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## Minimum Wages at a Turning Point?

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# Minimum Wages at a Turning Point?

## Abstract

This paper uses cross-country macroeconomic empirical evidence among OECD countries to examine possible non-linear effects on employment of raising the minimum wage, in particular that marginal disemployment effects become larger when the initial minimum wage is already high. Some evidence is found for such effects, particularly for female and older workers, although the estimated threshold beyond which this occurs -- at roughly 50%-60% of the median wage -- above which such effects become apparent should be viewed as indicative rather than precise point estimates. The paper also finds that these non-linear disemployment effects are much more apparent for countries with strict Employment Protection Legislation (EPL) and/or with a high labour tax wedge. This suggests caution in applying the findings from much of the 'new' minimum wage literature based on US evidence to other OECD countries where EPL and tax wedges are typically stricter/higher.

JEL-Codes: J200, J300.

Keywords: minimum wage, employment, EPL, tax wedge, female workers, older workers, youth workers.

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## 1. Introduction

Most OECD countries operate some sort of minimum wage system, with the level of minimum wages typically having increased over time. To provide a basis for comparison, both through time and across countries, it is useful to refer to the “Kaitz index” which is the ratio of the minimum to median wage. Roughly half of OECD countries had a minimum wage which implied a Kaitz index that exceeded 50% in 2020, with the number of countries exceeding that level doubling since the early 1990s. Several OECD countries have recently raised or are planning to raise their minimum wage levels considerably, with prominent examples being Estonia, Germany, Hungary, Lithuania; Spain, the United Kingdom and the United States.<sup>2</sup> In October 2022, an EU-wide Directive was adopted to ensure that all EU countries had “adequate minimum wages”, with member states having two years to transpose it into their national legislation (European Commission, 2022).<sup>3</sup> The current ‘cost of living crisis’ may provide a further reason for increasing the minimum wage to protect low-income households from high-price inflation.

Advice from international organisations has increasingly favoured the use of minimum wages. A 2012 joint report from the IMF, World Bank, OECD and ILO argued that “a statutory minimum wage set at an appropriate level may raise labour force participation at the margin” (ILO, 2012). This advice was, however, qualified by concern that if the level of the minimum wage exceeded around 30% to 40% of median wages, then any benefits “would be more than offset by lost job opportunities, especially for youth and low-skilled workers”. The updated OECD (2018) Jobs Strategy recommended “.. a statutory minimum wage set at a moderate level as a tool to raise wages at the bottom of the wage ladder, while avoiding that it prices low-skilled workers out of jobs”, recognising that the appropriate level of the minimum wage depends on country-specific factors.<sup>4</sup>

Published research on minimum wages has grown dramatically over the years.<sup>5</sup> The “new” minimum wage literature, inspired particularly by the work of Card and Krueger (1994, 1995), has gained considerable prominence using mostly single-country studies, focused largely on the United States, and exploiting differences between neighbouring regions or cities or changes in policies for specific groups, to challenge the view that minimum wages lead to job losses. Nevertheless, academic research remains divided, as exemplified by Neumark and Shirley (2022) who review almost 200 studies focused on the United States published since 1993 and report that almost 60% of that literature finds sizeable disemployment effects from minimum wages. In a selective review of recent studies entitled “*The Elusive Employment Effect of*

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<sup>2</sup> Minimum wages are expected to be raised by about 20% in Hungary and by more than 10% in Estonia and Lithuania (Eurofound, 2022). The German minimum wage rose from EUR 9.6 to EUR 12 per hour in October 2022 (German Ministry of Labour and Social Affairs, 2022). As of January 1, 2022, the monthly minimum wage rose from EUR 950 to EUR 1167 in Spain, implying a more than 20% increase (wageindicator.org, 2022). The UK government has set out an aim for the minimum wage to reach a value of 66% of median earnings by 2024, having reached 60% by 2020 (Francis-Devine, 2022). In the United States, the minimum wage of federal contractors was increased from USD 11.5 to USD 15 per hour in January 2022 (U.S. Department of Labor, 2022) and there have been proposals (although not legislated) to double the federal minimum wage to USD 15 (CBO, 2019).

<sup>3</sup> The EU Directive 2022/2041 on adequate minimum wages in the EU aims at improving the adequacy of minimum wages but does not prescribe any specific minimum wage level to be reached. It refers to the values of 60% of the gross median wage and 50% of the gross average wage as possible reference values to guide the assessment of the adequacy of statutory minimum wages.

<sup>4</sup> The advice in the 2018 OECD Jobs Strategy regarding minimum wages represented something of a U-turn compared the 1994 OECD Jobs Study, which had instead recommended that countries “reassess the role of statutory minimum wages as an instrument to achieve redistributive goals and switch to more direct instruments” (OECD, 1994).

<sup>5</sup> While less than ten papers a year were published in the 1980s, the average publications per year rose well above ten in the 2000s and exceeded 20 in the 2010s and reached 54 papers published in 2019 (Martinez and Martinez, 2021).

*the Minimum Wage*", Manning (2021) noted that there must be some level of the minimum wage at which significant disemployment effects occur and urged a reorientation of future research to investigate that issue. This paper takes up that challenge and examines: i.) whether there is any evidence of a non-linear effect on employment so that further increases in minimum wages from already high levels have more adverse employment effects than increases from lower levels; and ii.) whether such non-linear effects need to be assessed in conjunction with other labour market institutions, particularly Employment Protection Legislation (EPL) and the labour tax wedge.

Contrary to much of the existing literature based on micro (regional, city, industry, firm)-level data for individual countries, this paper uses cross-country macroeconomic time series data to address these questions. Such an approach has two advantages compared to single-country studies, as pointed out by Sturn (2018). First, changes in minimum wages in specific countries tend to be small and incremental, whereas cross-country data covers a wide range of minimum wage rates and include some episodes of larger policy changes. Second, cross-country data makes it possible to investigate the interaction of minimum wage rates with other nationwide labour market policies and institutions, which vary considerably across OECD countries, while single-country studies cannot easily account for such interaction effects because of a typical lack of time series and regional variation in labour market institutional variables.

The remainder of the paper is organised as follows. Section 2 provides a summary overview of minimum wage developments in OECD countries over the course of the past 20 years or so. Section 3 reviews recent advances in the minimum wage literature in OECD countries. Section 4 uses threshold regression analysis to shed light on the potentially non-linear employment effect of minimum wage changes conditional on the level of the minimum wage. Section 5 investigates whether minimum wage effects are sensitive to other labour market policies, in particular to Employment Protection Legislation (EPL) and the labour tax wedge. Finally, section 6 discusses the robustness of the estimation results.

## 2. Developments in minimum wages across the OECD

Currently, 28 out of 36 OECD countries have statutory minimum wages in place. Statutory minimum wages may exist alongside collectively agreed wage floors and can sometimes substitute for them when collective bargaining coverage is low. In the eight OECD countries without statutory minimum wages (Austria, Denmark, Finland, Iceland, Italy, Norway, Sweden and Switzerland), a large part of the workforce is, at least formally, covered by wage floors specified in sector- or occupation-level collective agreements. The three main types of minimum wage systems that are applied in the OECD include (1) minimum wages set at the national/federal level, (2) minimum wages set at the sub-national level, and (3) minimum wages determined at the sectoral level, mostly through collective bargaining. In some countries, these regimes are combined with one another and might be complemented with differential rates for i.) young workers, trainees and apprentices, ii.) different occupations and iii.) disabled workers.

The procedures underlying the setting of minimum wages take different forms across OECD countries. In the current environment of unexpectedly high inflation, of particular note are Belgium, France and Luxembourg, which have mechanisms that link minimum wages to past consumer price inflation through an automatic indexation formula. This means that minimum wage increases can be triggered whenever inflation picks up, and without the delay associated with a more bureaucratic determination over a fixed (usually annual) cycle. For example, in Belgium, high inflation triggered three minimum wage adjustments in September 2021, March 2022 and May 2022, in addition to an uprating in April 2022. The advantage of such mechanisms is that they protect the real disposable incomes of the low-paid (OECD, 2022a), although they may also risk igniting a wage-price spiral in response to a sharp pick-up in inflation, especially if caused by an adverse terms-of-trade shock. In other OECD countries, there is no automatic indexation to prices and inflation is only one of many factors that are considered (including productivity, price competitiveness, wage growth etc.). In the Netherlands, the government adjusts the minimum wages every

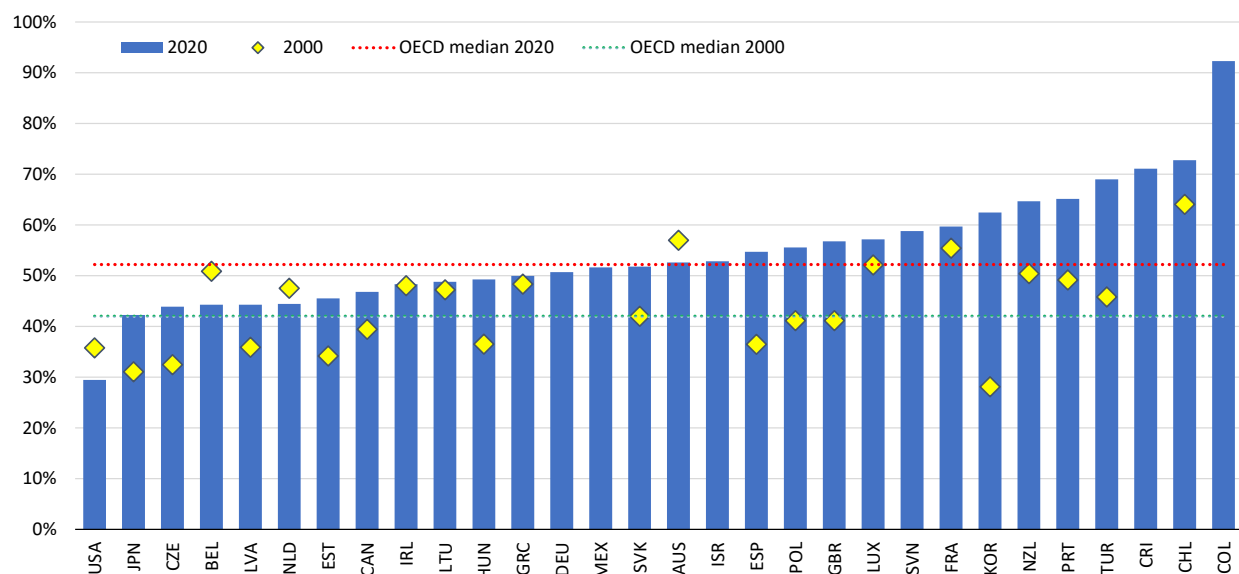
six months in line with average collectively agreed wages. In some countries, social partners agree on the minimum wage with the government stepping in only in case of disagreement, whereas in other countries, the government sets the minimum wage directly by considering recommendations from social partners or an expert committee.<sup>6</sup> In most cases, countries adjust minimum wages on a regular cycle, most often annually, however in an environment of sharply rising inflation this can lead to a deterioration in the purchasing power of the minimum wage, although it also reduces the risk of a wage-price spiral.

In 2020, minimum wage rates across OECD countries with a national minimum wage system implied a median Kaitz index of 52% (Figure 1). The majority of countries have their main rate set so as to imply a Kaitz index of between 40% and 60%. The United States has the lowest OECD main rate, implying a Kaitz index of 29%, while Colombia is at the other end of the distribution at 92%, followed by Chile, Costa Rica and Turkey with rates around 70%. However, the US minimum wage rate here refers to the federal rate, but many states (currently more than half) set a state minimum wage in excess of the federal rate.

The general tendency in OECD countries in the last three decades has been to raise minimum wages relative to the median wage. Over the period from 1990 to 2020, the number of OECD countries, with a Kaitz index exceeding 50%, more than doubled from nine in the 1990s to 18 in 2020. Most of the increases occurred in the aftermath of the 2008/09 Global Financial Crisis (Figure 2). Countries that have consistently set minimum wages in excess of 50% of median wages since the late 1990s or early 2000s include Australia, Belgium, Chile, France, Luxembourg, Portugal and Turkey. Five countries introduced minimum wages since the 1980s, including Korea (1988), Greece (1991), the United Kingdom (1999), Ireland (2000) and Germany (2015). By contrast, no country in the dataset with a minimum wage system in place has abolished it.

**Figure 1. Main minimum wage rates in OECD countries in 2020 and 2000**

Kaitz index, minimum wages expressed as a ratio to the median wage

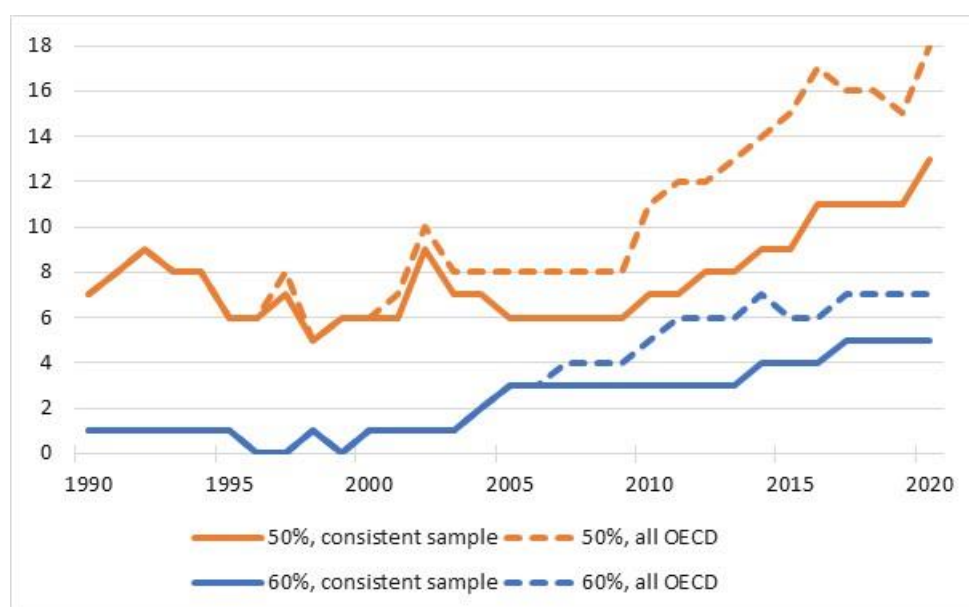


<sup>6</sup> Minimum wages are agreed by the social partners in countries where minimum wages are negotiated at the sectoral level as well as in Colombia, Costa Rica, Mexico and Turkey. Minimum wages are set by the government following recommendations from the social partners in Chile, Czech Republic, Estonia, Latvia, Lithuania, Poland, Portugal, Slovakia, Slovenia and Spain and following the advice of an Expert Committee in Australia, France, Germany, Ireland, Korea and the United Kingdom.

Note: Rates for 2000 are not shown for Costa Rica, Mexico, Israel and Slovenia, as median wage data in 2000 are not available for these countries.

Source: OECD and OECD calculations.

**Figure 2. The number of OECD countries with a Kaitz index exceeding 50%**



Note: The solid line shows the number of countries exceeding the 50% level for a group of 31 OECD countries for which the Kaitz index is available from 1990 to 2020. The dotted line counts the number of all OECD countries, including those with shorter time series (COL, CRI, ISR, LVA, LTU, MEX and SVN).

### 3. Literature overview

This section overviews the most recent literature focused on the employment effects of minimum wages. First, it reviews and discusses studies looking at the United States. Second, it summarises single-country studies analysing other OECD countries. Finally, it surveys the cross-country literature and research investigating possible non-linear effects.

#### 3.1. Studies focused on the United States

A prominent strand of recent papers focused on the United States echoes the Card and Krueger view about the absence of adverse employment effects in the United States. These studies, many by Arindrajit Dube and co-authors, concentrate predominantly on teen workers and workers in the restaurant industry and distinguish themselves from earlier studies, also using county-level data, by employing a different set of fixed effects and comparing only counties with common borders (and not pooling all counties together). The main feature of this strand is the absence of disemployment effects in the wake of minimum wage increases.

The idea of the border discontinuity analysis is presented in Dube et al. (2010): comparing changes in minimum wages in US counties with a common border eliminates the potentially spurious correlation between minimum wages and employment in faraway counties arising from idiosyncratic shocks. Considering county pairs with common borders ensures that the county pairs, which can be considered as an integrated economic area, are hit by the same shocks. In such a setting, they show the absence of correlation between minimum wages and employment. For example, Addison et al. (2015) fail to identify



negative employment effects in the restaurant and bar sector from 2000 to 2015. Dube et al. (2016) confirm these results and Allegretto et al. (2017) find small negative or zero effects for teen employment (1979 to 2014) and for the restaurant industry (1990 to 2014) over three to four years after the implementation of minimum wage hikes. Cengiz et al. (2019) cannot identify disemployment effects of 138 state-level minimum wage changes from 1979 to 2016 for low-wage jobs and detailed demographic groups. No adverse employment effects could be found from 29 minimum wage hikes between 1980 and the 2000s on the basis of the synthetic control method (Dube and Zipperer, 2015). Recent evidence exploiting minimum wage changes in large US cities confirms the absence of employment losses (Dube and Lindner, 2021). Finally, recent research extended to about three quarters of minimum wage workers, including low-wage, teen, older workers and single mothers, could not find negative employment effects of 172 minimum wage changes enacted between 1979 and 2019 (Cengiz et al., 2021). No adverse employment effects for the United States is confirmed by meta-regression analyses by Doucouliagos and Stanley (2009) and Belman and Wolfson (2014) as well as a recent selective literature review by Dube (2019).

These results are, however, contradicted by other recent papers, all using similarly disaggregated data and similar identification techniques, which identify non-negligible disemployment effects along a number of dimensions.

First, Jha et al. (2022) argue that multi-state commuting zones, rather than bordering county pairs such as in Dube et al. (2010), capture integrated economic areas better. Using this new definition, they report a robust negative relationship between minimum wages and employment. Using a similar study design for cross-border metropolitan areas, Taylor and West (2023) report negative employment effects in the restaurant and hotel industry for entry/level low-skill jobs in urban areas but much less so in rural areas.

Second, contrary to the services sectors, employment in the manufacturing industry is more likely to suffer from minimum wage increases (Cengiz et al. 2019; Gopalan et al., 2021) as well as seasonal employment in agriculture (permanent employment is unaffected). Minimum wage hikes appear to trigger capital investment in, and the consolidation of, the agriculture sector (Kandilov and Kandilov, 2019).

Third, employment effects are strongly heterogeneous across US States (Powell, 2021; Wang et al., 2019). For instance, large negative employment effects are detected in California, especially for county-industry pairs with the largest share of low wage workers, concentrated in the accommodation and retail sectors (Evan and MacPherson, 2018). Karabarbounis et al. (2022) show that high minimum wages go along with employment losses in the restaurant sector but not in other industries in Minnesota. In contrast, minimum wage increases did not appear to produce employment losses in the restaurant sector in 2007-09 in Alabama and Georgia (Hirsch et al. 2015).

Fourth, results are also surrounded by methodological and data-related controversies. For example, Sabia et al. (2012) report large disemployment effects in the State of New York. Hoffman (2015) shows that the effect is zero when using a more representative dataset. In their rebuttal, Sabia et al. (2016) demonstrate that Hoffman's results are not driven by data differences but by the use of parallel trends assumption for counties, the relaxation of which brings back the large disemployment effects found earlier. A similar controversy concerns the employment of minorities. Baillet et al. (2021) estimate considerable employment losses for black male workers in the aftermath of the 1966 Fair Labour Standards Act, which increased minimum wages to its highest level in the 20<sup>th</sup> century (as a share of the median wage) and increased coverage to almost 10 million additional workers. At the same time, Derenoncourt and Montialoux (2021) find no such effects for black workers from the same policy change.

Fifth, although minimum wage hikes might not immediately reduce the level, they can slow down the growth of employment for teen workers in the restaurant industry (Meer and West, 2016; Gilyard and Podemska, 2020), as firms reduce employment through less hiring (Gopalan et al., 2021). While research fails to find disemployment effects for teen and restaurant workers, it sheds light on a decline in separations, hires, and turnover rates (Dube et al., 2016; Gittings and Schmutte, 2016). Liu et al. (2016) confirm these results but also find considerable disemployment effects. Perhaps relatedly, some research suggests that

disemployment effects are negligible in the short run but become significant in the longer term (Aaronson et al., 2018).

In addition, indexing minimum wages to price inflation might lead to falls in employment. Immediate disemployment effects of minimum wage hikes are three times higher in indexing states (in the restaurant industry, in accommodation and food services; retail trade; manufacturing; healthcare and social assistance) compared to non-indexing states (Brummund and Strain, 2020).

More generally, Neumark and Shirley (2022) reviewed around 200 studies focused on the United States published since 1993. They focus on the evidence using subnational minimum wage variation within the United States that has dominated the research debate since the early 1990s, claiming to have assembled the entire set of published studies in this literature and identified the core estimates that support the conclusions from each study, in most cases relying on responses from the researchers who wrote these papers. Their key conclusions are: (i) there is a clear preponderance of negative estimates in the literature; (ii) this evidence is stronger for teens and young adults as well as the less-educated; (iii) the evidence from studies of directly-affected workers points even more strongly to negative employment effects; and (iv) the evidence from studies of low-wage industries is less one-sided.

### **3.2. Single country studies focused on other OECD countries**

The body of literature dealing with other OECD countries reports mixed evidence with regard to employment effects of minimum wages, as summarised below.

#### **3.2.1. Germany**

Much research has investigated the consequences of the 2015 introduction of nationwide minimum wages in Germany. Contrary to the literature on the United States where identification is based on the comparison of states with different levels of minimum wages, empirical research on Germany exploits the different regional, demographic or sectoral exposure to the national minimum wage. The level of the minimum wage, at 48% of the national median wage in 2015 might explain that most studies, summarised in Ahlfeldt et al. (2022), found limited aggregate disemployment effects in the one or two years following the policy change. There is agreement that employment of temporary workers declined whereas regular jobs were unaffected or even boosted. The comparison of firms having workers directly affected by the new minimum wage and firms having no such workers confirms the modest negative impact on aggregate employment (Bossler and Gerner, 2019). Finally, employment outcomes were less favourable in East German regions, where median wages were lower, in comparison with the rest of the country (Ahlfeldt et al., 2022) (see section 3.4 below for further discussion). More time will be needed to evaluate the minimum wage increase enacted in October 2022, which pushed the Kaitz index in the vicinity of 60%.

#### **3.2.2. The United Kingdom**

Existing empirical research studying possible employment effects of the UK minimum wage introduced in 2009 at the low level of 42% of median wage has so far reported no significant job losses (see the reviews by de Linde Leonard et al., 2014 and Hafner et al., 2017). Ever since, the minimum-to-median wage has been edging up, reaching 50% in 2016 and with an implied objective of around 66% in the near future (Francis-Devin, 2022). More recent analysis focussing on the years 2014 to 2018 maintains the no job loss finding (Dube, 2019).

#### **3.2.3. Other OECD countries**

Minimum wages appear to have little or no employment effects on young workers in Australia, Belgium and the Netherlands (Olssen, 2011; López Novella, 2018; Bezooijen et al., 2021). The 2001 minimum

wage reform in Hungary, which drove the Kaitz index from 36% to 50%, was found to result in modest negative aggregate employment effects four years after the reform, by which time the ratio had declined to 46%. Nevertheless, firms started substituting labour for capital and job losses were larger in industries where increased wage costs could not be passed on to consumer prices (Harasztosi and Lindner, 2019).

#### *3.2.4. Effects on vulnerable demographic groups*

Research also suggests that in some countries, particular groups, including the young, low-skilled, part-time and female workers, or workers in specific low-paid sectors (including residential home care and hospitality) may be more vulnerable to minimum wage increases (see e.g., Belman and Wolfson, 2014 for Sweden; de Linde Leonard et al., 2014 and Hafner et al., 2017 for the United Kingdom; and Kucera, 2020 for EU countries). Minimum wages are found to decrease the jobs of teenage workers in Canada, Portugal, Spain and Turkey (Shannon, 2011; Belman and Wolfson, 2014 and Campolieti 2020; Pereira, 2003; Lopez-Tamayo et al., 2021 and Dayioglu et al., 2022). Large disemployment effects for young workers are identified in Denmark: a large jump of 40% in Danish minimum wages at the age of 18 is associated with a fall of 33% in youth employment (Kreiner et al., 2020). Wage floor increases have been found to raise the unemployment rate of the young in New Zealand and Poland and to reduce student jobs in New Zealand (Hyslop and Stillman, 2007, 2011; Broniatowska et al., 2015).

#### *3.2.5. Effects on informality*

Informality might interact with minimum wage as well. There is some evidence that excessively high minimum wages reduce formal jobs and promote informality. For instance, for Colombia, where the national Kaitz index lies above 90%, a recent series of papers shows that i.) at the plant level, high minimum wages reduce jobs of low-skill workers, mostly in smaller firms (Arango and Rivera, 2020); ii.) high minimum wages have a large negative effect on aggregate employment by increasing firing and reducing hiring, with the impact being more considerable for smaller, new and young firms (Florez et al., 2022); and iii.) high minimum wages raises informality, especially in regions with lower productivity levels (Arango and Florez, 2022).

### **3.3. Cross-country studies**

The few studies exploiting time-series cross-country datasets to study the minimum wage – employment nexus provide some evidence for negative employment effects for teen, young and adult female workers. A distinctive feature of this literature is that it considers cross-country differences in other labour market policies as well, and their interaction with minimum wages. At present, no strong consensus is apparent on the role of other labour market policies and institutions in exacerbating or weakening negative minimum wage effects.

An early study by the OECD (1998) analysed 9 OECD countries over the period 1975 to 1996 and identified negative employment effects for teenage workers and mostly non-significant disemployment effects for young workers, whereas no employment effects could be established for adult workers. Neumark and Wascher (2004) analyse 17 OECD countries for 1975 to 2000 and find negative effects for teenage and young workers, though with large variations across countries. They also find that a greater degree of collective wage bargaining, and the existence of sub-minimum wage rates reduce the negative employment effects whilst stricter EPL and greater ALMP appear to diminish disemployment effects.

In a follow-up study, extended to adult female workers, Addison and Ozturk (2012) identify considerable negative employment effects of minimum wage increases for female workers in a set of 16 OECD countries from 1970 to 2008. They argue that this effect might be a result of the gender wage gap: the minimum wage starts biting earlier for female workers compared to male workers. Surprisingly (even to the authors), centralised wage bargaining is estimated to exacerbate negative employment effects whereas more

stringent EPL had either attenuated disemployment effects or had no significant impact. Marimpi and Koning (2018) show adverse employment effects for young workers for OECD countries. Similarly, Paun et al. (2021) identify aggregate disemployment effects, but also for vulnerable workers including young, female and older workers for a set of 22 EU countries from 1999 to 2016. By contrast, Sturn (2018) does not find evidence of negative employment effects for young and female low-skill workers for 17 OECD countries from 1997 to 2013, nor evidence of any interaction of minimum wages with other labour market policies comprising EPL, unemployment benefits, union density and spending on ALMP. Finally, Christl et al. (2018) show that raising minimum wages reduces jobs for young workers and that this effect is larger in countries with stricter EPL regulations.

Brzezinski (2017) argues that the inconclusive findings with regard to minimum wage effects on youth employment are largely due to the omission of interactions. He demonstrates for a panel of 19 OECD countries that higher unemployment benefits and union density amplify adverse minimum wage effects and that greater spending on active labour market policies attenuates negative employment effects.

### **3.4. Studies investigating possible non-linear effects**

As countries continue to raise minimum wages, a natural question is whether they will reach a level beyond which they would start to have a marked detrimental effect on employment. In empirical work, identifying a tipping point, usually discussed in terms of the Kaitz ratio, beyond which substantial negative employment effects might occur proves to be difficult, especially since many countries have a history of incremental changes and/or a history of relatively low minimum wages relative to the median wage. Specifying *a priori* the form of any non-linearity is also difficult. Therefore, and perhaps not surprisingly, the existing empirical literature on possible non-linear effects of minimum wages is scarce. It focusses on a few or single country cases or particular demographic groups, and often provides inconclusive results.

Some research identified, for a panel of selected OECD countries, a hump-shape implying decreasingly positive employment effects of minimum wages up to a certain minimum wage level and increasingly negative effects thereafter. For instance, Christl et al. (2018) considered 12 EU countries and estimated the effect of minimum wages (as a share of average wages) on the employment rate of young workers aged 15-24 years old. They identified a turning point at around 40% of average wages and concluded that minimum wages: i.) were detrimental to young workers' jobs in Belgium, France, Greece and the Netherlands; ii.) were close to the turning point in Ireland, Spain and the United Kingdom; and iii.) could be raised in Central and Eastern Europe without harming the employment of young workers. In a related work, Christl et al. (2017) showed similar hump-shaped effects of minimum wages negotiated at the sectoral level for young workers aged 19-25 years in 14 industries in Austria and pointed out that in the majority of the business sectors, the minimum wage exceeded the turning point beyond which employment effects become negative.

In a recent contribution, Ahlfeldt et al. (2022) exploit regional differences in wages around the introduction of Germany's nationwide minimum wage to show a skewed hump shape relationship between the national minimum wages relative to the (differing) regional median wage and regional employment. At lower levels of the Kaitz index, around 46% of the regional median wage, minimum wages and employment are not related. Between 46% and 53%, the minimum wage is associated with higher employment rates. Beyond 53%, the relationship weakens and a minimum wage in excess of 64% is accompanied by significantly lower employment rates.

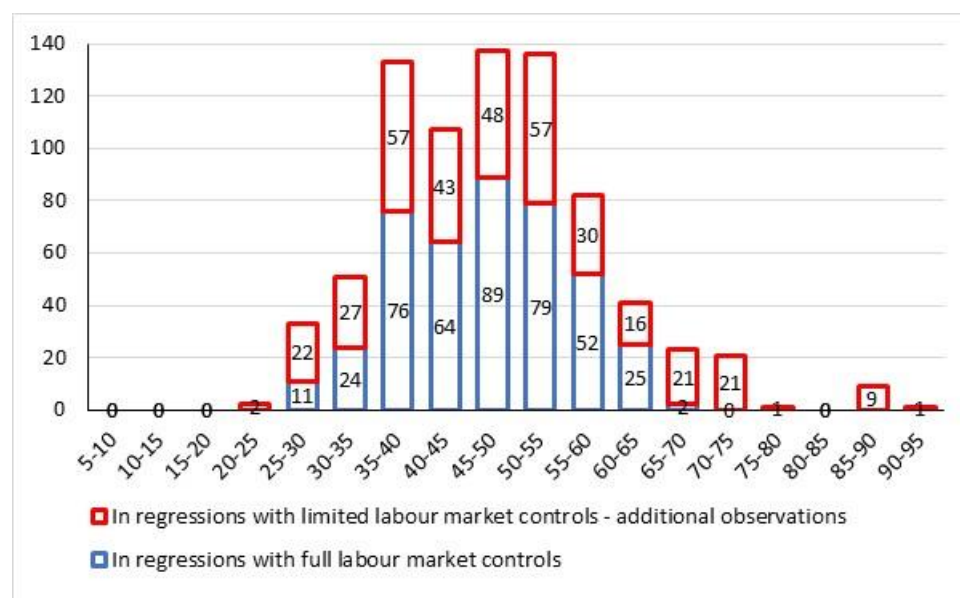
Others failed to find a statistically significant hump-shape. For instance, IMF (2016) estimated quadratic employment regressions for 17 Central and Eastern European countries and found increasingly negative employment effects at higher levels of the main minimum-to-average wage ratio, although this result rests on weak foundations since the linear and quadratic terms of the minimum wage ratios were jointly

insignificant. Another body of the literature could not identify non-linearities around more discrete and arbitrarily selected minimum wage thresholds. Sturn (2018) was unable to find any differential effects around the 40% and 55% levels of the Kaitz index for low-skill and young workers in 19 OECD countries. Using regional data for Romania, Pantea (2020) did not succeed in estimating negative employment effects for minimum wages exceeding 40% of the median wage.

#### 4. New evidence regarding non-linear effects of minimum wages on employment

This section reports new estimation work that pools data from OECD countries to test for non-linearities in the response of employment to minimum wages. Separate equations are estimated for the aggregate employment rate and the employment rate of subgroups of workers, distinguished by age and gender (young workers, prime-age female and male workers and older workers) all of which include country and time fixed effects and a cyclical control variable, over the period of 1985 to 2020.<sup>7</sup> In an initial stage of estimation, other labour market policy variables are excluded because their inclusion reduces the sample size by a considerable margin as some policies are not available for some countries or are available for shorter time periods (Figure 3).<sup>8</sup> This allows the sample size to cover a much wider range of observations for the Kaitz index both over time and across countries, including OECD countries with very high Kaitz indices such as Chile, Colombia, Costa Rica and Turkey. Having used the larger sample to investigate possible thresholds for any non-linearity and interaction effects between minimum wages and other labour market policies (EPL and the labour tax wedge), the paper examines the robustness of the findings to the inclusion of other labour market policies.

**Figure 3. Number of observations at different levels of the Kaitz index**



<sup>7</sup> Countries that introduced minimum wages during the estimation period are excluded from the estimation until the minimum wage is introduced.

<sup>8</sup> Data on some labour market policies are not available for Colombia, Chile, Costa Rica, Mexico and Turkey. The PMR and EPL indicators run until 2018, hence excluding subsequent observations from regression analysis. For some countries, the labour tax wedge variable starts in the late 1990s and early 2000s.

Note: Blue bars show the number of observations (vertical axis) for the Kaitz index in the employment regressions with the full set of controls (column 1 in Table A1) in the bins of 5-10%,..., 90=95%. Red bars show the additional observations available in regressions with the limited controls (fixed effects and the output gap) from column 1 of Table 2.

The empirical analysis makes use of the threshold regression model proposed by Hansen (1999), which, contrary to the previous studies cited above where non-linear effects are estimated threshold effects from quadratic functions or otherwise imposing arbitrary tipping points, estimates turning points from the data. Specifically, a grid search procedure is used to identify a minimum wage threshold that defines two different regimes with potentially different employment responses prevailing below and above the threshold (Box 1).<sup>9</sup>

Estimations explaining aggregate employment suggest a tipping point for a Kaitz index of roughly 50%, with minimum wage increases generating moderate positive employment effects below the turning point and resulting in significant disemployment effects above it: raising the Kaitz index by one percentage point is estimated to be accompanied by a 0.4 decrease in the aggregate employment rate (Table 1).

Estimations for employment by demographic groups, suggest a higher threshold of around 60% of the Kaitz index with some variation (54% for female workers, and 66% for young workers) (Table 1).

- For prime age male workers, the positive effect of minimum wage increases turns into non-negligible employment losses once the Kaitz index passes the estimated threshold of 60%.
- For young and older workers, no significant job losses or gains are detected below the estimated threshold, though disemployment effects are larger than for male workers above 60% of the Kaitz index.
- Female workers are the only group with negative employment effects below the threshold, which is estimated to correspond to a Kaitz index of 54%. These disemployment effects increase above the threshold, though they remain relatively moderate compared to the other demographic groups. Results obtained for the demographic groups are not easily compared with the aggregate employment results because estimated threshold values are different.

Overall, the estimation results suggest three main takeaways. First, the tipping point at which significant disemployment effects occur appears to be for a Kaitz index of around 50% to 60%. Second, there seems to be considerable disemployment effects at higher levels of the minimum wage, with each percentage point increase in the Kaitz index above the group-specific threshold reducing the employment rate by about 0.4-0.5 percentage points for prime-age workers and much more for older and younger workers. Third, across all equations, the employment effects of increases in the minimum wage are more negative above the threshold than below it, and in all cases this difference is statistically significant at the 5% level.

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<sup>9</sup> Quadratic functions were also experimented with in the paper, but they had implausible shapes and therefore have been discarded.

**Table 1. Employment regressions based on optimal choice of minimum wage thresholds.**

Sample period 1985-2020

	Dependent variable: employment rate of:					
	Total	Prime-age female	Prime-age male	Older	Young, 15-19	Young, 20-24
Estimated minimum wage threshold	51.4%	54.4%	59.1%	60.0%	60.8%	66.9%
Coefficient of the Kaitz index:						
When Kaitz index						
Below the estimated threshold	0.1408**	-0.1621**	0.1288**	-0.0291	-0.0835	-0.0894
Above the estimated threshold	-0.3896**	-0.367**	-0.5461**	-1.4186**	-2.0354**	-3.3195**
No. obs	1093	959	959	963	1059	1059
% of which above the threshold	25.9%	17.8%	10.0%	9.2%	8.1%	8.1%
No. of countries	38	34	34	34	38	38
Adjusted R-squared	0.920	0.901	0.739	0.922	0.897	0.791
Country fixed effects	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES
Share in OECD average (2020)	100.00%	32.0%	39.5%	17.6%	2.9%	8.0%

Note: Estimations based on annual data for a sample period of 1985 to 2020. The regressions also contain the output gap as a cyclical control variable as well as country and time fixed effects, which are not reported here. \* and \*\* denote statistical significance at the 10% and 5% level, respectively, based on robust standard error estimated using the Dynamic OLS estimator. Prime-age female and male workers are defined as those aged 25-54 and older workers those aged 55-64.

### Box 1. The estimation framework

#### Threshold regressions

A two-regime threshold panel regression following Hansen (1999) is estimated for a panel of OECD countries for aggregate employment rates as well as (separately) for the employment rate of disaggregated groups of workers (young, prime-age female and male and older workers) ( $ER_{c,t}$ ). The threshold is estimated using a grid search in steps of 1% by maximising the goodness-of-fit of the threshold model. The range of the grid search is limited so that at least 5% of observations are above and below the threshold to be tested (with the threshold necessarily exceeding 25% because this is the lowest value of the KI in the sample). The threshold regression takes the following form:

$$ER_{c,t} = \begin{cases} \alpha_1(KI_{c,t} - 25) & \text{if } 25 \leq KI_{c,t} < \Phi \\ \alpha_1(\Phi - 25) + \alpha_2(KI_{c,t} - \Phi) & \text{if } KI_{c,t} \geq \Phi \end{cases} + \beta OG_{c,t} + \varepsilon_{c,t} \quad (1)$$

Where  $KI$  is the Kaitz index,  $\Phi$  is the estimated threshold of the Kaitz index,  $OG$  denotes output gap to control for the business cycle and  $c$  and  $t$  subscripts denote country and time and country and time fixed effects are also included. Then the marginal (dis-) employment effects below and above the threshold are  $(-)\alpha_1$  and  $(-)\alpha_2$ , respectively. The coefficients are estimated using the Dynamic OLS (DOLS) estimator, which includes lags and leads of the first-differenced covariates in an attempt to control for endogeneity and serial correlation in the residuals (Stock and Watson, 1993).

It should be noted that the inclusion of the term  $a_1(\Phi - 25)$  in the ‘upper’ regime above the threshold is needed to ensure continuity in employment in the transition between the two regimes. Monte Carlo evidence on artificially generated data suggests that, at least for this application, this form of adjustment is superior to including separate fixed effects in the two regimes to account for any discontinuity, as proposed by Hansen.

## 5. Threshold effects as a function of other labour market policies

The existing literature suggests that employment effects of minimum wages might be leveraged by other labour market policies, though it does not provide conclusive evidence. This section revisits the issue with a particular focus on minimum wage interactions with EPL and the labour tax wedge.

### 5.1.1. Estimation results for minimum wages at different levels of EPL

Restrictive EPL increases the cost of hiring and firing (notably of recruitment errors) for business, which might exacerbate cost competitiveness problems arising from high minimum wages, especially for low-skill and young workers, in particular if wages and productivity are misaligned. Restrictive EPL might also discourage employers from taking on workers at a high minimum wage because of a concern that such a commitment will be difficult to reverse if business conditions in the future are less favourable. This intuition is corroborated by Christl et al. (2018)<sup>10</sup> although other empirical research (Neumark and Wascher, 2004; Addison and Ozturk, 2012; Sturn, 2018) could not confirm this association.

The empirical work here classifies countries as having ‘strict’ or ‘lenient’ EPL, according to whether their EPL is above or below the average of the OECD sample. In combination, with a minimum wage threshold, this implies four regimes: i.) high minimum wages coupled with strict EPL, ii.) high minimum wages with lenient EPL; iii.) low minimum wages with strict EPL, and iv.) low minimum wages with lenient EPL. Rather than re-estimate the minimum wage thresholds (which would be difficult given the reduced sample size once EPL data is required), the threshold is imposed at 51.4%, corresponding to that estimated for aggregate employment (Table 1). Imposing higher thresholds, such as those estimated for the demographic subgroups, would be problematic because, once the sample is reduced to include only observations in which there is coverage of EPL, higher minimum wage thresholds would result in an insufficient number of observations in some of the regimes and this inadequacy is exacerbated by the inclusion of other labour market variables.<sup>11</sup>

<sup>10</sup> Recent consecutive OECD country surveys of France (OECD, 2007, 2011) have argued that the combination of a high minimum wage and stringent EPL can be a particular problem.

<sup>11</sup> For instance, models with a 60% threshold would only have 25 observations in the high minimum wage/ low EPL regime and 71 observations in the high minimum wage/ high EPL regime. The inclusion of an extended set of labour market policy variables exacerbates the problem, with only 22 observations in the high minimum wage/ high EPL regime and 5 observations in the high minimum wage/ low EPL regime for the 60% threshold. However, defining the threshold at 51.4%, provides 120 observations in the high minimum wage/ low EPL regime and 161 observations in the high minimum wage/ high EPL regime, falling to 68 and 71 observations, respectively, once a full set of labour market controls is included.



Estimation results suggest that the employment effect of minimum wage rises does not only depend on the level of the minimum wage itself but also upon the stance of EPL policies. Aggregate employment regressions indicate that in the high-minimum wage regime (here defined when the Kaitz index exceeds 51.4%), marginal disemployment effects are almost double in countries with strict EPL compared to countries with more lenient EPL regulation (Figure 4 and Table 2). At lower levels of the Kaitz index (below 51.4%), positive employment effects are larger in a low-EPL environment.

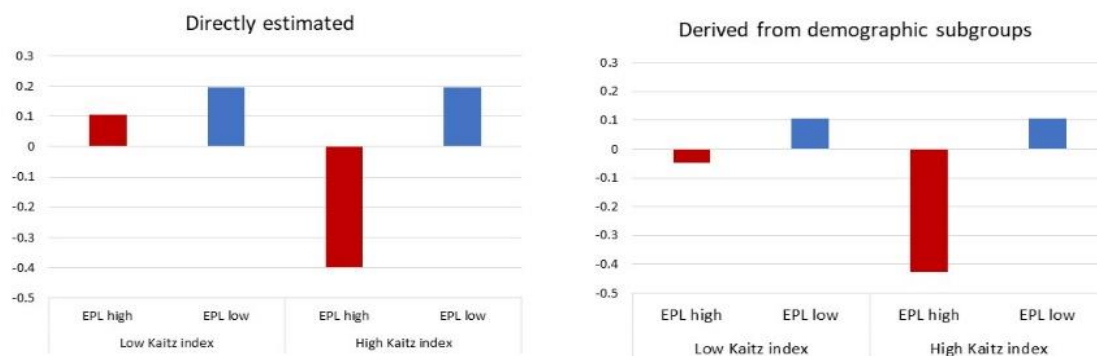
Estimation results for demographic sub-groups suggest that countries with a high Kaitz index and high EPL suffer from negative employment effects compared to countries where either the Kaitz index or the EPL is low (comparing row [1] with rows [2] or [3] in Table 2). More specifically, all groups of workers face substantial disemployment effects in countries with high EPL and a high Kaitz index (row [1] in Table 2 or third set of bars in Figure 4, panel B). Conversely, negative employment effects are lower (prime-age female workers), statistically non-significant (young and older workers) or even turn positive (prime-age male workers) in countries where high EPL is coupled with a low Kaitz index (row [3] in Table 2 or first set of bars in Figure 4, panel B). Similarly, negative job effects are reduced, non-existent or become positive in countries where a high minimum wage is accompanied by low EPL (row [2] in Table 2 or fourth set of bars in Figure 4, panel B).

The less favourable employment effects for vulnerable groups, in particular for women and older workers, especially compared to prime-aged men, may be due to a variety of factors. Discrimination of women and older workers may play a role, as well as other structural barriers for these groups in the labour market. Even perceived discrimination or certain social norms may influence employment outcomes not only via hiring decisions, but also because they can lead workers to restrict their job search (e.g., to part-time or low-skilled work) or to stop searching for employment altogether (OECD, 2019; Ciminelli et al., 2021). In addition, policies, such as the availability of affordable, good quality childcare, parental leave, or treatment of second earners in the tax code may also have an impact on employment outcomes of vulnerable groups. While increasing wage floors via statutory minimum wages can help shrink the gender wage gap (Ciminelli et al., 2021), the results suggest that caution is warranted in terms of finding the optimal level of such floors and that they should be part of a package of policies, so that their benefits in terms of equalising wages are not offset by potential negative employment effects.

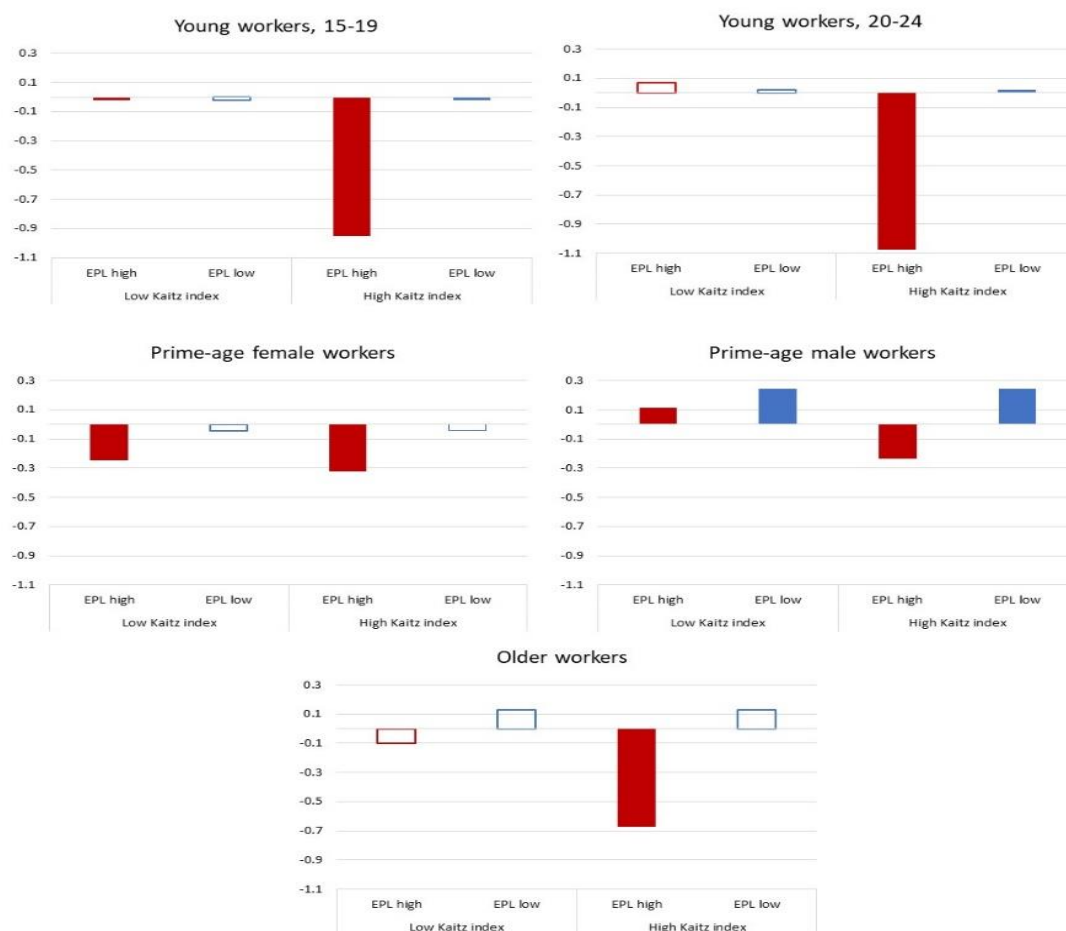
**Figure 4. Marginal employment response to a rise in the Kaitz index at different levels of EPL**

Percentage point change in the employment rate in response to a 1 percentage point rise in the Kaitz index

**Panel A. Aggregate employment effects**



**Panel B. Employment effects by demographic groups**



Note: Red and blue bars relate to “high” and “low” EPL countries, respectively, which are here defined as countries with EPL above (below) the sample median of EPL. Bars that are not filled in denote estimates that are not statistically significant to at least the 10% level. High (low) Kaitz index refer to the Kaitz index higher (lower) than 51.4%. Figures based on results reported in Table 2. The estimated thresholds are not fully overlapping for the specific demographic groups. The aggregate effects in the right-hand side figure of panel A are derived from combining the effects of the various demographic groups using weights that reflect the demographic employment structure of an average OECD country.

**Table 2. Employment regressions imposing minimum wage thresholds, distinguishing high and low levels of EPL.**

Sample period 1985-2020

	Dependent variable: employment rate of:					
	Total	Prime-age female	Prime-age male	Older	Young, 15-19	Young, 20-24
Constant	65.0926**	70.7927**	84.8132**	50.2059**	27.2139**	58.6408**
Output gap	0.6762**	0.6014**	0.6773**	0.5765**	0.4883**	0.6631**
Coefficient of the Kaitz index:						
When Kaitz index > 51.4%, and:						
[1] EPL > OECD median	-0.3987**	-0.3244**	-0.2336**	-0.6703**	-0.9506**	-1.0735**
[2] EPL < OECD median	-0.2898**	-0.0155	0.042	0.023	-0.806**	-0.4128**
When Kaitz index < 51.4%, and:						
[3] EPL > OECD median	0.1069**	-0.2462**	0.114**	-0.1002	-0.0205	0.0685
[4] EPL < OECD median	0.1946**	-0.0432	0.2455**	0.1297	-0.0238	0.0193
No. obs	1082	959	959	963	1059	1059
No. countries	38	34	34	34	38	38
Adjusted R-squared	0.920	0.901	0.736	0.920	0.890	0.767
Country fixed effects	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES

Note: Estimations based on annual data for a sample period of 1985 to 2020. \* and \*\* denote statistical significance at the 10% and 5% level, respectively, based on robust standard error estimated using the Dynamic OLS estimator.

### 5.1.2. Estimation results for minimum wages at different levels of the tax wedge

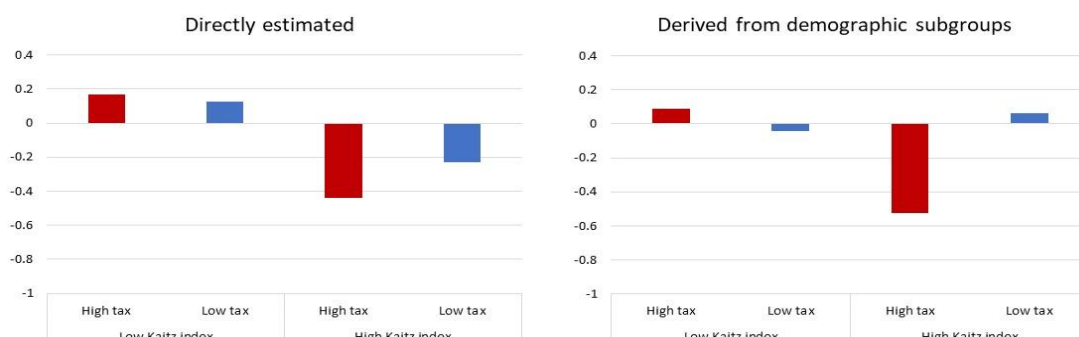
While high labour tax wedges alone can act as an impediment to job creation by raising labour costs, they might be particularly detrimental to jobs in countries with high minimum wages. This is because the increased tax burden cannot be easily passed on to, or shared with, minimum wage workers (and workers whose wage is linked to minimum wages), thus weakening firms' price competitiveness. The combined adverse employment effect is likely to exceed the effect of either high minimum wages or high tax wedge effects taken in isolation (Bassanini and Duval, 2006). For this reason, many OECD countries offer considerable subsidies, exemptions and exonerations for income tax and social security contribution for incomes at or around the minimum wage (Table B1 in Annex B). Needless to say that data is sparse on these measures, and any empirical work on tax wedges unadjusted for subsidies aimed at minimum wage workers, as is the case here, should therefore be considered with appropriate caution.

Looking at the interaction between the Kaitz index and the labour tax wedge, high tax wedges are found to go in tandem with sizeable employment losses only when the Kaitz index is 'high' (here taken to be above 51.4%) (comparing rows [1] and [3] in Table 3, or the first and third sets of bars in Figure 5). By contrast, a low Kaitz index coupled with a high tax wedge has mostly benign employment effects (row [3] in Table 3, first set of bars in Figure 5): i.) moderate employment gains are identified at the aggregate level, for young workers aged 20 to 24, and for prime-age male workers, ii.) no statistically significant relationship could be established between employment and minimum wages for very young workers (aged 15 to 19) and older workers. It is only for prime-age female workers that disemployment effects are found for high tax wedges and low minimum wage levels. A similar picture emerges comparing high minimum wages under alternative low and high tax wedge regimes. At the aggregate level and for all demographic groups, high minimum wages coupled with high tax wedges turn out to be more detrimental to employment than high minimum wages combined with low labour tax wedges (comparing rows [1] and [2] in Table 3, or the third and fourth sets of bars in Figure 5).

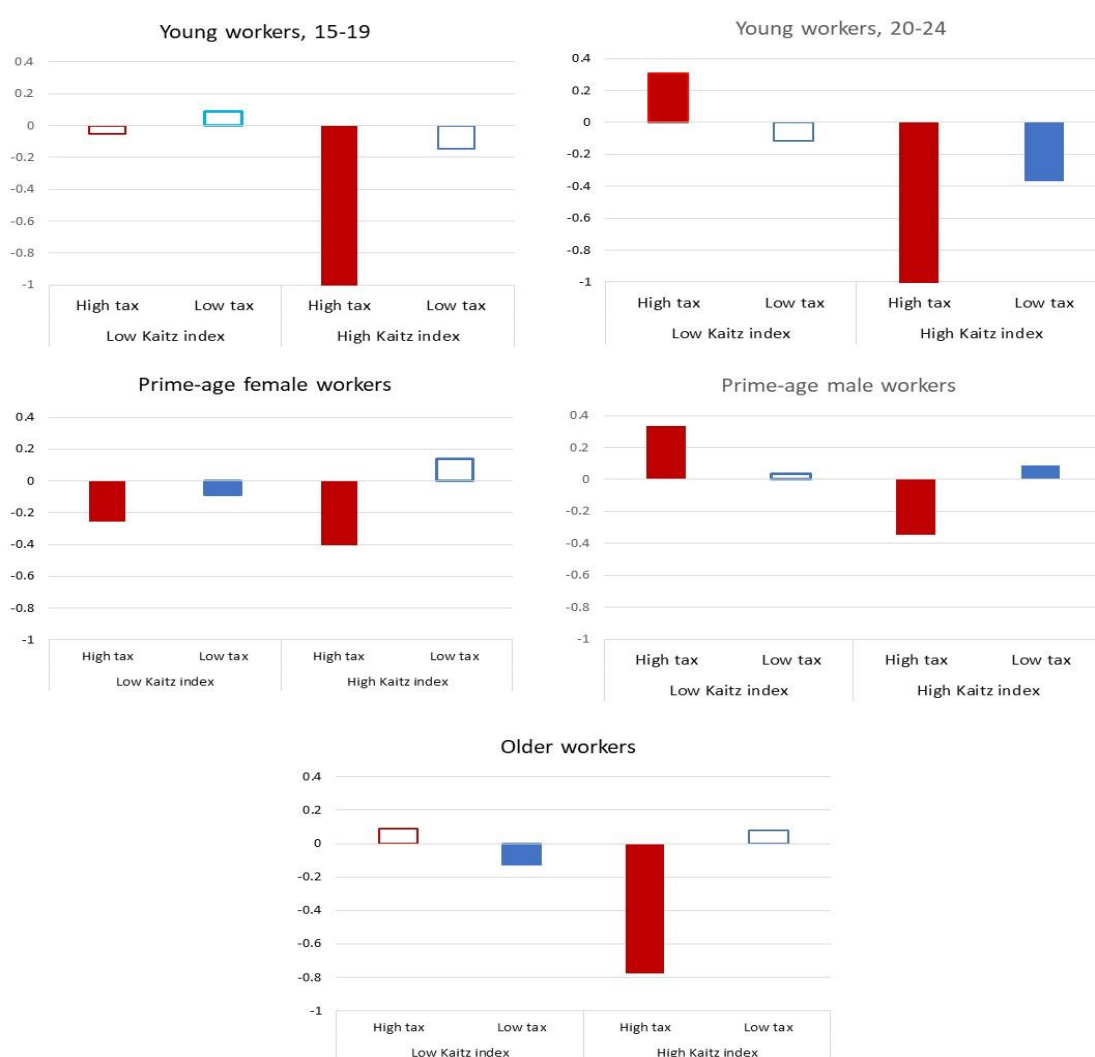
**Figure 5. Marginal employment response to rise in Kaitz index at different labour tax wedge levels**

Percentage point change in the employment rate

Panel A. Aggregate employment effects



Panel B. Employment effects by demographic groups



Note: Figures based on results reported in Table 3. The estimated thresholds are not fully overlapping for the specific demographic groups. The aggregate effect in RHS chart of Panel A is derived from combining the effects of the various demographic groups using average employment weights. Unfilled bars denote estimates that are not statistically significant on at least the 10% level. High (low) tax implies high (low) tax wedge.

**Table 3. Employment regressions imposing minimum wage thresholds, distinguishing high and low levels of the tax wedge.**

Sample period 1985-2020

	Dependent variable: employment rate of:					
	Total	Prime-age female	Prime-age male	Older	Young, 15-19	Young, 20-24
Constant	65.013**	70.7398**	84.6661**	50.2774**	26.235**	57.9586**
Output gap	0.6841**	0.626**	0.6843**	0.6237**	0.5414**	0.6986**
Coefficient of the Kaitz index:						
When Kaitz index > 51.4%, and:						
[1] Tax wedge > OECD median	-0.4378**	-0.4067**	-0.3434**	-0.7764**	-1.0546**	-1.1414**
[2] Tax wedge < OECD median	-0.2307**	0.1409	0.0879*	0.0805	-0.1464	-0.3682**
When Kaitz index < 51.4%, and:						
[3] Tax wedge > OECD median	0.1666**	-0.2581**	0.3348**	0.0911	-0.0519	0.3066**
[4] Tax wedge < OECD median	0.1277**	-0.0849**	0.034	-0.1237*	0.0859	-0.1138
No. obs.	1082	959	959	963	1059	1059
No. countries	38	34	34	34	38	38
Adjusted R-squared	0.921	0.903	0.743	0.92	0.898	0.774
Country fixed effects	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES

Note: \* and \*\* denote statistical significance at the 10% and 5% level, respectively, based on robust standard error estimated using the Dynamic OLS estimator. Average tax wedge for a single-earner couple with two children is used for all demographic groups except for young workers, where average tax wedge for a single household is employed in the regressions.

## 6. Robustness checks

The effect of minimum wages on the employment assessed in the regressions including country and time fixed effects and the output gap has been checked for robustness by adding a set of labour market variables. To repeat the earlier discussion, these additional variables were not previously included in identifying thresholds or examining differential responses in different regimes because they imply a reduction in the sample size by about 50%. These additional variables are active labour market policies, the unemployment benefits replacement ratio, average labour tax wedge and a measure of product market regulation. While there is some variation in coefficients from including the additional variables, the key comparisons across different regimes remain robust (Table 4)<sup>12</sup>, in particular:

- First, when labour market policy control variables are added, the findings that disemployment effects of higher minimum wages are present in the aggregate employment equation when the Kaitz index is initially high and there is a high degree of EPL, are maintained for aggregate employment and for all demographic sub-groups, although the effect on prime-age male workers is small and statistically insignificant (Table 4, panel A, comparing columns [3] and [1]).
- Second, focussing only on countries with a high minimum wage, the finding that there is a more negative marginal employment response when EPL is stricter is robust to the inclusion of controls, both in the aggregate employment equation as well as equations for all demographic sub-groups, except for prime-age male workers (Table 4, panel A, comparing columns [1] vs [2] with [3] vs [4]).
- Third, focussing only on countries with strict EPL, the finding that there is a more negative marginal employment response when minimum wages are high (above the 51.4% threshold) is

<sup>12</sup> Tables A1 and A2 in Annex A report the full estimation results including coefficient estimates on the labour market policies listed above.

robust to the inclusion of controls, both in the aggregate employment equation as well as equations for all demographic sub-groups, except for prime-age male workers (Table 4, panel B, comparing columns [1] vs [2] with [3] vs [4]).

Similar checks carried out for minimum wage effects depending on the level of the labour tax wedge (Table 5) again suggest that while there is some sensitivity of estimated coefficients, the main findings comparing different regimes remain robust:

- First, when labour market policy control variables are added, the findings that disemployment effects of higher minimum wages are present in the aggregate employment equation when the Kaitz index is initially high and there is a high labour tax wedge, are maintained for aggregate employment and prime-age females and younger workers, although the effect on prime-age male and older workers becomes positive but statistically insignificant (Table 5, panel A, comparing columns [3] and [1]).
- Second, focussing only on countries with a high minimum wage, the finding that there is a more negative marginal employment response when the tax wedge is high is robust to the inclusion of controls, both in the aggregate employment equation as well as equations for all demographic sub-groups, except for prime-age male and older workers (Table 5, panel A, comparing columns [1] vs [2] with [3] vs [4]).
- Third, focussing only on countries with a high tax wedge, the finding that there is a more negative marginal employment response when minimum wages are high (above the 51.4% threshold) is robust to the inclusion of controls in the aggregate employment equation, although this difference is smaller for most demographic sub-groups and reversed for older workers (Table 5, panel B, comparing columns [1] vs [2] with [3] vs [4]).

Finally, regressions in Tables 2 and 3 are estimated on a sample i.) excluding the United States and Canada, on the grounds that the available data of federal minimum wages may not be binding because of the prevalence of state or provincial minimum wages; ii.) excluding countries with no statutory minimum wages. Estimation results not reported here but available upon request further support the robustness of the findings for these sub-samples.

**Table 4. Sensitivity of marginal employment effects under different EPL regimes to extended controls**

**Panel A. Comparing high vs low EPL countries, when the Kaitz index is high.**

	Without extended labour market controls		With extended labour market controls	
	High EPL countries	Low EPL countries	High EPL countries	Low EPL countries
	(1)	(2)	(3)	(4)
Aggregate	-0.3987**	-0.2898**	-0.5013**	-0.0870
Prime-age female	-0.3244**	-0.0155	-0.4407**	0.0623
Prime-age male	-0.2336**	0.0420	-0.0705	0.0036
Older workers	-0.6703**	0.0230	-0.3288**	0.1868
Young, 15-19	-0.9506**	-0.806**	-0.7801**	-0.641**
Young, 20-24	-1.0735**	-0.4128**	-0.3884**	0.0669

**Panel B. Comparing high with low Kaitz index, for high EPL countries only.**

	Without extended labour market controls		With extended labour market controls	
	Kaitz index > 51.4%	Kaitz index < 51.4%	Kaitz index > 51.4%	Kaitz index < 51.4%
	(1)	(2)	(3)	(4)
Aggregate	-0.3987**	0.1069**	-0.5013**	-0.1842**
Prime-age female	-0.3244**	-0.2462**	-0.4407**	-0.2925**
Prime-age male	-0.2336**	0.1140**	-0.0705	0.0254
Older workers	-0.6703**	-0.1002	-0.3288**	-0.2523**
Young, 15-19	-0.9506**	-0.0205	-0.7801**	-0.3368**
Young, 20-24	-1.0735**	0.0685	-0.3884**	-0.0874

Notes: For regression without extended controls (including country and time fixed effects and the output gap) are taken from Table 2. For regressions with extended controls (including on top of fixed effects and the output gap a range of labour market policies), the coefficient estimates are taken from Table A1 that reports the coefficient estimates for the other labour market policies as well.



**Table 5. Sensitivity of marginal employment effects under different tax wedge regimes to extended controls****Panel A. Comparing high vs low tax wedge countries, when the Kaitz index is high.**

	Without extended labour market controls		With extended labour market controls	
	High tax wedge countries	Low tax wedge countries	High tax wedge countries	Low tax wedge countries
	(1)	(2)	(3)	(4)
Aggregate	-0.4378**	-0.2307**	-0.3482**	-0.1868**
Prime-age female	-0.4067**	0.1409	-0.6777**	0.0874
Prime-age male	-0.3434**	0.0879*	0.0246	0.0296
Older workers	-0.7764**	0.0805	0.2217	-0.0313
Young, 15-19	-1.0546**	-0.1464	-0.5065*	-0.2182
Young, 20-24	-1.1414**	-0.3682**	-0.1235	-0.112

**Panel B. Comparing high with low Kaitz index, for high tax wedge countries only.**

	Without extended labour market controls		With extended labour market controls	
	Kaitz index > 51.4%	Kaitz index < 51.4%	Kaitz index > 51.4%	Kaitz index < 51.4%
	(1)	(2)	(3)	(4)
Aggregate	-0.4378**	0.1666**	-0.3482**	-0.1979*
Prime-age female	-0.4067**	-0.2581**	-0.6777**	-0.5406**
Prime-age male	-0.3434**	0.3348**	0.0246	0.1468
Older workers	-0.7764**	0.0911	0.2217	-0.4555**
Young, 15-19	-1.0546**	-0.0519	-0.5065*	-0.4862**
Young, 20-24	-1.1414**	0.3066**	-0.1235	0.2802

Notes: See Table 5. For regression without extended controls, the coefficient estimates are taken from Table 3. For regressions with extended controls, the coefficient estimates are taken from Table A2 that reports the coefficient estimates for the other labour market policies as well.

## 7. Concluding remarks

The current paper provides three main findings. First, beyond a certain level of the Kaitz index –identified at somewhere between 50% and 60% -- increases in the minimum wage might be accompanied by job losses, especially for female and older workers.

Second, the estimation results suggest that such disemployment effects are more apparent in countries with strict EPL and/or a high labour tax wedge. This result underlines the risk of applying the results from studies of the effects of minimum wages that focus on a single country, such as the United States, to other countries.

Finally, the paper shows that the above results are robust to the inclusion of a number of additional labour market variables.

These findings, as well as confidence in their policy implications, should be seen in the context of the broader literature on minimum wages, recognising that they are contradicted by much of that literature.

Nevertheless, because the paper adopts a different empirical strategy to much of that literature, and because evidence of larger disemployment effects of more recent increases in the minimum-to-median wage may only just be becoming apparent in most recent data, the current findings suggest that employment developments of vulnerable groups should be monitored closely, also in the light of prospective further increases in minimum wage in a number of countries.

The scope of the current paper is limited to a focus on the relationship between minimum wages and employment. Obviously, the level of, and changes in, minimum wages can have implications for a variety of economic variables and outcomes including productivity, hours worked, inflation, wage distribution, inequality, social protection and differential effects on immigrant and native workers, and in different sectors. These aspects of minimum wages are beyond the scope of this paper but could be the subject of future work.

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## Annex A. Robustness checks

Annex A. presents the full regression results for regressions including a large number of labour market policies and institutions. The main text reports only coefficient estimates on the Kaitz index from these regressions.

**Table A.1. Estimation results for the minimum wage and EPL – including other labour market policies and institutions**

	Dependent variable: employment rate of:					
	Total	Prime-age female	Prime-age male	Older	Young, 15-19	Young, 20-24
Constant	70.6129**	80.8138**	92.1919**	59.4371**	24.7907**	71.2806**
Output gap	0.4361**	0.1225	0.4025**	0.2411**	0.3674**	0.3476**
Unemployment benefits replacement ra	-0.1368**	-0.2044**	-0.1402**	-0.2369**	-0.2272**	-0.1182**
Active labour market policies	0.169**	0.2106**	0.096**	0.0897**	0.0851**	0.1961**
ETCR indicator	-0.2528	-3.0917**	0.7139**	2.2772**	1.4935*	1.4003**
Average tax wedge, couples	-0.0972**	-0.0504	-0.227**	-0.2377**		
Average tax wedge, singles					0.1327	-0.5563**
Coefficient of the Kaitz index:						
When Kaitz index > 51.4%, and:						
EPL > OECD median	-0.5013**	-0.4407**	-0.0705	-0.3288**	-0.7801**	-0.3884**
EPL < OECD median	-0.087	0.0623	0.0036	0.1868	-0.641**	0.0669
When Kaitz index < 51.4%, and:						
EPL > OECD median	-0.1842**	-0.2925**	0.0254	-0.2523**	-0.3368**	-0.0874
EPL < OECD median	0.0314	-0.0532	-0.0158	-0.3921**	-0.0886	0.3039**
No. observations	615	592	592	594	604	604
Countries	31	31	31	31	31	31
Adjusted R-squared	0.938	0.919	0.813	0.952	0.951	0.942
Country fixed effects	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES

Note: as for Table 2.



**Table A.2. Estimation results for the minimum wage and the tax wedge – including other labour market policies and institutions**

	Dependent variable: employment rate of:					
	Total	Prime-age female	Prime-age male	Older	Young, 15-19	Young, 20-24
Constant	69.7573**	81.8433**	90.0993**	60.2029**	21.6718**	65.8457**
Output gap	0.467**	0.1301	0.4609**	0.2783**	0.4348**	0.4322**
Unemployment benefits replacement ra	-0.1258**	-0.1613**	-0.1329**	-0.2201**	-0.1247*	-0.1401**
Active labour market policies	0.1786**	0.2171**	0.0992**	0.0863**	0.1067**	0.2095**
ETCR indicator	0.1277	-2.9651**	0.8425**	2.8881**	2.0027**	1.9556**
Average tax wedge, couples	-0.1197**	-0.1205**	-0.1927**	-0.2948**		
Average tax wedge, singles					0.0847	-0.4675**
Coefficient of the Kaitz index:						
When Kaitz index>51.4%, and:						
Tax wedge>OECD median	-0.3482**	-0.6777**	0.0246	0.2217	-0.5065*	-0.1235
Tax wedge<OECD median	-0.1868**	0.0874	0.0296	-0.0313	-0.2182	-0.112
When Kaitz index<51.4%, and:						
Tax wedge>OECD median	-0.1979*	-0.5406**	0.1468	-0.4555**	-0.4862**	0.2802
Tax wedge<OECD median	-0.0196	0.0275	-0.0544	-0.3465**	-0.0083	0.0181
No. observations	615	592	592	594	604	604
Countries	31	31	31	31	31	31
Adjusted R-squared	0.936	0.921	0.815	0.950	0.957	0.940
Country fixed effects	YES	YES	YES	YES	YES	YES
Time fixed effects	YES	YES	YES	YES	YES	YES

Note: as for Table 2.

## Annex B. Major supportive income tax and social security contribution measures for incomes around the minimum wage in OECD countries

**Table B.1. Major income tax and social security contribution measures for low incomes in OECD**

Country	Measure
Australia	<b>Low Income Tax Offset</b> reduces income tax at low incomes of around the MW to zero and declines progressively with income, up to about 1 2/3 of MW. In addition, the <b>Low and Middle Income Tax Offset</b> applies in a similar manner to incomes up to about 3x MW. The Low and Middle Income Tax Offset is going to be discontinued and the last income year it will apply to is 2021-22.
Austria	The general tax commuting <b>tax credit</b> available to all employees is higher for low incomes. In addition, since 2007 low-income earners pay a <b>reduced rate of unemployment insurance contribution</b> .
Belgium	Since 2000, a “social work bonus”, i.e. <b>reductions in employee SSC</b> for low-income workers, is in place. Since 2011, this is accompanied with a “tax work bonus”, i.e. a <b>reduction in payroll taxes</b> for low-income workers eligible for the social work bonus. In addition, in 1999, <b>reductions in employers’ SSC</b> for low incomes were introduced.
Canada	Since 2007, a federal <b>tax credit</b> (as of 2021 “Workers Benefit”) is a tax credit for low-income earners (the exact design may vary according to province).
Chile	Low incomes (up to about 2x MW) are <b>exempt from the income tax</b> .
Colombia	<b>Zero income tax rate</b> applies to low incomes (up to about 3x MW). In addition, <b>employers’ health insurance contributions</b> are zero for incomes lower than 10x MW.
Costa Rica	<b>Zero income tax rate</b> applies to low incomes (up to about 2.5x MW).
Estonia	A general <b>tax allowance</b> applies to low incomes; it starts declining progressively at about 2x MW and becomes zero at incomes of about 3.5xMW. In 2016 only, a <b>tax credit for low-income earners</b> was in place.
Finland	<b>Earned income tax credit</b> on central government tax (as a percentage rate of income) applies fully to low incomes, and starts declining progressively from incomes exceeding a certain threshold (approx. 2/3x of AW).
France	Introduced in 1993, a system of <b>employers’ SSC reductions</b> applies to wages at or around the MW level (the exact design has changed over time). Between 1998 and 2002, the rebates were larger for firms that decided to reduce hours worked. Around 2003, the main aim has been to offset the increase in the minimum wage generated by the harmonisation of the various minimum wages created by the 35 hours week legislation.
Germany	A progressively decreasing <b>reduction of employee’s SSC</b> applies to very low earnings (up to about 0.8x MW; for so-called “mini-jobs”).

Israel	A <b>reduced rate of both employers' (since 2005) and employee (since at least 2000) SSC</b> applies to low incomes (below 60% of average wage).
Japan	<b>Employment Income Tax Deduction</b> applies to employment incomes up to about 1 2/3x AW in a progressively decreasing fashion, with the biggest deduction being applied to lowest incomes up to approx. the (national-average) MW level.
Korea	An <b>employment income tax deduction</b> , as well as a <b>working tax credit</b> applies to wages and salaries and declines progressively with income.
Latvia	Since 2016, a <b>non-taxable minimum applies to low incomes</b> , with the maximum amount of the allowance applying to incomes up around the MW and then progressively declining for incomes up to about 3.6xMW.
Lithuania	Since 2009, <b>general basic tax allowance</b> applies to employment incomes up to about 4.5xMW in a progressively decreasing fashion, with the highest exemption applying to incomes up to 1x MW.
Luxembourg	In 2019, the <b>social minimum wage tax credit</b> was introduced for low incomes up to about 1.4xMW, on top of the already existing <b>tax credit for employees</b> . Both decline progressively with income (the latter applies to incomes up to about 3xMW and starts declining at about 1.8x MW).
Mexico	An <b>employment subsidy tax credit</b> applies to low incomes (up to about 2.4x minimum wage). Beyond a threshold the tax credit declines progressively with income.
Netherlands	The <b>general tax credit</b> applies fully to incomes up to about 1xMW and declines progressively to zero thereafter. The amount of <b>work tax credit</b> on incomes from work rises with income up to about 1 2/3x MW and declines progressively to zero thereafter.
Portugal	In the case of taxpayers whose income stems primarily from dependent employment (earned income), <b>disposable income after application of tax rates</b> to taxable income <b>may not be less</b> than an amount of approx. 1x MW.
Slovakia	<b>General tax allowance</b> becomes degressive after a certain threshold of about 2.5x MW. In 2015, an <b>allowance for employee's and employers' (the latter abolished in 2018) health insurance contributions</b> for low earned incomes was introduced (decreasing progressively from a certain threshold to incomes up to about 1x MW).
Spain	A <b>tax allowance</b> is applied to low employment incomes (in full up to about 1x MW and progressively declining up to about 1.3x MW).
Sweden	<b>Earned Income Tax Credit</b> applies to labour incomes and is phased out at incomes of about 1.25xAW.
Turkey	As of January 2022, accompanying a large increase in minimum wage of 40% (followed by another increase of 30% in July; these took place during a period of record-high inflation), an <b>income and stamp tax exemption</b> on minimum wage was introduced, i.e. these taxes will only apply to incomes exceeding the minimum wage. Income up to the minimum wage is only subject to SSC. Until 2021, a tax allowance based on 50% of MW applied to each income tax taxpayer.
United Kingdom	A <b>universal tax credit</b> is gradually replacing several benefits and tax credits for low-income earners or people out of work or unable to work. The amount and eligibility depend on various criteria, such as age, number of children, whether one is single or in a couple, disability, savings, etc.
United States	<b>Earned Income Tax Credit</b> applies to low-income workers. For single workers without children, it starts to progressively decrease at about 0.8x federal MW and is phased out to zero at about 1.4x federal MW (or 1/3 of AW).

Note: AW means average wage (as estimated in OECD, 2022b and referring to 2021, unless stated otherwise); MW means minimum wage; SSC means social security contributions. Ratios to average and minimum wages are approximate and they relate to 2021, unless stated otherwise. Temporary measures designed specifically to tackle the effects of Covid pandemic are not included. Taxes refer to central/federal; subnational taxes are not taken into account, neither are any transfers/benefits that can also affect the tax wedge. The table includes the major income-tax related and social security contribution measures at or around minimum wage incomes; there are other measures that countries can and do use to support the incomes of low-income workers, such as in-work benefits, progressive taxation, general tax allowances, support measures targeted to families with children, etc. Tax and SSC scheme designs are usually very complex (with various thresholds, tax bases, rates and conditionalities, depending on marital or disability status, age, family type or size, etc.), so the broad summary in the table is a simplification, not taking into account family type, number of children or any other potential factors. For more details see OECD (2022b).

Source: Compilation based on OECD (2022b), OECD (2022c), OECD (2005), Buffel and Nicaise (2019), <https://www.sozercizmeci.com.tr/tax-exempt-minimum-wage/>, <https://www.ato.gov.au/Individuals/Income-and-deductions/Offsets-and-rebates/Low-and-middle-income-earner-tax-offsets/>, <https://www.bmf.gv.at/themen/steuern/arbeitnehmerinnenveranlagung/steuertarif-steuerabsetzbetraege/uebersicht-steuerabsetzbetraege.html>