677)	(0.0688)	(0.0608)	(0.0700)	(0.0635)
Inflation	−0.0259***	−0.0250***	−0.0248***	−0.0099***	−0.0097***	−0.0100***
	(0.0034)	(0.0036)	(0.0036)	(0.0029)	(0.0032)	(0.0029)
GDP	−0.1398***	−0.1402***	−0.1423***	−0.1436**	−0.1422****	−0.1437**
	(0.0081)	(0.0091)	(0.0095)	(0.0256)	(0.0056)	(0.0068)
Population	−0.1319***	−0.2130***	−0.1076***	−0.0997***	−0.1197***	−0.0999***
	(0.0360)	(0.0408)	(0.0388)	(0.0320)	(0.0396)	(0.0326)
Productivity	−0.0018	−0.0020	−0.0033	−0.0035	−0.0049	−0.0028
	(0.0030)	(0.0045)	(0.0030)	(0.0029)	(0.0045)	(0.0027)
FDI	−0.0020**	−0.0019**	−0.0019***	−0.0002	0.0024	−0.0001
	(0.0008)	(0.0008)	(0.0008)	(0.0007)	(0.0022)	(0.0008)
Debt	0.0064***	0.0060***	0.0068***	0.0044***	0.0044***	0.0038***
	(0.0008)	(0.0008)	(0.0009)	(0.0006)	(0.0006)	(0.0010)
Constant	8.6340***	8.1952***	9.1947***	6.9684***	6.4127***	9.7344***
	(0.7967)	(0.7984)	(0.8688)	(0.6165)	(0.6968)	(0.7025)
N	500	400	440	480	380	440
R^2 within	0.5586	0.5944	0.5542	0.4721	0.4963	0.4963
R^2 between	0.2425	0.2611	0.1433	0.1227	0.1210	0.1209
R^2 overall	0.1160	0.1649	0.2137	0.1186	0.1014	0.1017

Notes: In the ordinary brackets below the parameter estimates are the corresponding *z*-statistics, computed using White (1980)'s heteroskedasticity-robust standard errors. *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.