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THE EFFECT OF THE MINIMUM WAGE ON EMPLOYMENT AND
PRODUCTIVITY:
AN EMPIRICAL ANALYSIS

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1. Introduction

The theme of the minimum wage is a very timely and important topic during these days. In fact, one of the winners of the Economics Nobel Prize 2021 was David Card with his work on minimum wages. Moreover on 6th June 2022 a EU directive has been deliberated: it promotes adequate minimum wages in all the EU countries

The analysis of the effect produced by an introduction or an increase of the minimum wage on the employment has been one of the main research fields in Labour Economics. Despite the main reason below minimum wage is to aid low-income families, the empirical literature demonstrates that this economic policy is a significant cause of unemployment. Low skilled workers, guaranteed by the minimum wage, claim a higher salary in respect to their job performances; companies, by contrast, were used to paying them less therefore they will change their hiring policy downwards.

Considering a social point of view the minimum wage policy has positive implications like allowing families to reduce poverty by increasing their incomes. However, the situation for employers is different: if the minimum wage is determined over the market-clearing line of wages, the demand for labour will decrease whereas the supply rises, so there is no equilibrium anymore.

Nevertheless, the work led by David Card, Joshua Angrist, and Guido Imbens reaches different conclusions: analysing the effect in fast-food restaurants in New Jersey and Pennsylvania, by introducing a minimum wage at a low level, increases the employment rate contrary to the dominant theory. The main aspects are that the minimum wage must be fixed at a low level and the social reason could be that employers had a strong bargaining power thus they would determine low salaries making work not convenient; in this case, even a little increase in wage should raise employment.

This work is structured as it follows: chapter 2 gives the main definitions of the labour market; chapter 3 describes the labour market equilibrium; chapter 4 analyses the effect of an increase of minimum wage; chapter 5 illustrates the medium run equilibrium; chapter 6 summarizes the main work in this topic; chapter 7 regards the empirical analysis.

2. The Labour Market: definitions

2.1. Labour market and minimum wage

Labour market dynamics refers to changes in jobs that take place as well as entries into and departures from economic activity affected by hirings, separations and the establishment and closure of self-employment activities¹.

The labour market is that place where the demand of the labour force finds its equilibrium with the supply at a specific price, which determines the market clearing line. This level is reached after a period of bargaining between employers and workers trying to achieve the best results for themselves. Therefore, in the labour market a stronger bargaining power is correlated to wages: a more skilled worker will always have a higher power on employers than an unskilled one could have ever had.

In determining the equilibrium wages there can be two types of bargaining: an individual one based on direct interaction between the company and the employees; a collective one through labour unions and companies. Generally, most of the workers receive a wage greater than the reserve one, which is the level that makes the worker the same to work or not.

Moreover, along with the bargaining there are some rules and laws from institutions which come from political processes and decisions: thus, they are slightly different in Euro States and obviously it depends on whoever political side has the majority. Analysing the political aspect, the laws can change during the years, so it is difficult to establish a continuous view on the topic: considering that political decisions have been always influenced by the equity and efficiency trade-off, so it is understandable why there are frequent changes in orientation.

¹ Definition of “Labour market dynamics” by OECD

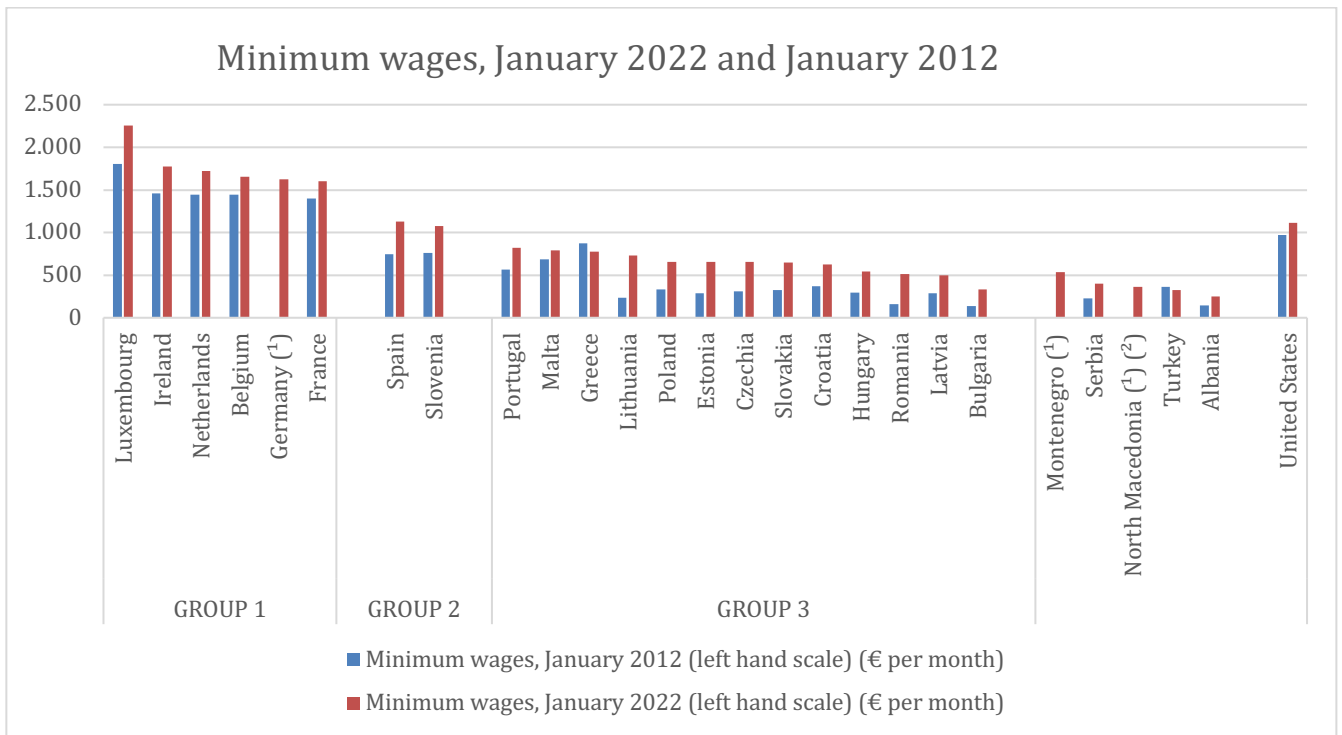


Figure 1 Minimum wages, January 2022 and January 2012²

Minimum wage laws set legal minimums for the hourly wages paid to certain groups of workers³.

On 1st January 2022, 21 out of the 27 EU Member States had a national minimum wage. EU countries without a national minimum wage were Denmark, Italy, Cyprus, Austria, Finland and Sweden. Monthly minimum wages vary widely across the Member States, from EUR 332 in Bulgaria to EUR 2 257 in Luxembourg (in Figure 1.1)⁴.

According to the minimum wage level of each State, they are divided into three groups: they have all experienced a raise but compared to the difference in price levels (using the PPPs) it is smaller.

The establishment of minimum wage level is a consequence of a political procedure: for example, in Italy the minimum wage never had success for both employers and labour unions. The opinion of the syndicates is surprising: their main reason is that they are worried that the more paid workers can receive negative effects with the introduction of the minimum wage.

² Source: “Eurostat”

³ Employment Standards Administration, U.S. Department of Labour, *History of Changes to the Minimum Wage Law*, 2003

⁴ “Minimum Wage Statistics” by “Eurostat”

2.2 Labour force and unemployment rate

The labour force (LF), or currently active population, comprises all persons who fulfil the requirements for inclusion among⁵:

- the employed (N) are defined as those who work for pay or profit for at least one hour a week, or who have a job but are temporarily not at work due to illness, leave or industrial action⁶.
- the unemployed (U) are defined as people without work but actively seeking employment and currently available to start work⁷.

The unemployment rate represents the number of unemployed people as a percentage of the labour force⁸ The unemployment rate is calculated as: $\frac{\text{Unemployed}}{\text{Labour Force}} \times 100$.

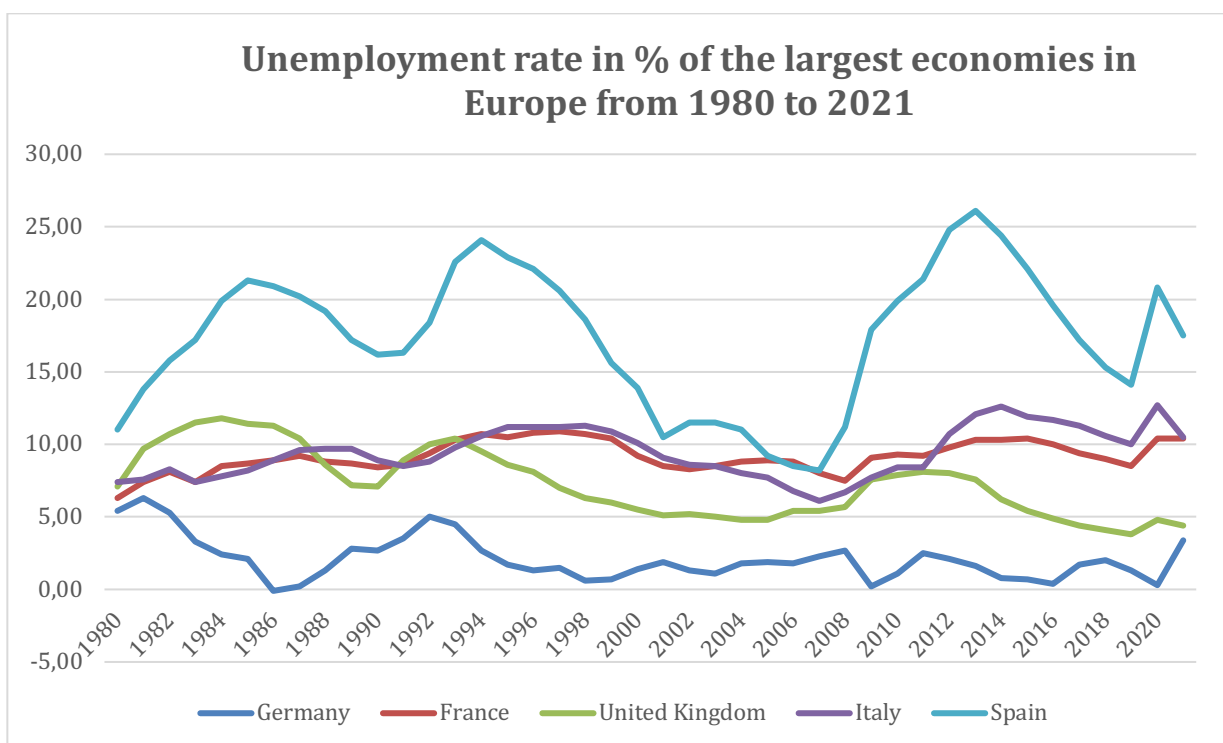


Figure 2 Unemployment rate of the largest economies in Europe from 1980 to 2021⁹

In this graph is shown that during the recent crises, most of the European States experienced a growth in unemployment: crises cause effects and the measures taken are different between States; the shocks are not homogeneous because every country has its own economy and law system.

We can distinguish three different types of unemployment:

⁵ Definition of "Labour Force" by OECD

⁶ Definition of "Employed people" by OECD

⁷ Definition of "Unemployed people" by OECD

⁸ Definition of "unemployment rate" by OECD

⁹ Source IMF, 2022

- *voluntary*: some workers prefer not to work when the wage level is not high enough; the reasons for that could be hopes to find a better suited job, higher taxation that reduces the net salary or excessive demeaning or tedious potential jobs. In this case it is clear the trade-off between work and leisure; it is a decision made by the worker that claims leisure as more valuable compared to those conditions made by the labour market. This condition is not useful to explain unemployment, because a voluntary unemployed is not a proper unemployed according to official statistics.
- *structural*: wage rigidities and institutions determine that wages will remain higher and do not adjust towards the equilibrium level, thus this unemployment is the outcome of this disequilibrium.
- *frictional*: there is a more fluid mechanism; it is generated by frictions in the labour market: job-search requires time, the economy is characterised by a continuous creation and destruction of job placements, thus there is always an amount of workers without a job. Therefore, the equilibrium unemployment is generated by inefficiencies of the labour market, thus the matching between offer and demand is difficult.

3. Equilibrium in the Labour Market

3.1 Demand and supply of Labour

The model is explained by using labour as a “product”, but it is different from the usual concept, so the labour market will have its own specific characteristics. The Labour Market can be considered as a group of aggregates (like the United Kingdom Labour Market) and as a market of a specific type of job.

In addition to that there are: the “sellers” (workers), that search for the best price to sell labour; on the other hand, there are the “buyers” (employers) interested in paying the least possible for the “product” always labour.

The supply curve, at variation of prices, corresponds to variations in the quantity offered; we can assume that the slope is positive: at the growth of prices, the quantity offered increases with it; but it is not always true.

The demand curve slopes down: if the labour costs less, the employer will ask for more. From the workers’ point of view a production cost has two elements:

- effort
- trade-off between work and leisure

The equilibrium price is fixed from the intersection between the demand and the supply curve.

Most of the work in analysing the supply curve is based on the trade-off between work and leisure.

Leisure (T) is defined as the time spent not working; instead, Labour (L) is time spent working. Thus, in one day $T=24-L$.

They are both measured in time units thus we assume that along with the increase of leisure the utility will also raise.

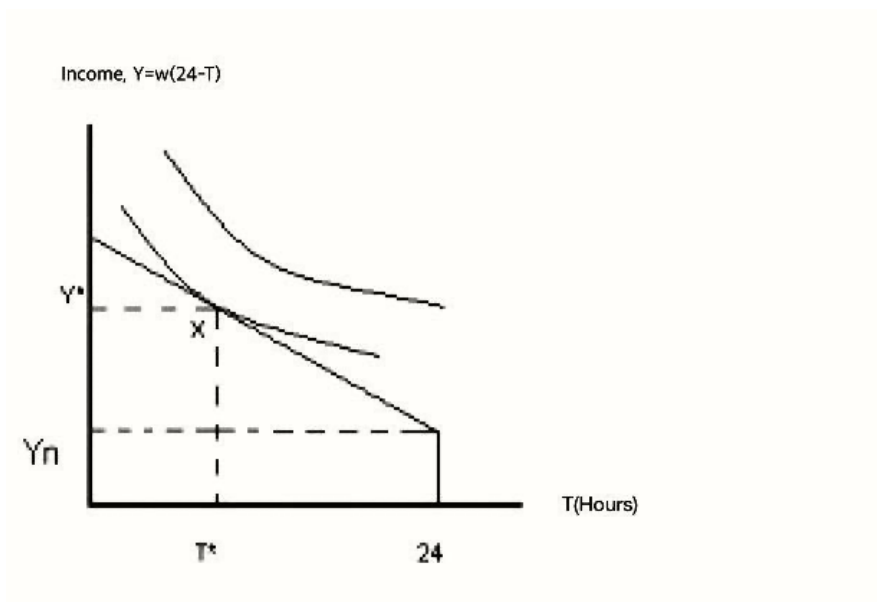


Figure 3 Worker's choice

We can assume that hourly wage is constant: therefore, the income from work is hourly wage \times hours of work; it is a linear function of worked hours.

Moreover, we can intend work time and income as continuous.

The worker has a maximum of 24 hours per day, thus the work income: $Y = (24 - T) \times w = 24w - wT = w \times (24 - T)$. This is the budget constraint.

$T =$ leisure time; $w =$ best salary he can obtain¹⁰

This linear function indicates that if the employee works for 24 hours per day, he obtains $Y = 24w$ and it declines when the time dedicated to leisure raises; thus “ w ” can be interpreted as the cost for one hour of leisure: in order to have an hour more of leisure it is necessary to give up to one hour of payment.

Considering that work and leisure are “normal goods”, there is a clear trade-off between these two activities: the *marginal rate of substitution* (MRS) is the fraction of the amount of income that you must give up and the quantity of leisure that you need to have, to establish the same level of utility. It corresponds to the slope along a part of the indifference curve.

Thus, in equilibrium the wage is also the MRS of income with leisure because it indicates how much income you must renounce for having a unit more of leisure.

The supply curve relates labour supply to wage, so wage varies as the budget constraint shifts.

$$Y = (24 - T) \times w + Y_n$$

¹⁰ “best salary” is a mixture of lots of elements: a worker can choose a less paid job, but more interesting or effortless.

When w raises, the line becomes steeper (if the workers do not work, nothing happens): so every new value of w creates a new budget constraint determining new intersections between the curves; grouping all these intersections the individual labour supply is generated, because a value of T and a wage level are linked.

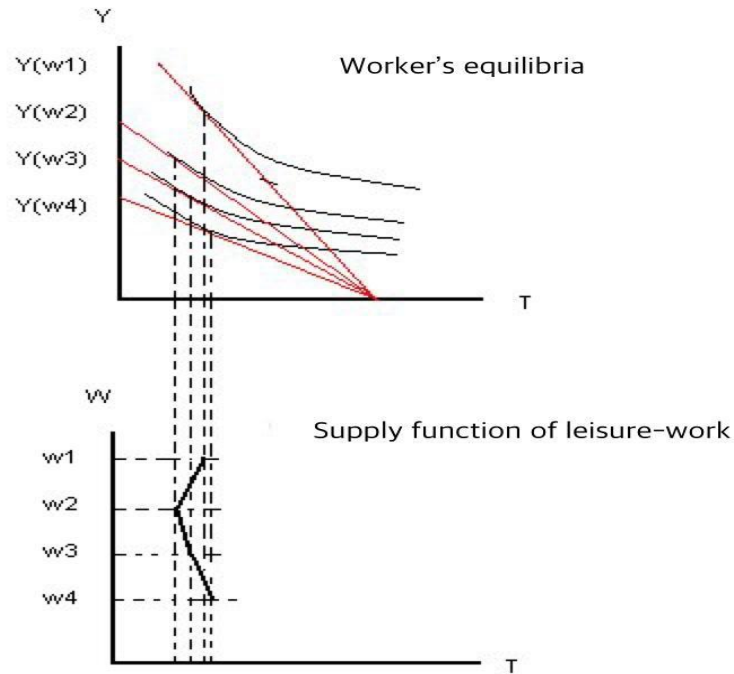


Figure 4. Worker's equilibria and supply function of leisure

When w increases at the beginning, leisure is reducing and then labour supply raises; at a certain point, the opposite happens.

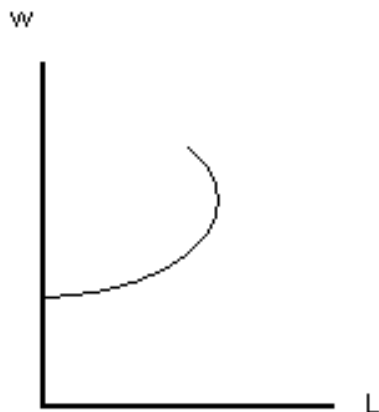


Figure 5. Labour supply function

The supply curve has a positive slope, because with higher wages the worker will be more encouraged to dedicate more time to work. There is an exception for very high wages: in this case the curve starts to turn back.

Concerning low wages, this relation is fundamental: a raise of the minimum wage can push into the labour market all the workers that had a wage lower than their reserved one. On the other hand, firms are less willing to hire employees with these higher wages.

Consider the main feature of the perfectly competitive market: a firm cannot change the price through its demand; at the current wage, it will find every labour supply it needs; a singular firm is too small to alter the conditions of the market.

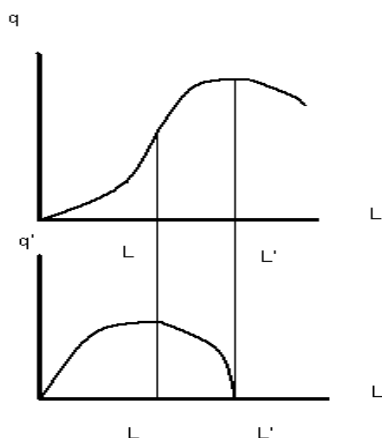


Figure 6. Labour's production function

The upper graph shows the quantity of production linked to the amount of labour: in the early phase, when labour (L) raises, production raises even proportionally more but, going further, it becomes always less: it is reported in the graph below which shows the *marginal productivity of labour (MPL)*, that is, at first, growing and then is decreasing.

$$MPL = \frac{\partial Q}{\partial L}$$

This formula represents the $\frac{\text{change in output}}{\text{change in labour}}$; when MPL is > 0 , the line in the Y and Q graph has positive slope; when MPL is < 0 , the line has negative slope.

Multiplying MPL by P (price of the product), we obtain the *marginal revenue of labour*, that is the change in revenue by adding a unit more of work.

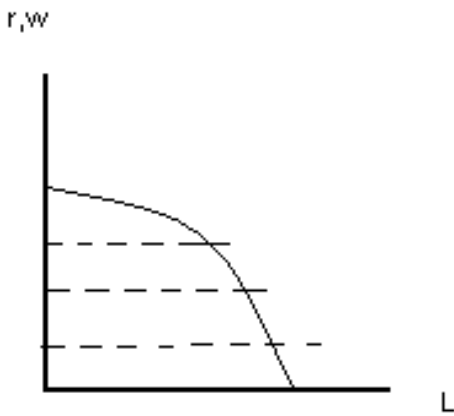


Figure 7. Labour demand in the short run

The curve recognizes the marginal revenue of labour, while the horizontal broken lines represent different levels of marginal costs of labour, that is salary “w”.

Analysing a perfectly competitive market, considering that the salary is given, so the cost of an additional of labour is the same of the units before.

If the marginal revenue of labour is greater than the marginal cost of labour, it is convenient to use more of it; so, the intersection between the curve and the dotted line fixes the quantity of labour demanded for that level of w.

$$w = MPL \times P$$

Thus, this formula realizes if when w declines, the marginal cost of the product declines also, so it will be convenient to expand labour.

In the long run the company can modify its dotation of capital: more capital implies more revenue and if the wage keeps diminishing, there will be more labour. A variation in “w” in the long run has a stronger effect than the one in the short run: the demand function is flatter, thus even more elastic than the short run one.

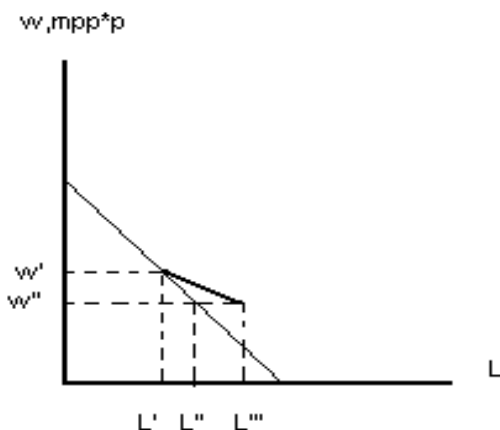


Figure 8. Demand of labour in short run vs long run

A decline of “w” will cause a raise in L, in the short run, considering the capital amount unchangeable, the marginal productivity of capital will augment; instead, in the long run the stock of capital can be modified, so the firm will increase it, then the marginal productivity of labour increases and L experiences a major raise. The raise in L caused by the decline of “w” gives L’ and augments the marginal productivity of capital. However, increasing the stock of capital, marginal productivity of work will grow, in L’ the productivity is greater than w thus it is necessary to augment L in order to reach L’’.

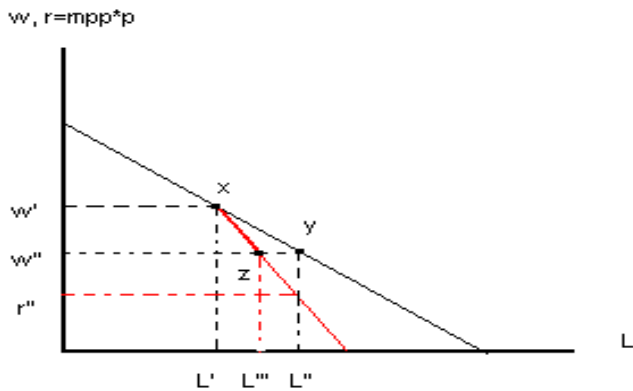


Figure 9. Aggregate demand vs individual

The demand of labour at an aggregate level is not the simple sum of the individual ones: considering a decline of “w”, companies will increase production and occupation; P will go down and so will MPL: in this case, firms are paying a salary which is higher than MPL and they need to reduce L (passage from L’’ to L’’’). Thus, the overall effect of L is smaller than what we would have obtained by summing all the firm’s specific demands.

3.2 Aggregate equilibrium in a perfect competitive market

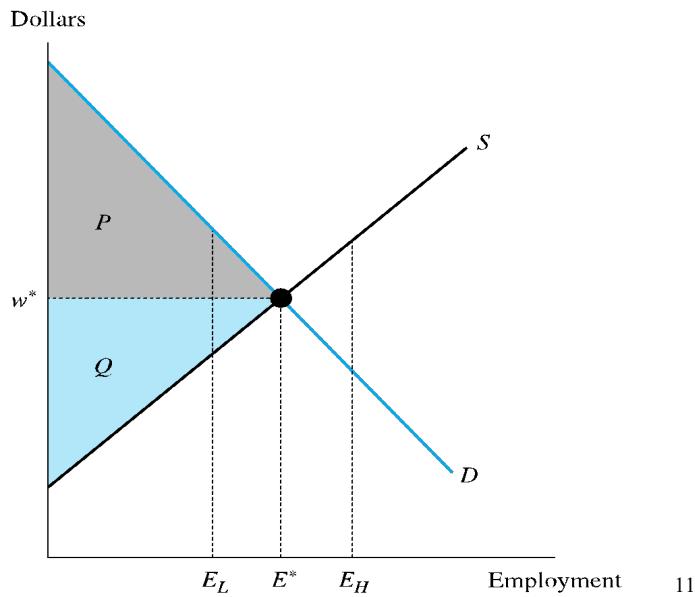


Figure 10. Equilibrium in a perfect competitive market

The triangle P is the producer surplus; the triangle Q gives the worker surplus.

The supply curve is positively sloped and describes the amount of labour (intended as employers-hours) that companies request at that specific wage; the demand curve gives the number of labour firms demanded at a determinate level of wage.

The equilibrium is reached when supply equals demand, creating w^* and E^* (L^*): the w^* is the market clearing level, because any other level would create excess on the supply or demand side: there would be too many workers for a little number of jobs available or an excessive request for jobs with a restricted number of available workers.

¹¹ Borjas G. , *Labor Economics*, McGrawHill, 2013

3.3 Equilibrium in an imperfectly competitive market

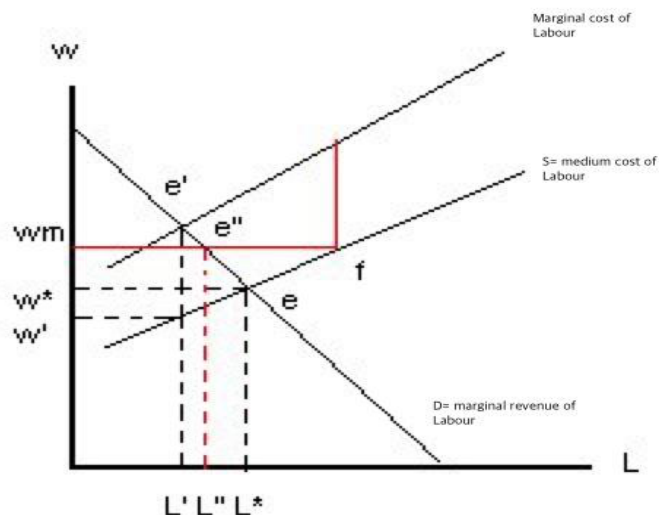


Figure 11. Equilibrium in an imperfectly competitive market

The equilibrium in the perfect competitive market is in “e”; every firm has a horizontal supply curve, where marginal and medium cost are the same.

If the demand comes from a monopsonist, the supply curve is “S” and the equilibrium is in “e’”, where the marginal cost of labour is equal to the marginal revenue.

If there is a minimum wage which pushes the supply curve up (red line) until “f”, the red line is also the medium cost and, because it is constant, the marginal cost is the same; thus, the marginal curve is the red one and the new intersection between marginal cost and marginal revenue is in “e” “: introducing a minimum wage would reduce the unemployment from monopsony but not re-establish the perfectly competitive market equilibrium.

4. The effect of increasing minimum wage

4.1 Perfectly competitive market

In a perfectly competitive market when the wage is set above the market clearing level, more labour is offered than the amount requested at that level: thus, there is a surplus of labour supplied. Therefore, employers augment the use of capital, hire fewer workers, and reduce their hours: the unemployment increases.

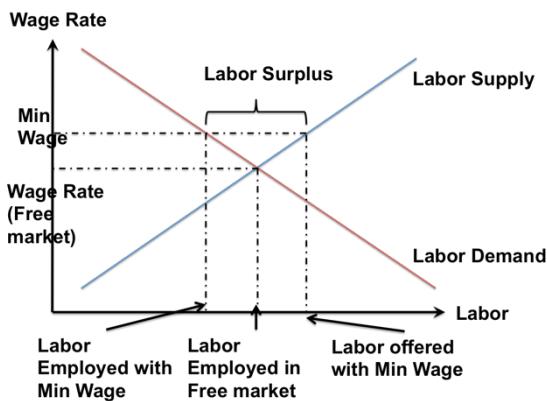


Figure 12. A binding minimum wage in a perfectly competitive market

Considering two inputs: capital and labour. Figure 2.2 analyses the effects on labour and capital after augmenting the minimum wage: the former level of the isoquant curve was “ q_1 ” and the one of the isocost line was AA’; raising the minimum wage level, the cost of labour grows, thus there are two effects:

- substitution effect: holding the output level constant, since the labour costs more, will be used less in favour of its substitute (capital); it is described by the shifting of the isocost line from AA’ to BB’ and consequently the modification of the tangent point from E_1 to E_2 .
- scale (income) effect: as a consequence of an increase of the production costs, the marginal costs of producing have risen as well; considering the main goal to maximise the profit, companies must reduce their outputs. Figure 2.3 in which the marginal cost curve shifts from MC_1 to MC_2 . To make $MC=MR$, the new equilibrium represents a decline in the level of quantity, from “ q_1 ” to “ q_2 ”. Moreover, in the Figure 2.2 this change moves the isocost line from BB’ to CC’. The new tangent point is E_3 , thus this scale effect pushes down the amount of labour even more.

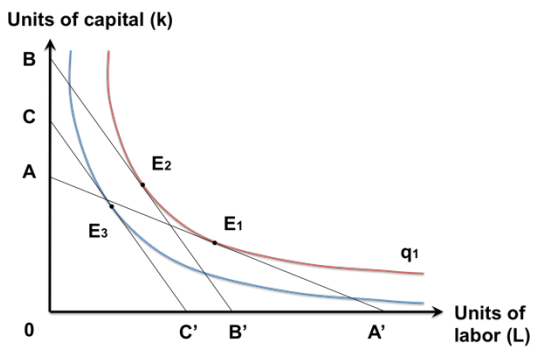


Figure 13. Substitution effect and scale effect

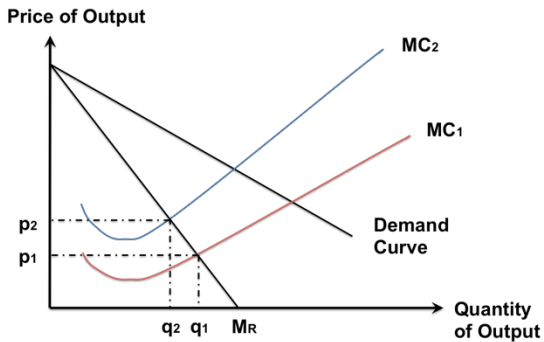


Figure 14. Determination of the Optimal Quantity Level

The analysis on a perfectly competitive market states the theory of negative employment effects of minimum wages.

4.2 Monopsony model

On the other hand, economists state that in some cases a minimum wage can raise the level of unemployment: one situation is the monopsony model. A monopsony consists of a market with a single buyer. In general, when buyers have some influence over the price of their inputs, they are said to have monopsony power.¹²

In a monopsony market, the labour supply curve is upward sloping and the marginal cost (due to a presence of power towards the market) is greater than the wage rate: the marginal cost (MC) curve is above the labour supply one. The marginal revenue product of labour (MRP_L) has a negative slope caused by the diminishing marginal return of labour; thus, for maximising the profit $MC_L = MRP_L$ in the point A as reflected on the supply curve in A' (W_{ms} ; L_{ms}). The efficient equilibrium is in C, which generates the area ACA' , that represents the loss due to monopsony.

¹² Definition of “monopsony” by OECD

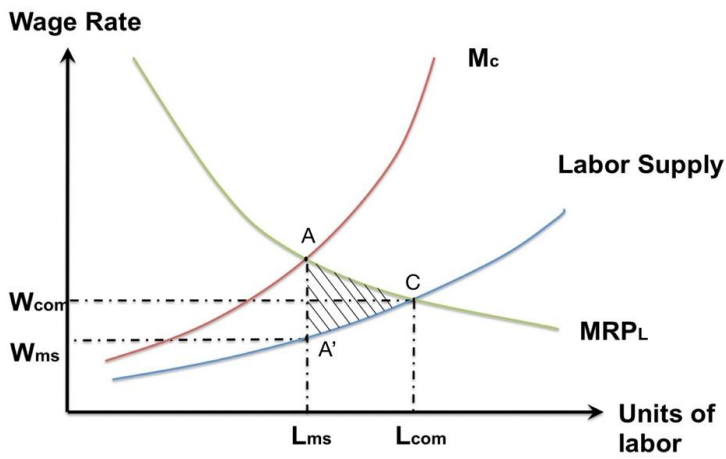


Figure 15. Monopsony Model

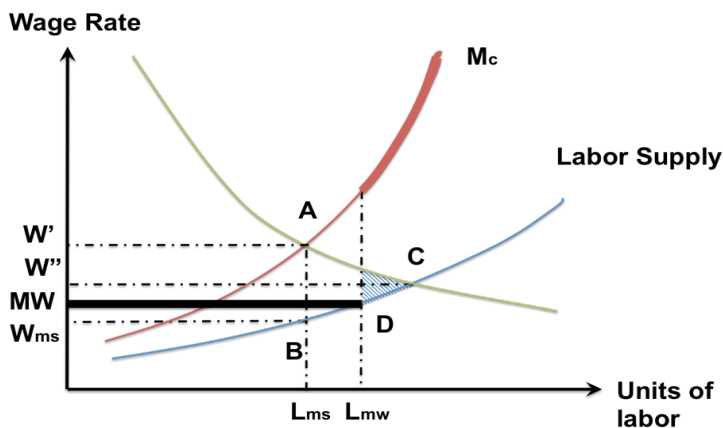


Figure 16. Monopsony Model with Minimum Wage

In this figure is described the effect of an increase of the minimum wage above the level of the monopsony; the marginal cost is constant up to “D” (the intersection between minimum wage line and labour supply curve). Thus, the profit-maximising level is “D” and the new employment level is L_{mw} and is higher than before. The marginal cost has a new configuration made by two parts: the black bold horizontal line and the bold part in red; the MC of labour is decreased, so the company has an equilibrium with an L^* higher and the loss area is reduced. Analysing those results, some economists maintain that minimum wage can have a positive effect on the economy considering the raise of employment level and the improvement of social welfare.

5. Equilibrium in the medium run¹³

5.1 Wage and price determination

For determining wages there are two main theories:

- bargaining of wages theory
- efficiency wages theory

The wage determination is strongly affected by the bargaining power: the main methods of finding the equilibrium wage are individual bargaining between firm and worker, collective bargaining between companies and trade unions. The strength of the bargaining power a worker has, depends on how easy it is for firms to substitute the employee, on how easy the worker can find a new job and finally on the level of protection of the worker. Moreover, there should be specificity of the competencies (difference between qualified and unqualified workers), if the job does not require particular skills and the labour supply for that job is high, the worker has not a strong bargaining power. The main conditions on the labour market (unemployment level) when the unemployment rate is low, will make it difficult for the firms to find available workers and workers, on the other hand, can change job easier, in this case the employee has a major bargaining power, thus the law system and the institutions in the labour market experience an increase in subsidies and the worker can exercise a stronger bargaining power.

The efficiency wage theories connect the productivity of workers to wage: most companies want to make their workers feel fine with their job, making it financially attractive, allowing promotions (which increase productivity), thus their goal is to teach the job and reduce workers turnover. This theory relies on some conditions:

- Companies with more specific and technical jobs, which require skills or abilities tend to pay more their workers than unskilled ones
- market conditions affect the wage: as before, a high unemployment rate keeps the workers more tied to their job, because it is really difficult to find another one.

The equation is:

$$W = P^e F(u, z)^{14}$$

(-, +)

¹³ Blanchard O., & Amighini A., & Giavazzi F., “*Macroeconomics, a European Perspective*”, Pearson, 2020

¹⁴ Ibidem

The aggregate nominal wage, W , depends on three factors:

- The expected indicator, P^e .
- The unemployment rate, u .
- A variable, z , that groups all other variables that might affect the outcome of wage setting¹⁵.

Regarding the aspect of the expected price level, workers and firms are interested in the real amount W/P : that represents the real salary, how much of the good you can pay through work; it is also a clear indicator of the living standards of employees.

The unemployment rate negatively influences wages, because considering that they are determined through bargaining: a lower unemployment rate would allow workers to be in a stronger bargaining position that could lead them to achieve higher salaries.

In this model the minimum wage can be inserted in the variable “ z ”, we can interpret his impact as before: introducing a minimum wage there can be wage rigidities, because the equilibrium wage cannot be settled under the minimum wage level; this causes an imbalance for the low-skilled and young workers, considering that they usually earn a salary lower than the minimum one, thus firms will reduce their demand for this kind of workers.

This model is determined in the medium run, so the expected price is correct: $P=P^e$ and in real terms we have: $\frac{W}{P} = F(u,z)$ known as WS curve.

In determining the equilibrium price from the firms’ point of view, it clearly depends on the production function - that is the relation between the inputs used in production and the quantity of output produced¹⁶- because it has a direct impact on costs.

In this model we hypothesize that labour is the only factor used for producing goods, the production function is $Y=AN$

Y =output

A = labour productivity

¹⁵ Blanchard O., & Amighini A., & Giavazzi F., “*Macroeconomics, a European Perspective*”, Pearson, 2020

¹⁶ Ibidem

N= employment

Considering a $Y = f(N)$ we define the marginal productivity of labour:

$MPL = \frac{\partial f(N)}{\partial N}$ that represents the increase in the overall output when one unit extra of labour is added.

And we define the average productivity of labour:

$AP = \frac{Y}{N}$, that is a common measure for labour productivity.

Focusing on costs, the marginal cost of production (MC) is $\frac{W}{A}$, in fact for augmenting Y by one unit it is necessary to increase the input quantity by $\frac{1}{A}$, thus the costs are $\frac{1}{A} * W$. Using a simplification by considering A as a constant (so $A=1$), the marginal cost of production is W: the cost of producing one unit more corresponds to the wage.

The equation for determining the equilibrium price is: marginal cost + mark-up: $P = (1 + \mu) \frac{W}{A}$; μ represents the amount of price over the cost. If we analyse a perfectly competitive market of goods, the mark-up would be zero, in that case the price would be equal to the marginal cost: $P = \frac{W}{A}$; a competitive market brings more efficiency to the economy, because it helps to correct distortions in production, allows the increase of productivity therefore producers are more incentivized in selling higher quality products at lower prices.

In reality, the majority of goods markets are not perfectly competitive, thus in that case the mark-up would always be greater than zero.

If the price equation is $P = (1 + \mu) \frac{W}{A}$, in real terms is $\frac{W}{P} = \frac{A}{1+\mu}$, known as PS curve. It depends positively on productivity, negatively on markup and there is no relation with the unemployment rate.

5.2 The natural rate of unemployment

The natural rate of unemployment (NAIRU) is the rate of unemployment arising from all sources except fluctuations in aggregate demand. Estimates of potential GDP are based on the long-term natural rate¹⁷.

In this model it is found in the intersection between the Wage Setting and the Price Setting curve.

$$(WS) \quad \frac{W}{P} = F(u, z)$$

$$(PS) \quad \frac{W}{P} = \frac{A}{1 + \mu},$$

Equalizing both equations we obtain the equilibrium which is formalized in this way:

$$F(u, z) = \frac{A}{1 + \mu},$$

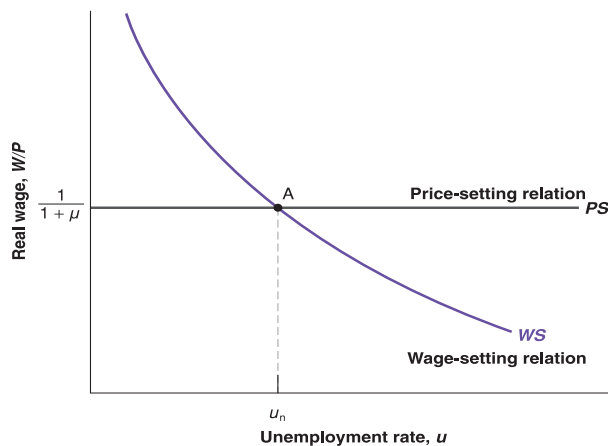


Figure 17. Wages, prices and the natural rate of unemployment

The equilibrium resulted from the intersection finds the natural unemployment rate. It corresponds to that unemployment rate found when the real wages from the WS curve are equal to the real wages from the PS curve.

The natural unemployment rate is also defined as the rate of unemployment that is compatible with a steady inflation rate or the rate of unemployment that would occur in absence of cyclical

¹⁷ Definition by “U.S. Congressional Budget Office”

fluctuations; it can be interpreted as the sum of structural and frictional unemployment. Considering that institutional and structural factors change over time, the rate also varies.¹⁸

5.3 The effect of introducing the minimum wage

In this model the minimum wage is inserted in the variable z : introducing or increasing a minimum wage implies the raise of z . Since z has a positive impact to the wages in the WS relation, W augments for every level of u thus generating a shift to the right of the WS curve. However, since wages per workers are higher and W is positively related to P in the PS curve, P also grows and the economy moves along the PS line. Therefore the natural unemployment rate increases.

The reason is that an introduction or a raise in the minimum wage level brings benefits to workers who are less worried about being unemployed, thus in order to get back real wages to the level firms are willing to pay, an increase in the unemployment rate becomes necessary.

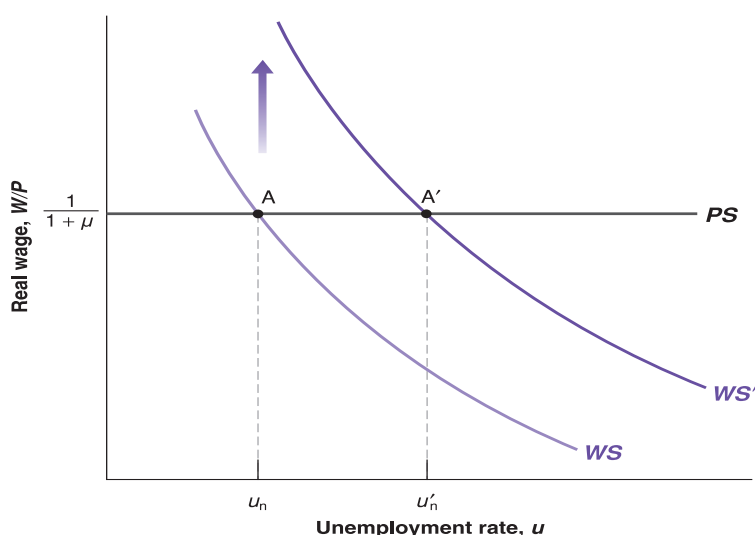


Figure 18. The effect of introducing or increasing minimum wage

¹⁸ Rissman E., "What is the natural rate of unemployment?", Economic Perspectives, Federal Reserve Bank of Chicago, 1986.

6. Main works

The first form of fixing wages towards a level comes from the Ordinance of Labourers (1349), a decree by King Edward III for setting maximum wages. The historical background in the years after the Black Death provided workers with a stronger bargaining power and the decree stated that ...”all healthy non-self-sufficient people under sixty years of age work at reasonable wages until the end of their agreed term.”¹⁹

This situation forced workers to accept salaries that did not reflect their abilities and their real value, in fact all workers wanted higher wages in order to get a better lifestyle; these conditions created discontent and lead to some farmers-lead revolutions.

Adam Smith, the most important exponent of the classical economy, was supportive of a mandatory living wage for labour for reasons of equity and economic growth; he sustained a support from public policies to obtain the living wage.²⁰ From Smith’s point of view the living wage has both a financial aspect and a moral one concerning the ethics of work.

Smith created the concept of wages as a living: as salary maintains labour, they also are what men and women need for living. He likewise added the concept of ethical, in which too low wages would decrease productivity and then also collective welfare. The living wages, intended as minimum ones, could be handled from government to protect the stability of the society and the liberty of individuals.

John Stuart Mill analyses the effect of particular policy measures on the “free market” with application to the workers and employers’ behaviour. Mill says that minimum wage will misemploy some labourers hence the public assistance has to do something creating a disincentive to work. Mill highlights the trade-off between contrasting poverties and supporting work: if fired workers receive a guaranteed salary, they will have not the incentive to work since the minimum wage is set above this level.

¹⁹ King Edward III of England, “*Ordinance Of Laborers*”, 1349

²⁰ Clary B, “*Smith and Living Wages: Arguments in Support of a Mandated Living Wage*”, *The American Journal of Economics and Sociology* , 2009.

6.1 Abwod, Kramarz, Margolis²¹

The work from John M. Abwod, Francis Kramarz and David N. Margolis analyses the effects of changes in the real minimum wage on the employment status of a single worker using data from individual wages and unemployment in France and United States. The authors would like to see the effect of real increases in France or real decreases in United States on the individual's conditions, grouping them in sub-populations and focusing in particular on low-skilled (wage) workers who could be more affected by minimum wage.

Considering that the minimum salary in those States moved in opposite directions, they used statistical comparisons built in this way: after a minimum wage variation, they analysed the different probabilities for a worker to find a job conditional on his position in the wage distribution. They divided the wage distribution in four regions related to the minimum wage: under, around, marginally over and over.

They proved that, concerning all age categories and both sexes, the probability of being employed is lower for those having wages between two minima than the group with salaries marginally over the minimum; thus, the minimum wage has a stronger impact on workers with lower wages.

In addition, for a better comparability of results, they computed the unconditional elasticities implied by the estimates.

They demonstrated that an increase of 1% of minimum wage in France makes less probable to get employed by 1.293% for a man and by 0,972% for a woman; concerning United States augmenting minimum wage by 1%, the probability of being employed decreases by 0,416% for men and by 1,566% for women.

In conclusion the work showed that, variations in the minimum wage strongly affect employment, towards the conclusion reached by the competitive market labour theory: for low-wage workers (and young ones), after an increase in minimum wage, the employment probabilities fell significantly, and this effect is clear as well for France and United States.

²¹ Abwod J., & Kramarz F., & Margolis N. "*Minimum Wages and Employment in France and the United States*", National Bureau of Economic Research, 1999.

6.2 David Card, Alan B. Krueger²²

The work led by David Card and Alan Krueger was revolutionary because it proves that an increase in the minimum salary would cause a slight decrease in unemployment regarding the used data. From conventional economic theory, the effect of increasing minimum wage in low-wage labour market, in perfect competitive situations, will bring employers to cut employment.

On April 1, 1992, in New Jersey there was a rise in minimum wage from 4,25\$ to 5,05\$ per hour; 410 fast food restaurants were analysed in New Jersey and Pennsylvania before and after the increase. New Jersey is a small State, and its economy is related to bordering and nearby States: a control group of fast food from eastern Pennsylvania is a perfect comparison with New Jersey's ones.

The particular choice of using data from fast food was dictated by some factors. First, fast-food industries were used to provide a low-waged job; second, fast-food restaurants respected the minimum wage policies; lastly, job requirements and products were homogeneous, thus it would be easier to obtain reliable measures of wages, employment and product prices.²³

The methods used are called Differences in Differences. In fact, they consist in collecting samples before and after the increase in minimum wages and using the difference in results as dependent variable: comparing not the outcomes but the change in the outcomes, pre and post treatment, the researcher can adjust the remaining differences between the treatment and the control group. Since this estimator is the difference between groups or across time, it is called difference in differences.

There are two groups: the treatment one in which they are exposed to the change and the control one which does not receive the treatment. In this case the control is Pennsylvania, and the reason why it is a good choice is, as mentioned before, that the former is near to New Jersey, as a matter of fact they have similar demographic characteristics and they are influenced by the same exogenous variables.

²² Card D., Krueger A.B., "*Minimum Wages And Employment: A Case Study Of The Fast Food Industry In New Jersey And Pennsylvania*", American Economic Review, 1993.

²³ Ibidem

Using FTE (full-time employees) we can find the estimator, represented by β_1 diffs-in-diffs, that is the difference between the average change in FTE in New Jersey and the average change in FTE in Pennsylvania. Hence considering that in New Jersey the treatment has been applied, if this difference is lower, it means that in New Jersey, FTE, namely the employment, has grown more than in Pennsylvania, therefore increasing minimum wage had a positive effect on employment.

The confrontation of the means proves that the employment in New Jersey has improved confronting with Pennsylvania.

In conclusion the work led by David Card and Alan Kruger is an empirical demonstration of that an increase in minimum wage can bring a slight diminishment in unemployment, contrasting all the previous studies.

6.3 Neumark and Wascher²⁴

They studied the effects of minimum wages across seventeen OECD States, taking account of variation of policies and institutions.

They started using a standard panel data specification for employment, adding a one-year lag of the minimum wage; the models are estimated for teenagers (aged 15- 19) and youths (aged 15-24), with data from 1975-2000.

They used a regression composed by the employment- to-population ratio for youths, the ratio of the minimum to the wage average and the vector X that includes the unemployment rate for adults and the relative size of the youth group.

In some specifications four other sets of variables are included: fixed country effects (a), year effects (k), separate time trend variables for each country (δ_t), and a lagged dependent variable.²⁵

²⁴ Neumark D., & Wascher W. "Minimum Wages And Employment: A Review Of Evidence From The New Minimum Wage Research, Working Papers, 2006.

Neumark D., & Wascher W. "Minimum Wages, Labor Market Institutions, and Youth Employment: A Cross-National Analysis", ILR Review, 2004

²⁵ Neumark D., & Wascher W. "Minimum Wages, Labor Market Institutions, and Youth Employment: A Cross-National Analysis", ILR Review, 2004

The results confirm the negative correlation between minimum wage and employment, with statistically significant coefficients attached to minimum wage.

The minimum wage elasticity for youth ranges between $-.13$ and $-.28$ while for the teenager between $.09$ and $-.31$.

Additionally, they augmented the models to control for institutional differences like how minimum wages are determined firstly by statute, bargaining, through unions or government and this could influence the impact of wages on labour market; secondly that minimum wage policies are different across countries and thirdly every state is different in how much the minimum wage between youth and adults is different.

The strongest evidence is that the presence of a young subminimum reduces the negative effect of minimum wage on unemployment for youth and teenagers: because a higher minimum wage could introduce substitution in young workers. Moreover, in some countries with certain type of bargaining, the minimum wage does not cause an increase in unemployment.

Other characteristics regarding labour market policies and institutions may affect the influence of minimum wage on youth labour market. They used interaction variables between minimum salary and state specific measures of the strength of labour rules, labour protection, and policies by government and union density.

Consistently with Coe and Snower's position they prove that more restrictive labour standards will lead to a stronger negative effect of minimum wage on employment, because these factors force more of the adjustment to a higher minimum through the employment channel.

On the other hand, when the employment protection is higher, the negative correlation between employment and minimum wage is muffled, thus there is the same effect when the labour market policies are active because they could involve some of the non-employed. When the union density is high, the minimum wage will have a negative effect on employment for the reason that they could support the power of incumbent workers.

6.4 Lustig and McLeod²⁶

They studied an interesting relation between minimum wages and poverty: they are inversely related, in fact an increase in minimum wage is followed by a fall in poverty. They used some of poverty indicators as headcount ratio and poverty gap, poverty lines and population groups. The results obtained in terms of inverse relationship between minimum wage and poverty is not saying that minimum wage is the most efficient measure to reduce poverty.

The empirical results show that a higher minimum wage can reduce poverty under these conditions: higher minimum salary has to result in more elevated uncovered sector wages, the rise in them is large enough to push some of the population out of indigence; and the number of the beneficiaries (that is, those who are no longer poor) exceeds the number of those who become poor because the increase in minimum wages leaves them unemployed or earning less in the uncovered or “subsistence” sector.²⁷

The dependent variable is the annual change in poverty in logarithms assessed by the headcount measure, interpreted as the growth rate of the poor less than that of the total population.

Focusing on the effect of real wages and real per capita income growth on poverty, it is clear that an increase in minimum wage or in income per capita will reduce the headcount ratio.

The conclusion is that minimum wage increases or decreases could be associated to raise or diminishments in poverty rates: the results are consistent across high or low poverty lines, the status of the economy and the kind of population. This evidences have not the goal to point the minimum wage as an instrument to reduce poverty: in fact it, usually, seems to increase unemployment and this effect in long terms could hurt the poor.

²⁶ Lustig N., & McLeod D. “*Minimum Wages and Poverty in Developing Countries: Some Evidence*”, Brookings Institution International Economics, 1996.

²⁷ Ibidem

6.5 Donald Deere, Kevin M. Murphy, And Finis Welch²⁸

They studied the two increases in minimum wage that occurred in 1990 and in 1991. In 1990 the federal minimum wage raised from \$3.35 to \$3.80 and to 4.25\$ in 1991.

Their goal was to examine the effects of these increases on employment focusing on the changes in the distribution of wages.

The idea is to compare changes in employment rates of high and low-wage populations, using data from the 1985 through 1993 CPS Outgoing Rotation Files.

The division between high and low-wage population is demographic (by age, education, race, ethnicity, marital status and gender) and geographic (by state).

In conclusion the study is consistent with the economic theory: when the cost of low-wage workers augments, less low-wage workers are employed. This could find a reason in the fact that firms were used to pay less than the new minimum wage this category of workers and when they had to raise the wage, they hired less.

²⁸ Deere D., & Murphy K., & Welch F., *“Employment and the 1990-1991 Minimum-Wage Hike”*, The American Economic Review , 1995.

7. The effect of minimum wage on employment and productivity: an empirical analysis.

The effect of increasing minimum wage and its impacts on the labour market have been one of the most important concerns for policy makers during the years.

The amount of the minimum wage differs from country to country, especially the low waged ones in which the main goal is to aid and support poor families.

In fact, supporting the increase or the introduction of the minimum wage can be seen from a social and economic point of view: socially speaking it could be used for reducing disparities and from an economic perspective the whole system can experience a growth by augmenting the consumption also in the low wage people.

From the academic approach there was a huge number of research studies linking minimum wage and unemployment. The results were ambiguous: all the main economic theories state that an increase in minimum wage reduces employment like those ascribed to Neumark and Wascher (2007) or Deere, Murphy and Welch; instead, Card and Kruger 's work (1994) proves that a minimum wage increase will lead to a raise in employment, analysing only a low waged and low skilled market, such as fast-food employees in New Jersey.

In this work, starting from the previous studies, we look for a correlation between minimum wage and unemployment: the goal is to verify how a change in minimum wage during time impacts on the labour market; we focus in particular on the share of low skilled, young and women because they could have a major impact after a minimum wage variation.

In order to avoid factors that could cause omitted variable bias, we use a panel data analysis, that pursues a more accurate model because if an omitted variable does not change either over state or over time, any change in the dependent variable during time cannot be caused by it.

7.1 Summary statistic

The main goal of this work is to find the effect of the minimum wage on employment; in order to do so, the more useful solution is to pursue a panel data analysis and enrich the model with controls and interactions.

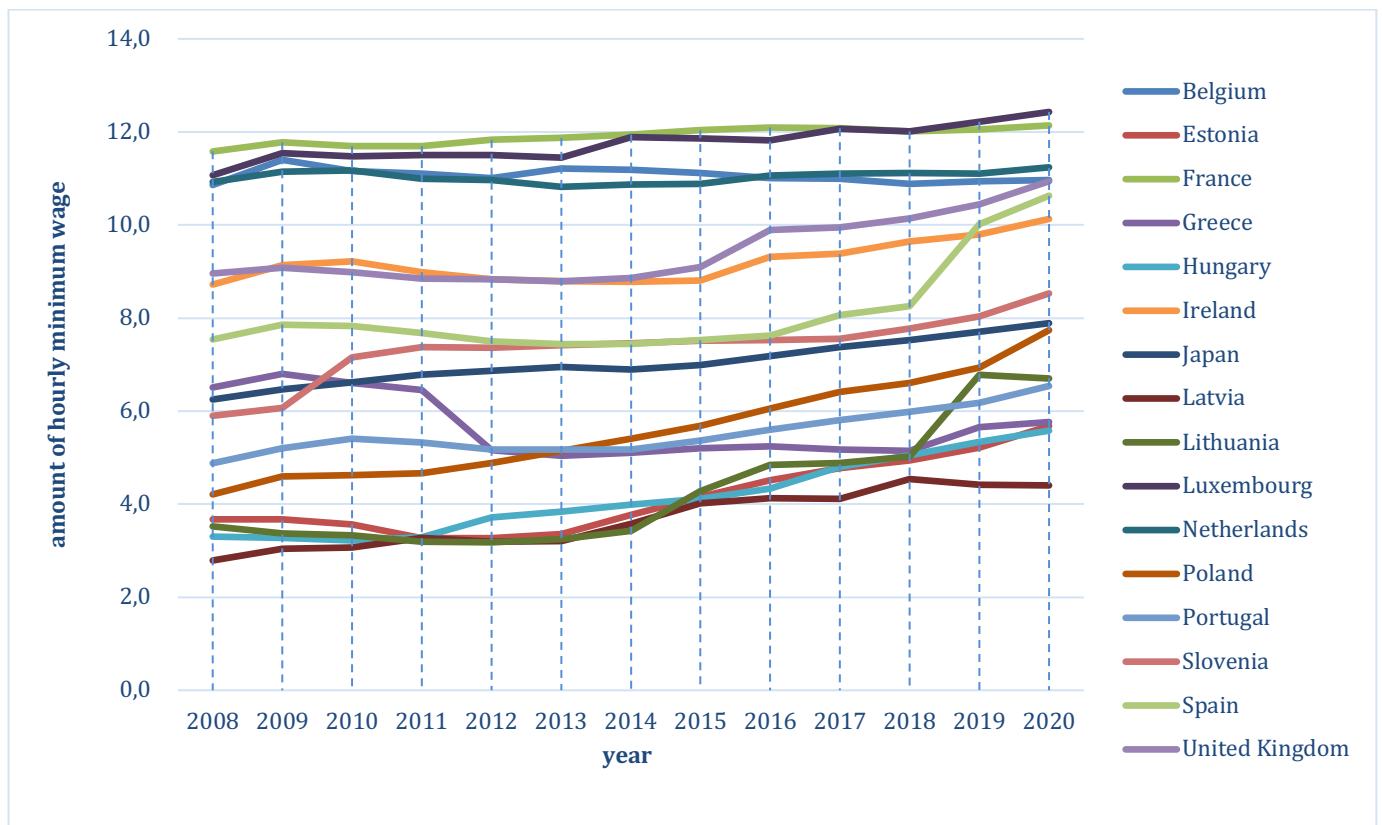


Figure 19. Hourly wage per nation from 2008 to 2020²⁹

It is interesting to observe that only Slovenia, in that years, experienced an increase in the minimum wage as an instrument to contrast the crisis: in fact, all the other States have kept it at the same level or for example Greece even have reduced it from 6.5 hourly minimum wage in 2011 to 5.2 in 2012. The opinion that an increase in minimum wage would have caused a further decline in employment was substantiated also by the fact that in a period of crisis it would have been difficult to pursue a persistent augment in salaries.

Country	AV_MW	AV_UN
Belgium	11,1	7,3
Estonia	4,1	8,4
France	11,9	9,1
Greece	5,7	19,2
Hungary	4,1	7,4
Ireland	9,2	10,1
Japan	7,0	3,7
Latvia	3,7	11,4
Lithuania	4,3	10,3
Luxembourg	11,8	5,6
Netherlands	11,0	5,2
Poland	5,6	7,1
Portugal	5,5	10,7
Slovenia	7,4	7,1
Spain	8,1	19,2
United Kingdom	9,4	8

Table 1. Average minimum wage and average unemployment rate for the countries in the sample from 2008 to 2020

²⁹ Source: OECD Database

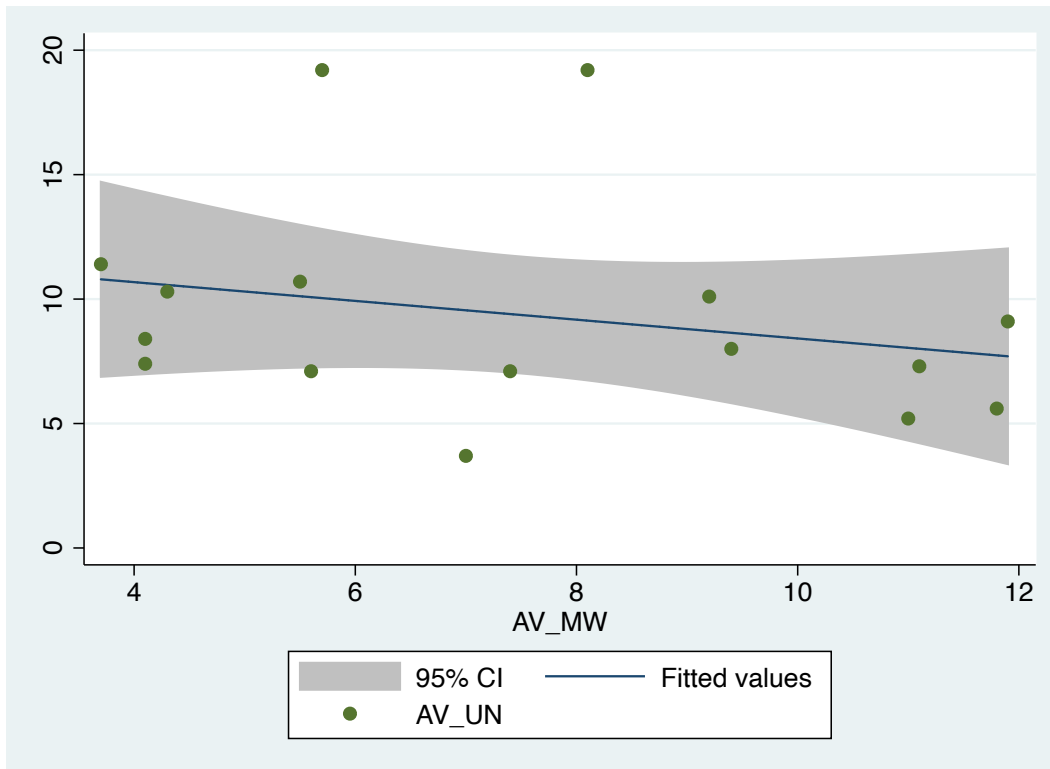


Figure 20. Plotting the average of minimum wage and the average of unemployment rate in each State from 2008-2020

Confronting the average unemployment rate, as a dependent variable and the average minimum wage, as an independent variable, of the countries examined in the analysis period 2008-2020, there is a negative correlation of $-0,2533$ between these two variables. It could mean that an increase in minimum wage would reduce the unemployment rate, but this result could be not significant.

That is why I will analyse this relationship more accurately with a particular focus on the low-skilled workers.

7.2 Data analysis and specification

The source for the dataset on the minimum wage is the OECD (Organisation for Economic Co-operation and Development) Statistics Database. The data were available hourly and annually, however we decided to focus on the hourly ones to facilitate comparability between States. Real hourly minimum wages are the ones established by the law turned into common hourly wages for the OECD countries; all the results are deflated by national CPI (Consumer Price Indices) using 2020 as base year; then the data are transformed into a common currency unit by USD\$ exchange rates or by PPPs (Purchasing Power Parities) theory.

Regarding the data on labour, we used the EUKLEMS & INTANProd database, run by the Luiss Lab of European Economics.

The database provides both statistical and analytical modules: the statistical one, which is the one I will use, provides national account variables for productivity.

EUKLEMS & INTANProd gives data for 27 EU States, US, Japan, and UK; it includes 40 industries and 23 industry sectors, from 1995 to 2019.

Concerning the European countries, data come from “Economy and Finance” from the Eurostat database; in particular Spain, considered that there is a lack of data, the IVIE (Instituto Valenciano de Investigaciones) helped providing missing data. Instead for the US, data are gathered from BEA (Bureau of Economic Analysis) and BLS (Bureau of Labor Statistics); data for Japan are provided by RIETI institute and Hitotsubashi University.

Analysing the output data for the EU countries, output, expenditure and income are classified on the main output, income and employment per industry: the data are collected from the “Annual national accounts”. The majority of data is in gross value, current prices and volume terms; for the countries which do not report gross output in volume terms, gross output deflators are calculated using other sources, as National Statistical Institutes, OECD STAN Database and the SUT from the Eurostat website.

The US data for output, the value added, and the consumption come from GDP-by-Industry tables and the ones for employment are provided by BLS Industry Productivity Studies.

Labour is divided into labour quality and labour quantity. The labour quality, at a sector’s State specific level, analyses workers by education, age, and gender, considering that these specific characteristics may affect productivity and thus labour market. This information may not be public, so the EUKLEMS and INTANPROD 2021 asked EU to access to the Labour Force Survey (LFS), Structure of Earnings Survey (SES) and European Union Statistics on Income and Living Conditions (EU-SILC).

Concerning the US, wage and employment were provided by the Bureau Labour of Statistics and Industry Productivity Studies.

Using this dataset on the labour quality, it provides information on employment and wages across counties and industries, classifying workers by sector, age and gender. From the share

of employment (Sh_E) we need the share of the low skilled workers (sh_low) to use in our regressions.

The low-skilled are measured by the variable education, a low skilled job does not require some training, professional education or experience and needs a very low range of abilities, thus is in the range with less years of education. This type of workers has a particular relationship with minimum wage: in the work led by David Card and Alan Kruger there is a positive effect of the minimum wage on employment focusing the research on low-skilled workers.

Variable	Obs	Mean	Std. Dev.	Min	Max
sh low	8,436	18.72301	18.412	0	100

Table 2. Descriptive statistics of sh_low

The labour quantity instead is measured by various variables in national account: like EMP that indicates the number of people employed in thousands and EMPE the number of employees. Between the two I decided to use EMPE, because in EMP there may be included employers or even family work and it could be correlated with the minimum wage causing problems of reverse correlation;

In addition, it is useful for our analysis the VA_CP that measures the Gross Value Added (GVA) at current prices. That value is necessary to create the variable ln_prod that represents the natural logarithm of wa, that is the productivity generated by dividing VA_CP by EMPE.

The data are available for these industries sector; they are various in order to give a larger statistical population for the analysis and the specificity of the sector may influence the overall output. However, since we run a panel regression, all the exogenous effects on the interest variables are reduced.

Nace_r2_name	mean (sh_low)
Accommodation and food service activities	26,354
Administrative and support service activities	27,749
Agriculture, forestry and fishing	37,750

Arts, entertainment and recreation	14,935
Construction	30,558
Education	6,007
Electricity, gas, steam and air conditioning	16,694
Financial and insurance activities	15,132
Human health and social work activities	13,562
Information and communication	9,015
Manufacturing	23,158
Mining and quarrying	35,148
Other service activities	17,142
Professional, scientific and technical activities	5,978
Public administration and defence;	13,368
Real estate activities	19,004
Transportation and storage	24,110
Water supply; sewerage, waste management	28,871
Wholesale and retail trade;	19,142

Table 3. Mean of *sh_low* for every sector

Concerning the time of the analysis, the data from EUKLEMS & INTANProd are from 2008-2020, thus this is the temporal range we used.

7.3 Model

After an analysis on the minimum wages and the employment during years in every State, we can develop the empirical analysis. The model is a panel data with country fixed effect, sector fixed effect and time fixed effect.

I decided to run four different regressions:

- (1) In which I regress the dependent variable only on the natural logarithm of minimum wage, without interactions and controls, but with all the fixed effects. The dependent variables used are: \ln_EMP , \ln_hours and $\ln_productivity$.
- (2) In which I regress the same dependent variables on the natural logarithm of minimum wage, with interaction $\min_wage \times share_low_skilled$ and sh_low skilled as a control; there are also all the fixed effects.
- (3) In which I regress sh_low on $\ln_minimum$ wage in order to check the effect of minimum wage on the percentage of low skilled workers.

(4) In which I regress one time without interaction and control and the other time with the natural logarithm of compensation on the natural logarithm of minimum wage.

Using a log-log model in regression (1) (2) (4) allow us to interpret the coefficient attached on the \ln_min_wage as elasticities: a 1% raise in minimum wage corresponds to a $\beta_1\%$ variation in the dependent variable.

Instead in the regression (3) is a linear-log model, that is interpreted as a 1% change in minimum wage corresponds to a $0,01\beta_1$ change in $share_low$.

\ln_EMPE	Natural logarithm of EMPE	
\ln_h	Natural logarithm of hours worked	
\ln_prod	Natural logarithm of VA_CP/EMPE	
\lnmin_wage	Natural logarithm of minimum wage	ct
$min_wage \times sh_low_skilled$	Interaction variable between minimum wage and share low skilled	
Sh_low	% of low skilled workers	cst
λ_c	Country fixed effect	
λ_s	Sector fixed effect	
λ_t	Time fixed effect	
ε	Error	cst

Table 4. Regression legend

Regression 1

$$(1.1) \ln_EMPE_i = \beta_0 + \beta_1 \lnmin_wage + \lambda_c + \lambda_s + \lambda_t + \varepsilon$$

$$\frac{\partial \ln_EMPE}{\partial \ln_min_wage} = \beta_1$$

$$(1.2) \ln_h_i = \beta_0 + \beta_1 \lnmin_wage + \lambda_c + \lambda_s + \lambda_t + \varepsilon$$

$$\frac{\partial \ln_h}{\partial \ln_min_wage} = \beta_1$$

$$(1.3) \ln_prod_i = \beta_0 + \beta_1 \lnmin_wage + \lambda_c + \lambda_s + \lambda_t + \varepsilon$$

$$\frac{\partial \ln_prod}{\partial \ln_min_wage} = \beta_1$$

Dependent Variable:	<i>employment (log)</i>	<i>hours (log)</i>	<i>productivity (log)</i>
<i>min_wage (log)</i>	0.00788 (0.0867)	-0.009 (0.087)	0.0588 (0.0715)
<i>min_wage × sh_low</i>			
<i>sh_low</i>			
Fixed effects			
Country FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R2	0.9462	0.9451	0.9634

Table 5. Regression 1: results

The first regression is computed without interactions and control variables, but only with the regressor of interest and the dummies used for the fixed effects.

The results are as we expected: the first dependent variable is $\ln_employment$ calculated on EMPE, the number of employees, and the effect of \ln_min_w on \ln_emp is not statistically significant: because there is not a clear relationship that links minimum wage and employment. The same assumption can be applied when we regress the \ln_hours (H_EMPE), that is the amount of hours worked by employees, on \ln_min_w ; the hour variable should follow the results given by the employment one: thus also in this case the coefficient is not statistically significant, because the effect of minimum wage on the hours of work is not certain.

On the other hand, when we regress $\ln_productivity$ on \ln_min_wage the coefficient of the regressor is positive and statistically significant.

The effect of minimum wage on productivity is that an increase of 1% in minimum wage corresponds to a raise of 0,058% in productivity.

The introduction of minimum wage helps firms to get more productivity: both at enterprise and aggregate level.

At firm level workers are more motivated to work better and according to the “efficiency wage theory”, not only employees produce more effort with higher salaries but also higher pays can attract more experienced workers; as a consequence of that, higher minimum wage will reduce turnover and so the workers will keep their job, learning more, gaining experience and so productivity increases. At a macro level, some firms may feel encouraged to improve efficiency: as long as labour costs increase, they augment productivity, improving trainings, total factor productivity and apply the efficiency wages. On the contrary, overall efficiency

gets better, because minimum wages cause that less productivity firms will leave the market and allow higher productivity firms to enlarge.

Regression 2

$$(2.1) \ln_EMPE_i = \beta_0 + \beta_1 \ln min_wage + \beta_2 min_wage * sh_low_skilled + \beta_3 sharelow_skilled + \lambda_c + \lambda_s + \lambda_t + \varepsilon$$

$$\frac{\partial \ln_EMPE}{\partial \ln_min_wage} = \beta_1 + \beta_2 sh_low$$

$$(2.2) \ln_h_i = \beta_0 + \beta_1 \ln min_wage + \beta_2 min_wage * sh_low_skilled + \beta_3 sharelow_skilled + \lambda_c + \lambda_s + \lambda_t + \varepsilon$$

$$\frac{\partial \ln_h}{\partial \ln_min_wage} = \beta_1 + \beta_2 sh_low$$

$$(2.3) \ln_prod_i = \beta_0 + \beta_1 \ln min_wage + \beta_2 min_wage * sh_low_skilled + \beta_3 sharelow_skilled + \lambda_c + \lambda_s + \lambda_t + \varepsilon$$

$$\frac{\partial \ln_prod}{\partial \ln_min_wage} = \beta_1 + \beta_2 sh_low$$

Dependent Variable:	<i>employment (log)</i>	<i>hours (log)</i>	<i>Productivity (log)</i>
<i>min_wage (log)</i>	0.136 (0.092)	0.121 (0.093)	0.699 (0.075)
<i>min_wage × sh_low</i>	-0.005 (0.0015)	-0.0054 (0.0015)	-0.005 0.0008
<i>Sh_low</i>	0.009 (0.003)	0.0093 (0.0026)	0.005 (0.001)
Fixed effects			
Country FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
R2	0.9466	0.9455	0.9642

Table 6. Regression 2: results

In this second regression the introduction of the interaction *min_wage × sh_low* and *sh_low*, allows us to interpret that an augment of minimum wage by 1% will reflect in a raise in employment by 0,136%-0,005×sh_low. This means that inserting minimum wage has a positive effect when low_skilled are 0%, but this is not statistically significant.

In fact, minimum wage can have a significant effect when it is binding. A binding minimum wage means that it is set above the competitive equilibrium wage, in fact if we do not put in the regression the low skilled interaction and the control variable, checking only for the overall effect of the minimum wage, it would lead to a non significant result as before. Indeed, considering all the different sectors, there is heterogeneity and assuming that a great part of sectors has wages which are already greater than the minimum wage, it will be useless and it does not have any effect.

sh_low

Percentiles		Smallest		
1%	.0124218	.0003868		
5%	.1577162	.0006222		
10%	2.44984	.0052718	Obs	3,535
25%	6.07713	.0052887	Sum of Wgt	3,535
50%	13.97318		Mean	19.95193
		Largest	Std. Dev.	19.50608
75%	27.29627	9.999.998,000		
90%	46.40622	9.999.998,000	Variance	380.4872
95%	61.06446	100,000	Skewness	1.745019
99%	96.50555	100,000	Kurtosis	6.346292

Table 7. Distribution of sh_low

Concerning mean and median the effect is not statistically significant, but we can test for the 95% percentile.

At 95% percentile is still not statistically significant, because $P > F = 0,1596$.

It begins to be statistically significant from the 67%: when we analyse the marginal effect considering that significant level is:

$$\frac{\partial \ln_{EMPE}}{\partial \ln_{min_wage}} = \beta_1 + \beta_2 sh_low$$

$$-0.199 = 0.136 - 0.005 * 67$$

This result is coherent with our expectations, because the more the sector is influenced with low skilled workers, the more a minimum wage has its effect.

In a situation with binding wages, thus with an higher share of low skilled workers, a minimum wage will reduce employment more than in a situation with higher wage settings: mainly,

employers will substitute low-skilled labour that is more expensive with other inputs such as capital.

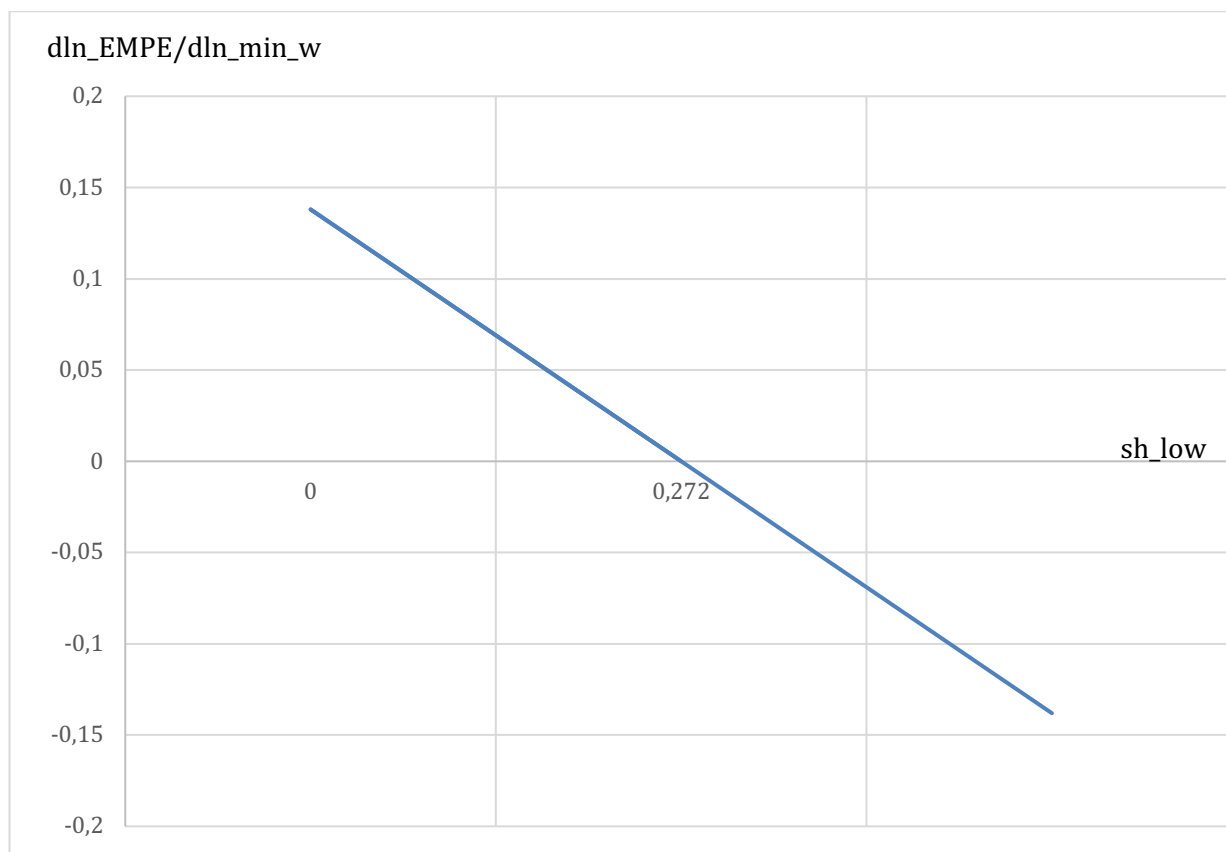


Figure 21. Confidence interval and level of significance for sh_low

This is the effect on employment of minimum wage: on the y-axis there is the derivative and on the x-axis the share of low-skilled workers. The marginal effect is equal to zero when there is a share of low skilled equal to 27% and it starts get negative for values above it.

And when the share of low skilled is 67% it will be statistically significant at a 10% level.

Analysing hours, the concept could be similar: first of all the coefficient starts being significant since 61% and since the coefficient attached on the interaction is negative, firms reduce their employees by reducing their labour demand, especially in that sectors with lower salaries, in fact an increase in wages reduces the labour demand. Also in this case when the share of low skilled workers is higher, the effect is overall negative.

Concerning productivity, an increase in minimum wage augments productivity for the reason said before; however, in the sectors with a more binding minimum wage, this positive effect is reduced. The interpretation could be that firms, when there is a minimum wage increase, do reduce the share of low skilled and then augments the share of medium and high skilled, hence

the overall productivity increases: there is a substitution effect, that is lower in that firms where the minimum wage is more binding, because there are more low-skilled. The effect is greater in the sector where it is possible to substitute in an easy way.

This can be verified by regressing the share of low skilled on minimum wage to see the effect of minimum wage on the percentage of low skilled workers.

Regression 3

$$Sh_low_i = \beta_0 + \beta_1 \ln min_wage + \lambda_c + \lambda_s + \lambda_t + \varepsilon$$

$$\frac{\partial sh_low}{\partial \ln_min_wage} = \beta_1$$

Dependent Variable:	<i>sh_low</i>
<i>min_wage (log)</i>	-6.65 (3.02)

Table 8. Regression 3: results

In this model a change in minimum wage of 1% corresponds to a change in the share of low skilled equal to -0.0665, meaning that minimum wage clearly reduces the percentage of low skilled workers and it highlights the substitution effect we have considered before.

Therefore this effect of the minimum wage can be seen in the “labour-labour” substitution which states that part of the elasticity of the demand comes from possible substitution between other inputs and labour. This theory arguments that an higher minimum wage prompts firms to replace low-skilled workers with more skilled ones.

The labor-labor substitution hypothesis could have some policy implications: if a law on minimum wages leads to a replacement of low-skilled workers in favour of higher skilled ones, the latter will receive the benefits of the increase in salaries, not the original workforce. The complete dissipation of wage is empirically not confirmed but it is established that there is a peak in the wage distribution nearby the minimum wages: it argues that low-skilled’s wages are influenced by wage rules.

It is interesting to interpret this labour substistution as a “people versus machines”: in fact the substistution triggered by the minimum wage can lead to a substitution of employees whose

works can be easily automated; the explanation could be that employers may substitute low-skilled workers with technological instruments and assume workers that can be with complement technologies. It is understandable that workers easier substituted are the low-skilled, thus low-waged, who directly resent of the minimum wages' increase; otherwise the more skilled ones can work along with tecnhoogy.

Regression 4

$$(4.1) \quad \ln_COMP_i = \beta_0 + \beta_1 \ln min_wage + \lambda_c + \lambda_s + \lambda_t + \varepsilon$$

$$\frac{\partial \ln_COMP}{\partial \ln_min_wage} = \beta_1$$

$$(4.2) \quad \ln_COMP_i = \beta_0 + \beta_1 \ln min_wage + \beta_2 min_wage * sh_low_skilled + \beta_3 sharelow_skilled + \lambda_c + \lambda_s + \lambda_t + \varepsilon$$

$$\frac{\partial \ln_COMP}{\partial \ln_min_wage} = \beta_1 + \beta_2 sh_low$$

Dependent Variable:	<i>COMPENSATION</i> (1)	<i>COMPENSATION</i> (2)
<i>min_wage (log)</i>	0.603 (0.092)	0.811 (0.097)
<i>min_wage × sh_low</i>		-0.0085 (0.00151)
<i>Sh_low</i>		0.013 (0.0025)
Fixed effects		
Country FE	Yes	Yes
Sector FE	Yes	Yes
Year FE	Yes	Yes
R2	0.9770	0.9773

Table 9. Regression 4: results

In (1) regression an increase by 1% in minimum wage causes a raise by 0.603% in overall compensation, this result can be interpreted, in this case, from the higher-earning workers point of view: considering skilled-workers markets, in which employers need to compete for workers, an increase of the minimum wage can be reflected also upwards, while firms adjust their salaries; in fact it is mandatory to maintain the relative wages within a company, employees care about the comparison with other workers, and, if the low-waged suddenly see their salaries go up, even the highly waged will require a more elevated pay. Often, to avoid

problems, employers will provide salaries adjustments and that is the reason of that coefficient in regression (1).

Regression (2) is enriched with the interaction variable and the control for the share of low skilled workers.

The coefficients point out a negative coefficient attached on the interaction variable that means that the marginal effect of \ln_min_w on compensation is: $\beta_1 + \beta_2 sh_low$: $0.811 - 0.0085 * sh_low$, thus the more is the share of the low skilled, the less positive is the effect of minimum wages on overall compensation.

This result is coherent with the precedent variables analysed in fact considering that when the share of low skilled is higher employment, hours worked and productivity start to decline more, in this case the situation is the same.

A decrease in overall compensation, not normalized for employment, when there is an increase in minimum wage, could be interpreted as a consequence of all the factors examined before: since there are less low skilled employed and they work less hours, it would be understandable if their overall compensation will fall.

Conclusion

The effect of minimum wage on the labour market in particular on the employment has been subject of studies over the years even though there is not a common vision on how large the impact is and in which direction it goes. The empirical analysis has found contrasting results, pointing out that all the consequences depend strictly on the context analysed.

In this work, I tried to explain the effect of minimum wages on four different specifications with a particular focus on the low skilled workers: employment, hours, productivity and compensation. The centre on the low skilled laborers is explained by the presence of an interaction variable between the share of the low skilled workers and the natural logarithm of the minimum wage which represents the regressor of interest.

The results are coherent with the classical theory in which a raise in the minimum wage will cause decline in employment, hours, productivity and overall compensation: this only when the percentage of low skilled is around 65% to get a significative work.

The analysis is run through a sample of 16 OECD countries, 19 different industry sectors, from 2008 to 2020; thus, the large statistical sample and the fact that all the specifications move in the same direction, indicates that the results are consistent.

The reason that came up from the analysis is that firms are more likely to substitute low-skilled workers when they experiment an increase in wages; in fact this raise will properly lead to a lose in jobs and compensation for the low-skilled. The nature of the minimum wage law is to help low-waged people to get a better lifestyle, but in this analysis the output is just the opposite. Indeed the advantages of a minimum salary can go beyond the negative effects on employment and productivity and a welfare economic system will always be needed and supported. In fact the minimum wage in certain social situation could be mandatory: EU Governement has just recognized it.

In conclusion this model can benefit of other improvements like introducing other variables, as the share of young people, job fixity, preferential hiring, average productions or a variable indicating the workers protections.

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