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Minimum Wages in the Presence of In-Kind Redistribution

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Abstract: To many economists the public's support for the minimum wage (MW) institution is puzzling, since the MW is considered a "blunt instrument" for redistribution. To delve deeper in this issue we build models in which workers are heterogeneous in ability. In the first model, the government does not engage in any type of redistributive policies – except for the payment of unemployment benefits; we find that the MW is preferred by the majority of workers (even when the unemployed receive very generous unemployment benefits). In the second model, the government engages in redistribution through the public provision of private goods. We show that (i) the introduction of a MW can be preferred by a majority of workers only if the unemployed receive benefits which are substantially below the after-tax earnings they would have had in the perfectly competitive case, (ii) for a given generosity of the unemployment benefit scheme, the maximum, politically viable, MW is lower than in the absence of in-kind redistribution, and (iii) the MW institution is politically viable only when there is a limited degree of in-kind redistribution. These findings can possibly explain why a well-developed social safety net in Scandinavia tends to co-exist with the absence of a national MW, whereas in Southern Europe the MW institution "complements" the absence of a well-developed social safety net.

Key words: Minimum wage; in-kind redistribution; heterogeneity; unemployment.
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"Of course, nothing helps families make ends meet like higher wages…and to everyone in this Congress who still refuses to raise the minimum wage, I say this: If you truly believe you could work full-time and support a family on less than $15,000 a year, go try it. If not, vote to give millions of the hardest-working people in America a raise."
President Obama, State of the Union address (January 20, 2015)

1. Introduction

To many economists the public's support for the minimum wage institution is puzzling, since the minimum wage is considered a "blunt instrument" for redistribution (Card and Krueger, 1995, p.285). The purpose of this paper is to provide an explanation for the popularity of the minimum wage institution even when non-blunt instruments of redistribution are part of the policy landscape.[1]

The public's support for (statutory) minimum wages is well documented. For instance, in a January 2014 Pew Research Center poll, 73% of Americans supported a rise in the national minimum wage to $10.10 (per hour) from the then (and still) current $7.25 rate. Moreover, in a December 2013 Wall Street Journal poll, 63% were in support of an increase to $10.10, whereas 43% said they backed an increase to $12.50 an hour, and 28% backed a $15 wage. These figures reveal that if the question involved smaller increases in the minimum wage (e.g. to $9.00) the support would be overwhelming. In Germany, one of the few countries which only recently (July 2014) voted to introduce, for the first time, a (national) minimum wage, a survey of German managers, conducted for the Handelsblatt business newspaper in July 2013, showed that 57% wanted a mandatory minimum wage in the country. (Interestingly, managers in service industries were the most in favour, with 61% saying they wanted a minimum wage.) The decision by the German government to proceed with minimum wage legislation must partly reflect the overwhelming support for it by the public.[2]

In contrast to the public's (and politicians') support, minimum wage laws have been vociferously condemned by (many) economists since they were first introduced.[3]

[1] An often mentioned example of a less blunt instrument is the Earned Income Tax Credit (EITC) in the US, and similar schemes exist in Canada and the UK. Many continental European countries also operate means-tested social minima schemes.
[2] According to a ZDF "political barometer" poll in October 2013, 83% of respondents were in support of introducing a nationwide hourly minimum wage of €8.50 – this was in fact the minimum wage that became effective in January 2015.
[3] Economists are not alone in opposing minimum wage laws. Prominent exponents of "egalitarian liberalism" like, e.g. John Rawls (1971, p. 245), insist that justice is a matter of fairness, especially for society's worst off and have suggested that tax-and-transfer policies are preferable to minimum wage laws as means of achieving distributive justice. This is because liberals' priority concern for society's

Webb (1912), with reference to the imposition of a minimum wage in the Australian province of Victoria in 1896, mentions that it was opposed with familiar arguments, i.e. that 'it was "against the laws of Political Economy", that it would cause the most hardly pressed businesses to shut down, that it would restrict employment, that it would drive away Capital, that it would be cruel to the aged worker and the poor widow, that it could not be carried out in practice, and so on and so forth' (p. 973). Yet, Webb concluded, that in a few years the minimum wage institution was receiving such widespread support that '… no statesman, no economist, no political party nor any responsible newspaper of Victoria, however much a critic of details, ever dreams now of undoing the Minimum Wage Law itself' (p. 976).

One can probably understand why in the age of "unfettered capitalism" (Eichengreen, 1992) even conservative politicians like Winston Churchill would see minimum wage laws as a benign development when he argued in favour of introducing the minimum wage (MW) in the UK in 1909.[4] It is however less easy to understand why nowadays even conservative politicians in countries with (still) relatively generous means-tested social minima (e.g. Chancellor Angela Merkel) are willing to introduce minimum wages as a redistributive/anti-poverty device, despite the strong opposition of academic economists, and the evidence that minimum wages are not an efficient device for transferring incomes to the working poor.[5]

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worst off may render the minimum wage especially problematic, since those with few skills or marginal labour market connections face the greatest likelihood of job loss after a mandated wage increase.

[4] Churchill stated that "It is a serious national evil that any class of His Majesty's subjects should receive less than a living wage in return for their utmost exertions. It was formerly supposed that the working of the laws of supply and demand would naturally regulate or eliminate that evil... and... ultimately produce a fair price. Where... you have a powerful organisation on both sides... there you have a healthy bargaining... But where you have what we call sweated trades, you have no organisation, no parity of bargaining, the good employer is undercut by the bad, and the bad employer is undercut by the worst.... where those conditions prevail you have not a condition of progress, but a condition of progressive degeneration." (available at: http://hansard.millbanksystems.com/commons/1909/apr/28/trade-boards-bill). Churchill's justification appears to capture well the sentiment of a New England textile worker whose response to a journalist's question regarding the minimum wage provisions established by President Roosevelt was: "You can guess that the money is handy...But there is something more than the money. There is knowing that the working man don't stand alone against the bosses and their smart lawyers and all their tricks. There is a government now that cares whether things is fair for us." (quoted in Vincent and Amidon, 1964).

[5] The standard argument is that most workers who gain from minimum wage increases do not live in poor households, while some of those who do may lose their job as a result of such increases. Moreover, most people living in poverty do not work, and many of the working poor do not work full-time; or they work at hourly wage rates above the new minimum (Card and Krueger, 1995; Neumark and Wascher, 2008). The empirical evidence regarding the effect of minimum wage increases on poverty for the US is not unambiguous as Neumark and Wascher (2008) and Dube (2013) reach different conclusions. However, the Congressional Budget Office (2014) found the Earned Income Tax Credit (EITC) is a far superior way to provide additional income to workers who live in poor

To provide an answer to this question we build models in which the only point of departure from the conventional labour market model is in assuming that workers are heterogeneous in ability, which is in turn reflected in differences in labour income across workers. This assumption allows us to differentiate among high- and low-ability workers, as it will be the former that may gain from the rise in the wage *rate* per efficiency unit of labour - whereas the latter may face unemployment – as a result of the imposition of a minimum wage per unit of labour *time.* The reason we deliberately adopt an oherwise bare bones perfectly competitive labour market framework in our analysis is not because we believe that the perfectly competitive framework would be the "natural" outcome in the absence of minimum wages – after all, political institutions, government policies and regulations have a discernible impact on the so-called "market" outcomes. (Thus, outcomes that appear like 'natural' market allocations may in fact be the result of political decisions, or indeed of deliberate policy inaction.) It is also done not because we wish to ignore the various arguments that have been put forward in order to explain the possibly benign influence of minimum wages on employment, growth, or welfare. We do it because we wish to use a first-best benchmark and to ensure the disemployment effects of minimum wages, since in the opposite case there would be no puzzle regarding the support for the minimum wage institution.

In the first model we present, the government does not engage in any type of redistributive policies. We use this model to enquire whether the introduction of the MW can be beneficial for the majority of workers, whilst taking into account of the need to raise taxes to support the workers that remain unemployed. By deriving the conditions required for the MW to be preferred by the majority of workers we are able to demonstrate that under any plausible constellation of plausible parameter values the MW is preferred by the majority of workers (even when the unemployed receive very generous unemployment benefits).

We then proceed to build a model in which the government engages in redistribution through the public provision of private goods (in-kind transfers)[6] and

families. This conclusion appears to be also supported by ex-ante simulations regarding the new German minimum wage which predict that the minimum wage will be an ineffective instrument for poverty reduction, because much of its cost will be offset by reductions in existing means-tested income support and high marginal tax rates (Müller and Steiner, 2013).

[6] In virtually all countries, developed and developing, a significant amount of redistribution occurs in-kind. The fraction of GDP spent on these programs is quite substantial, and has ranged between 10.0 to 15.0 percent of GDP in OECD countries during the last decade. In contrast, the amount paid through a

enquire whether there can be a majority of citizens supporting the introduction of minimum wages as an additional redistributive tool. Thus, our approach is not normative, and should be contrasted with models which adopt an optimal taxation perspective (see, e.g. Allen, 1987; Guesnerie and Roberts. 1987; Marceau and Boadway, 1994; Boadway and Cuff 2001; and Lee and Saez, 2012).[7]

In our model the government uses the tax proceeds to finance the public provision of a good which is also provided by the private sector, albeit at different quality levels – a vertically differentiated product (VDP) like health, education, housing, or day care. Households are assumed to derive utility from the consumption of the VDP (either of the variety freely provided by the government or of the variety offered by the private sector) and of a privately produced homogeneous product. We assume this type of in-kind redistribution since we wish the government to already have in use (i.e. before the introduction of a minimum wage) a programme which is well targeted. As noted by Besley and Coate (1991) and Boadway and Marchand (1995), people with different incomes can value publicly provided goods differently, thus public provision can induce self-selection (e.g. only the poor choose to consume the relatively low quality of the good provided by the government - with the better-off preferring to avail themselves of higher quality varieties which are privately supplied) and achieve redistribution with lower efficiency costs than if cash transfers were used.[8]

The introduction of a (binding) minimum wage - which is set per unit of time rather than per effective unit of labour – will drive the lowest ability workers out of private employment, thus raising the marginal product and the wage *rate* (per

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cash-transfer program like the EITC in the US is substantially smaller (e.g. about 0.5 percent of GDP in 2015).

[7] Note that among the more recent of these papers a minimum wage policy combined with forcing non-working welfare recipients to look for jobs (and accept job offers) can increase the amount of redistribution from those working to those not working, and possibly reduce unemployment (Boadway and Cuff, 2001), while Lee and Saez (2012) show that a binding minimum wage enhances the effectiveness of transfers to low-skilled workers as it prevents low-skilled wages from falling through incidence effects thus, minimum wages can be an efficient complement to other transfer programmes.

[8] It bears noting that actual transfer programmes, like the Earned Income Tax Credit (EITC) in the United States, in addition to being less efficient than what lump-sum redistribution can achieve in theoretical models (since, e.g., the implicit marginal tax rates involved in EITC can be higher than 80 percent), are not easy to administer. According to the IRS, for fiscal year 2013, 24.0 percent of EITC payments were improper (e.g. payments to ineligible recipients) – as a comparison of the waste involved, note that only 9.3 percent of the payments made by the unemployment insurance scheme were deemed as improper (for more details, see: https://www.treasury.gov/tigta/press/press_tigta-2014-50.htm).

effective unit of labour) of employed workers.[9] As in the previous model, the government is assumed to atone for such an adverse effect on low-ability workers through the payment of unemployment benefits. Even though no analytical results can be derived in this case, we are able to establish the following results. First, the introduction of a MW can be preferred by a majority of workers only if the unemployed receive benefits which are substantially below the after-tax earnings they would have in the PC case. Thus, the presence of in-kind redistribution reduces substantially the political popularity of the MW. Second, for a given generosity of the unemployment benefit scheme, the maximum, politically viable, markup of the MW (per unit of time) relative to the PC benchmark is lower than in the absence of in-kind redistribution. This implies that –ceteris paribus - countries with non-existent (or meager) in-kind redistributive schemes would tend to have higher minimum wages than countries with extensive in-kind redistribution. Third, the stronger is the extent of in-kind redistribution (measured by the difference between the quality of the VDP provided by the government and the quality provided by the private sector), the smaller will be the proportion of workers supporting the introduction of a minimum wage irrespective of the generosity of the unemployment benefit system.

These findings imply that if, for exogenous reasons, the political equilibrium shifts from one which involves generous redistribution (high quality of the publicly provided VDP) to one of less generous redistribution (lower quality), then there can now be a majority of workers who are in favour of introducing a (binding) minimum wage. This finding can possibly explain why a well-developed social safety net in Scandinavia tends to co-exist with the absence of a national minimum wage, whereas in Southern Europe nationally binding (and relatively-high) minimum wages are usually paired with the absence of a well-developed social safety net.[10] Arguably, it can also have been one of the factors[11] influencing the recent decision in Germany to

[9] This feature of our model is akin to the assumption made by Lee and Saez (2012) that the unemployment induced by the minimum wage is efficient, i.e. unemployment hits workers with the lowest surplus first.

[10] For example, currently (2017) in Greece the unemployment rate is close to 23% and yet only about 10 percent of the unemployed receive unemployment benefits; this is due to various strict eligibility criteria. Moreover, the monthly unemployment benefit is set at €360 (which is 55% of the minimum wage), is independent of previous earnings, and its maximum duration is 12 months; for those ineligible to receive unemployment benefits there exist some welfare benefits whose maximum monthly value (if eligibility criteria make it available) is €200.

[11] Other factors, including the decline of trade union coverage, the increasing incidence of low-wage employment, and public opinion strongly in favour of the minimum wage, induced unions to move in favour of a statutory minimum wage. Framing the issue was also important: the principle was that the

institute a (national) minimum wage, which followed the previous decade's reductions in the generosity of explicit and implicit welfare support involved in the, so-called, Hartz reforms. In this vein, our finding echoes Acemoglu and Robinson's (2013) recent argument[12] that the politico-economic environment may have features (e.g. an overly generous welfare system) whose removal may ex-ante look efficient if one does not take into account how their removal may affect the future political equilibrium. But, if their removal induces unions now to switch their support in favour of minimum wages as a "savior of last resort", it can lead to the emergence of policies that generate greater efficiency losses than those entailed by the policies which were removed.

The remainder of the paper is organized as follows. In Section 2 we present the model without in-kind redistribution. Section 3 introduces in-kind redistribution, and examines how the interplay between the generosity of unemployment insurance and in-kind redistribution shapes political preferences with regard to the introduction of a minimum wage. Concluding remarks are presented in Section 4.

2. The Model without In-Kind Redistribution

The main interest in this model is to establish that in the absence of other redistributive policies the imposition of a minimum wage can be beneficial to the majority of workers. To this purpose we construct a model in which worker heterogeneity in ability generates differences in preferences over the introduction of minimum wages.

2.1 Perfectly Competitive Labour Market

We consider a closed economy which produces and consumes a single homogeneous good, X, which is produced by private-sector firms only. We assume that all households are endowed with one unit of labour, which they offer inelastically. There

minimum wage should be set such that single person working full-time would earn enough not to require additional support from social assistance, and thus to regulate the subsidization of low pay by the welfare state. This framing of the minimum wage debate built on opposition to the Hartz reforms and resistance to the emergence of a second-class welfare status for workers who could not establish an insurance record. The desire to regulate competition from service contractors based in other countries drew out support from CDU and CSU politicians at the state level, as the SMW provided a straightforward way to insist on minimum wages in public contracts (for more details see, Hassel (2014) and Eichhorst (2015)).

[12] See also Dixit (1997) and Drazen (2002) who made a plea that economists' policy advice should be informed by what is incentive compatible for politicians.

are, however, differences in skill between households, which are reflected in differences in the endowment of each household's effective labor supply. This is in turn reflected in differences in income across households. We assume that firms pay the same wage rate per effective unit of labor –thus the distribution of talent across firms does not affect unit production costs.

Good *X* is a homogeneous good produced by private-sector firms only, whereas good *Y* is a (vertically) differentiated product which can be produced at different quality levels by private-sector firms and by the public sector.

2.1.1 Production

We use good *X* as the numeraire, and set its price to one, $P_X = 1$. The technology employed by the firms producing good *X* is:

$$X = \gamma L - \frac{\delta}{2} L^2 \ , \quad c, d > 0 \tag{1}$$

where *L* stands for the number of effective units of labour used. Denote by *w* the wage *rate* per effective unit of labour. Profit maximization implies that the demand for effective units of labour is:

$$L = \frac{\gamma - w}{\delta} \tag{2}$$

The profits resulting from the production of the homogeneous good are[13]:

$$\Pi = \frac{\delta}{2} \left(\frac{\gamma - w}{\delta}\right)^2. \tag{3}$$

2.1.2 Households

All workers/households are assumed to have identical preferences, and their mass is set to 1. For simplicity, and in order to aid comparison with the model of the following section, we write the utility function as

[13] We are implicitly assuming that production requires the existence of a fixed factor (e.g. entrepreneurship) whose quantity is fixed at 1, and which is provided by the owners of the firms. We also set the number of firms to 1, and assume that the number of firm owners is very small relative to the population of workers so that their spending patterns can be ignored. Alternatively, we could assume that their income is such that they would always choose to buy the privately provided vertically differentiated product; doing so has no discernible effect on the qualitative nature of our results.

$U = \sqrt{C_i}$,

where C_i stands for the consumption of household *i.*

Let e_i stand for household's i endowment of effective number of labour units. We assume that there is a continuum of households, $i \in [0,1]$, with Pareto distributed abilities. The Pareto distribution is defined over the interval $e \geq b$, and its CDF is

$$F(e) = 1 - (b/e)^a, a > 1. \quad (5)$$

Parameter b stands for the lowest ability (i.e. effective labour units) among households, and parameter a determines the shape of the distribution (higher values of a imply greater equality). The Pareto distribution, in addition to being easy to work with, is a good approximation of actual income distributions. Empirical estimates of the value of a range between 1.7 and 3.0 (see, Creedy (1977)). The mean ability of the Pareto distribution is equal to

$$\mu = \alpha b/(\alpha - 1) \quad (6)$$

and the ability of the median household is equal to

$$m = 2^{1/a} b \quad (7)$$

The consumption of each worker will be equal to her labour income, i.e.

$C_i = we_i$.

2.1.3 Labour Market Equilibrium

Labour market equilibrium obtains when the aggregate demand for effective units of labour is equal to the aggregate supply of effective units of labour. The latter is just the mean ability in the population, which is equal to $(\frac{\alpha b}{\alpha - 1})$. Thus, we can state the condition for labour market equilibrium as:

$\frac{\gamma - w}{\delta} = \frac{\alpha b}{\alpha - 1}$.

This implies that the market-clearing wage *rate* per efficiency unit of labour is:

$$w = \gamma - \frac{\delta \alpha b}{\alpha - 1}. \quad (8)$$

Thus, the competitive wage rate depends on the technology parameters (γ and δ) – which determine the demand for labour – and on aggregate labour supply (as determined by parameters α and b). We note that the elasticity of labour demand with respect to the wage rate per effective unit of labour – evaluated at the market-clearing wage rate is: $elasticity = 1 - \frac{\gamma(\alpha - 1)}{\alpha \delta b}$. Hamermesh (1993), in his review of more than 70 empirical studies, concludes that the most probable interval for the (absolute) value of the elasticity of labour demand is [0.15, 0.75]. Normalizing b to be equal to 1, assuming a value of α equal to 2, and choosing the values of γ and δ such that $\gamma = 3\delta$, implies that the value of the elasticity is 0.5, i.e. within the range of plausible empirical values suggested by Hamermesh. We note that as long as the value of the elasticity is lower than 1, then the imposition of a binding minimum wage will result in a rise in aggregate labour income.

2.2 Minimum Wage

We now assume the existence of a government-imposed minimum wage per unit of labour *time* (e.g. per hour) equal to y, which is the minimum amount that an employer must pay in order to employ one person. This minimum wage per unit of time must be distinguished from the wage rate per *effective* unit of labour, which will be market-determined (i.e. as in the previous section).

2.2.1 Labour Market

The minimum wage constraint implies that firms will not be willing to employ workers whose level of ability (i.e. number of efficient units of labour per unit of time) is such that:

$y > e_i \varpi$,

where ϖ stands for the market-determined wage rate per effective unit of labour in the presence of the minimum-wage (per unit of time) constraint at time *t*.[14] To avoid confusion in what follows we shall refer to the exogenously set, y, simply as the minimum wage, in order to differentiate it from the minimum *wage rate* per effective unit of labour, ϖ, and the competitive wage rate per effective unit of labour, w , both of which are endogenously determined. Let ε denote the level of ability for which it holds that:

$$y = \varepsilon\, \varpi. \tag{9}$$

It follows that only workers with $e_i \geq \varepsilon$ will be employed by firms, and that the individual with ability ε will just earn the minimum wage, y. Workers with ability smaller than ε_t will be unemployed, thus the unemployment rate – as well as the number of unemployed workers - will be:

$$u = 1 - \left\{\frac{b}{\varepsilon}\right\}^{\alpha} \tag{10}$$

The total number of effective units of labour possessed by individuals with $e_i \geq \varepsilon$, and which are supplied is:

$$L_s = \int_{\varepsilon}^{\infty} e \left\{\alpha \frac{b^{\alpha}}{e^{\alpha+1}}\right\} de = \frac{\varepsilon\alpha}{\alpha-1}\left\{\frac{b}{\varepsilon}\right\}^{\alpha} \tag{11}$$

The wage *rate* per effective unit of labour paid by private sector firms is determined by equating the demand for effective labour units with the supply of effective labour units possessed by individuals with $e_i \geq \varepsilon$,

$$\frac{\gamma - \varpi}{\delta} = \frac{\varepsilon\alpha}{\alpha - 1}\left\{\frac{b}{\varepsilon}\right\}^{\alpha}.$$

This implies that the wage *rate* per effective unit of labour will be equal to:

[14] We assume that the minimum wage per unit of time is such that $y > b\varpi$, i.e. that is binding for low-ability workers.

$$\varpi = \gamma - \frac{\delta \alpha b}{\alpha - 1} \left\{ \frac{b}{\varepsilon} \right\}^{\alpha - 1}. \quad (12)$$

A simple comparison of equations (8) and (12) reveals that –ceteris paribus- a binding minimum wage constraint, which implies that $b < \varepsilon$, will be associated with a higher wage *rate* per effective unit of labour than in its absence ($\varpi > w$), due to the reduction in the aggregate effective units of labour supply caused by the exclusion of the lowest-ability workers from employment**.**

2.2.2 Government

In addition to setting (and enforcing) the minimum wage constraint, the government is assumed to levy a comprehensive income tax (τ) on all sources of income (except unemployment benefits), in order to finance the payment of benefits for the low-ability workers that are unemployed. We assume that the level of the unemployment benefit is a fixed proportion of the minimum wage, i.e. it is equal to φy ($0 \leq \varphi < 1$). Parameter ϕ describes the generosity of the unemployment benefit system. We note that in this model the granting of these benefits has an indefinite duration since the lowest-ability workers are permanently excluded from employment. In this sense, the income support provided to the unemployed is comparable to the real-world welfare payments (e.g. social assistance) provided to individuals whose eligibility for unemployment benefits has expired, or those who have never fulfilled the eligibility criteria for receiving them. Equation (12), i.e. the government budget constraint, just states that the net payments to the unemployed are equal to total tax receipts:

$$t\left[\left(\frac{\gamma - \varpi}{\delta}\right)\varpi + \frac{(\gamma - \varpi)^2}{2\delta}\right] = \left[1 - (b/\varepsilon)^{\alpha}\right]\varphi y \quad (13)$$

We assume that the tax rate adjusts so as to keep the budget in balance.

2.3 Comparison

In the perfectly competitive (PC) case the wage *rate* is uniquely determined according to equation (8). In the minimum wage (MW) case, the wage *rate*, as a function of the minimum wage, *y*, can be determined by solving equations (9) and (12), and is, as noted earlier, higher than the PC wage rate.

However, we wish to enquire whether the workers which retain their jobs after the imposition of the MW have higher after-tax incomes than in the PC case. This will be the case if the after-tax wage *rate* in the MW case is larger than the PC wage *rate*, i.e. if

$$(1-\tau)\varpi > w.$$

To examine whether the above inequality holds, we start by assuming that a minimum wage (per unit of time) is imposed which is set higher than the wage income (per unit of time) which the worker with the lowest ability in the population would receive in the PC case; i.e. $y = \lambda(bw) = \lambda w, \lambda \geq 1$. Parameter λ measures the extent by which the income of the lowest-ability worker would increase if he remained in employment after the introduction of the minimum wage; in other words it is the gross "mark-up" on the competitive wage rate. Moreover, in order to derive an analytical expression for the tax rate, we assume that the inequality parameter α is equal to 2. This assumption is necessary since otherwise we would not be able to derive an analytical expression for the tax rate.

In the appendix we show that the tax rate in the MW case is:

$$\tau = \frac{[(\lambda-1)(\gamma-2\delta)][\lambda(\gamma-2\delta)+2\delta+\gamma]\varphi\lambda(\gamma-2\delta)}{2\gamma^2[\lambda(\gamma-2\delta)+\delta]} \qquad (14).$$

We note that if $\lambda = 1$ - which is the PC case - the tax rate is zero as no unemployment benefits need to be paid.

The imposition of a minimum wage will be prefered by a majority among workers if (i) the after-tax wage income of employed workers is higher than their wage income in the PC case, and (ii) if the unemployment rate is less than 50 percent. In the Appendix we show that both of these conditions are satisfied if the following two conditions hold simultaneously for the parameter describing the generosity of the unemployment benefits system (φ), and the "mark-up" parameter (λ):

$$\varphi < \frac{4\gamma\delta(\lambda-1)(\delta+\lambda(\gamma-2\delta))}{\lambda^2(\gamma-2\delta)[(\lambda(\gamma-2\delta)+2\delta)^2-\gamma^2\ ]} \qquad (15)$$

$$\lambda < \frac{\gamma\sqrt{2}-2\delta}{\gamma-2\delta} \qquad (16)$$

How likely is it for these conditions to hold? To answer this question we note that if, as we have already assumed, $\alpha = 2$ and $b=1$, then to generate a labour demand elasticity equal to 0.5, we must set $\gamma = 3\delta$. Doing so, equation (15) implies that $\lambda < 3\sqrt{2} - 2$=2.243. Since $\lambda - 1$ measures the percentage difference between existing minimum wages (per unit of time) and the hypothetical wage (per unit of time) that the lowest ability worker would earn in a perfectly competitive market, $\lambda \leq 2.243$ implies that the "mark-up" on the competitive wage could be as high as 124 percent and the condition would still be satisfied.[15] Assuming that $\lambda = 2.24$, the maximum value of φ for which both conditions would be satisfied is 1.07; i.e. even if (some of) the unemployed workers received far more than what they would earn in the PC case[16] - thus necessitating the imposition of a high tax rate to pay for their unemployment benefits, the after-tax income of employed workers would be larger than in the PC case.

What if $\alpha \neq 2$, and $\gamma \neq 3\delta$? Although in this case it is impossible to derive analytically conditions equivalent to equations (15) and (16), after a wide experimentation with plausible parameter values regarding parameters α, b , λ, γ and δ (as long as the labour demand elasticity remains less than 1), we have not been able to find a single case in which the imposition of a MW would not be supported by the majority of workers.

The reason why there will be a majority of workers in favour of imposing a minimum wage is that when the labour demand elasticity is less than 1, aggregate wage income can increase by imposing a binding minimum wage that leaves some workers (i.e. the lowest-ability ones) unemployed. It is thus possible, through the use of an appropriate unemployment benefits scheme to fully compensate the unemployed for their loss of wage income, and still leave the after-tax incomes of employed workers higher than in the PC case.[17]

[15] Regarding actual minimum wages, it is not obvious what this difference could be mainly because no actual labour market can be considered as perfectly competitive even in the absence of a national minimum wage. Still, it is rather improbable that $\lambda \leq 2$ is not a safe assumption to make for most countries.

[16] For example, if $\varphi=1$, the (after-tax) income of the lowest ability worker, who will be unemployed in the MW case, will be 2.24 times the income that he would receive in the PC case (=w) if $\lambda = 2.24$. A worker with ability $e = 2.24$, would receive an income exactly equal to the income she would receive in the PC case.

[17] Note also that some of the taxes necessary to support the unemployed would be raised through the taxation of profit income, thus making the political support for minimum wages even stronger (see, e.g. Adam and Moutos, 2011). However, as argued by Economides and Moutos (2016), this argument may

3. In-Kind Redistribution

We now consider an economy which produces and consumes two goods (X and Y). Good X is a homogeneous good produced by private-sector firms only, whereas good Y is a (vertically) differentiated product which can be produced at different quality levels by private-sector firms and by the public sector.

3.1 Perfectly Competitive Labour Market

3.1.1 Production

We again use the homogeneous good X as the numeraire ($P_X = 1$), and assume the same technology as in Section 2. Thus, equations (1) to (3) of Section 2 hold for the present model as well.

The vertically differentiated product, Y, can be produced at various quality levels in both the private and the public sector. We wish to capture the fact that, for many government-provided goods (or services), some citizens choose not to "consume" them (even though they are eligible for doing so and there is no price-tag attached to them), preferring instead to purchase them from the private sector. Typical examples of such publicly provided goods are health care, child care, old-age care, housing, and education. One reason for this is that these goods may be provided by the government at a lower quality level than the quality level that (high-income) households would like to consume, and there is a large degree of lumpiness associated with their consumption. For example, it is nearly impossible for a student to attend at the same time a public and a private educational institution (or to attend both institutions part-time thus achieving a full-time status), or for a patient to have part of a heart operation at a public hospital and the rest of the operation at a private one. Moreover, in many cases it confers no extra utility (or it is detrimental) to supplement publicly provided goods with privately provided ones (i.e., first having an operation at a public hospital and afterwards supplementing it with another operation at a private hospital). High-income households will often elect to pay in order to avail themselves of the highest quality of these services – rather than be satisfied with the (sometimes) mediocre quality offered by the public sector.

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not hold if we allow for capital accumulation and take into account the detrimental effects of higher taxation on capital accumulation – and thus on the position of the static labour demand curve.

We assume that quality is measured by an index $Q > 0$, and that there is complete information regarding the quality index (see, e.g. Rosen, 1974; Helpman and Flam, 1987). We further assume that for private sector firms, average costs depend on quality and that, for any given quality level, the average cost is independent of the number of units produced. These assumptions are captured by the following production function:

$$Y_{Q_P} = \frac{L_Y}{\beta Q_P} \ , \ \beta \leq 1 \ . \tag{17}$$

In equation (17), Y_{Q_P} denotes the number of units of good Y of quality Q_P provided by the private sector, and L_Y denotes the effective units of labour used. This particular specification implies that as quality increases more (effective) units of labour are required to produce each unit of the Y good. It also implies that the (average) cost and, under perfect competition, also the price at which each unit of the good of quality Q will be a function of quality – but independent of the level of output[18]:

$$AC_P(Q_P) = P(Q_P) = w\beta Q_P. \tag{18}$$

For simplicity, and without loss of generality, we assume that the public sector uses a similar technology to produce the good, pays the same wage rate (per effective unit of labour), but for various reasons it may be a less efficient producer than private sector firms.[19] We capture this (potential) difference in efficiency between the private and the public sector by assuming that $\beta = 1$ in the public sector. Accordingly average costs in the public sector are

$$AC_G(Q_G) = wQ_G \tag{19}$$

[18] Thus, private producers of the vertically differentiated product earn zero profits.

[19] The assumption that the public sector is less efficient than the private sector dates back to Baumol (1967) and is discussed in Katsimi (1998). This relative inefficiency may be justified (even if the two sectors use the same technology) on the grounds of imperfect monitoring as a result of the absence of competition or the lack of transparency of property rights. We note that the qualitative nature of our results would not change if we assumed that the public sector is as efficient as the private sector (i.e. $\beta = 1$).

where the subscript G denotes the public sector, and Q_G is the quality offered to households at no charge by the public sector.

In what follows we assume that there is a single quality offered by the private sector (Q_P), and a single quality offered by the public sector (Q_G). Since no household would wish to pay to buy the privately provided quality if $Q_G \geq Q_P$, we assume that $Q_G < Q_P$.

3.1.2 Households

All households are assumed to have identical preferences, and their mass is set to 1. Following Rosen (1974), and Flam and Helpman (1987), we assume that the homogeneous good is divisible, whereas the quality-differentiated product is indivisible and households can consume only one unit of it. For simplicity we write the utility function as[20]

$$U_i = \sqrt{C_i Q_i}$$

where C_i and Q_i stand for the quantity of the homogeneous good and the quality of good Y (either the privately or the publicly provided variety) consumed by household i. The distribution of ability (i.e. effective number of labour units) is assumed to be as in the previous Section.

Since good Y is also offered by the public sector, and households can consume either the privately provided variety or the variety provided by the government, households, in effect, face two mutually exclusive budget constraints. The budget constraint of a household deciding to acquire a variety of Y which is offered by the private sector is:

$$e_i w(1-t) = C_i + \beta w Q_P.$$

where t stands for the income tax rate. Given the quality level of the privately provided variety, the household's demand for the homogeneous good is:

[20] The Cobb-Douglas utility function has the advantage – in addition to being easy to work with – that it produces results which are independent of the level of the economy's average income.

$$C_i = e_i w(1-t) - \beta w Q_P. \quad (20)$$

If the household chooses to consume the publicly (and freely) provided variety (Q_G) the entire disposable income of the household is spent on the homogeneous good, and the demand for it is:

$$C_i = e_i w(1-t). \quad (21)$$

The resulting indirect utility of the household is then,

$V_i^P = \sqrt{w[e_i(1-t) - \beta Q_P]Q_P}$, if it chooses to consume a privately offered variety

$V_i^G = \sqrt{we_i(1-t)Q_G}$, if it chooses to consume the publicly offered variety

We note that the difference between V_i^P and V_i^G is increasing in ability (and income). Thus, only households with relative large incomes will be willing to pass by the possibility of consuming for free the publicly provided variety and instead pay to acquire the high quality variety offered by the private sector. Let θ denote the ability of a household that is indifferent between consuming the publicly provided variety and the privately produced variety, i.e., for this household it holds that:

$$\sqrt{w[\theta(1-t) - \beta Q_P]Q_P} = \sqrt{w\theta(1-t)Q_G}$$

We term θ the *dividing* level of ability. Households with ability greater than θ will prefer to pay in order to acquire the privately offered variety, whereas households with ability smaller than θ will avail themselves of the freely offered public variety. Solving the above equation for θ we find that:

$$\theta = \frac{\beta Q_P^2}{(1-t)(Q_P - Q_G)} \quad (22)$$

From equation (22) we note that $d\theta/d\beta > 0$, i.e. that – *ceteris paribus* – as the private sector becomes more productive in the provision of the vertically differentiated product (β becomes smaller), the higher will be the number of households who would

choose to pay in order to acquire the privately supplied variety. From the same equation we note also that – *ceteris paribus* – the higher is quality provided for free by the public sector (Q_G), the higher will be θ , and the fewer will be the households willing to pay for the private variety.

From the Pareto distribution we know that the proportion (and number) of households with ability smaller or equal to θ is

$$F(\theta) = 1 - \left[\frac{b}{\theta}\right]^{\alpha}. \tag{23}$$

This implies that the number of households which choose to consume the publicly provided variety will be equal to $1-(b/\theta)^a$, and this will also be the number of units of quality Q_G produced by the public sector. The corresponding demand, and production, of units of quality Q_P by the private sector will be equal to $(b/\theta)^a$. As a result, the demand for effective units of labour by the public sector will be equal to $\left\{1 - \left[\frac{b}{\theta}\right]^{\alpha}\right\} Q_G$, whereas the corresponding demand by the private producers of the vertically differentiated good will be equal to $\left[\frac{b}{\theta}\right]^{\alpha} \beta Q_P$.

3.1.3 Labour Market Equilibrium

Aggregate demand for effective units of labour is equal to the sum of labour demand by the producers of the homogeneous good and the demand by private and the public producers of the vertically differentiated product[21], i.e. it is equal to

$$\frac{\gamma - w}{\delta} + \left[\frac{b}{\theta}\right]^{\alpha} \beta Q_P + \left\{1 - \left[\frac{b}{\theta}\right]^{\alpha}\right\} Q_G.$$

The aggregate supply of effective labour units is just the mean ability in the population, which is equal to $(\frac{\alpha b}{\alpha - 1})$. Thus, the equation describing labour market equilibrium is:

[21] For completeness, one must add the demand for labour arising from the consumption of the VDP by the fixed number of the owners of the firms which receive the profits from their operation. We assume that the (after-tax) profit income of these individuals is high enough so that they always consume the privately provided variety, thus adding a constant to the aggregate demand for labour – which, for simplicity, we ignore.

$$\frac{\gamma-w}{\delta}+\left[\frac{b}{\theta}\right]^{\alpha}\beta Q_P+\left\{1-\left[\frac{b}{\theta}\right]^{\alpha}\right\}Q_G=\frac{\alpha b}{\alpha-1}. \quad (24)$$

Another way to write this equation will prove more informative for what follows, i.e.

$$\frac{\gamma-w}{\delta}=\frac{\alpha b}{\alpha-1}-\left[\frac{b}{\theta}\right]^{\alpha}\beta Q_P-\left\{1-\left[\frac{b}{\theta}\right]^{\alpha}\right\}Q_G. \quad (24a)$$

This equation states that labour market equilibrium obtains when the *net* supply of labour to the homogeneous sector –i.e. the total supply of labour minus the effective labour units required for the production of the private and public varieties of the VDP – is equal to the demand for labour by the producers of the homogeneous good.

3.1.4 Government Budget Constraint

The government's revenue consists of taxes on wage income and on profits. We assume that a common, and proportional, tax rate is applied to both wage income and profits. Given that aggregate wage income is equal to $w(\frac{\alpha b}{\alpha-1})$, and aggregate profits from the production of the homogeneous good[22] are equal to $\frac{\delta}{2}(\frac{\gamma-w}{\delta})^2$, the government's budget constraint can be written as:

$$\tau\left\{w\left(\frac{\alpha b}{\alpha-1}\right)+\frac{\delta}{2}(\frac{\gamma-w}{\delta})^2\right\}=w\left\{1-\left[\frac{b}{\theta}\right]^{\alpha}\right\}Q_G \quad (25)$$

The right-hand-side of equation (25) is government spending, which just equals the total cost of producing the required units of the vertically differentiated product (i.e. the units demanded by households with ability less or equal to θ).[23]

We assume that the tax rate adjusts so as to keep the government's budget in balance.

[22] See equation (3). Note also that private producers of the vertically differentiated good make no profits.

[23] In principle, the government could, instead of providing for free the vertically differentiated good, charge a price lower than the cost of producing it. We discuss below the possible ramifications of this for our analysis.

3.1.5 General Equilibrium

Since all private budget constraints are satisfied, general equilibrium in this economy obtains when the labour market is in equilibrium, and the government budget in balance.

Equations (22), (24), and (25) can be solved to determine the values of $\theta,\ w,$ and t, and then the rest of the endogenous variables can be determined. We note that although the system is block-recursive, it is non-linear, and no analytic solution can be derived. Moreover, due to the nonlinearity of the system, it is not possible to exclude theoretically the possibility of multiple equilibria. Nevertheless, we can report that after extensive numerical simulations with a wide range of plausible parameter values we have not found a single case of multiple equilibria. These numerical simulations are available upon request.

3.2 Minimum Wages

We now assume the existence of a government-imposed minimum wage per unit of labour *time* (e.g. per hour) equal to y, which is the minimum amount that an employer must pay in order to employ one person. This minimum wage per unit of time must be distinguished from the wage rate per *effective* unit of labour, which will be market-determined (i.e. as in the previous section).

Since, preferences, technology, and the distribution of ability remain as in the case with a perfectly competitive labour market, the *dividing* level of ability, θ, is still determined by equation (22).

3.2.1 Labour Market

As in Section 2, the minimum wage constraint implies that firms will not be willing to employ workers whose level of ability (i.e. number of efficient units of labour per unit of time) is such that $y > e_i\varpi$, where ϖ stands for the market-determined wage rate per effective unit of labour in the presence of the minimum-wage (per unit of time) constraint. If ε denotes the level of ability for which it holds that $y = \varepsilon\,\varpi,$ the total number of effective units of labour supplied by individuals with $e_i \geq \varepsilon$ is equal to $\frac{\varepsilon\alpha}{\alpha-1}\left\{\frac{b}{\varepsilon}\right\}^{\alpha}$ (see equation (11)).

The wage *rate* per effective unit of labour paid by private sector firms is determined by equating the demand for effective units of labour (which is equal to the

sum of labour demand by the producers of the homogeneous good and the demand by private and the public producers of the vertically differentiated product) with the supply of effective labour units possessed by individuals with $e_i \geq \varepsilon$:

$$\frac{\gamma-\varpi}{\delta} + \left[\frac{b}{\theta}\right]^{\alpha} \beta Q_P + \left\{1 - \left[\frac{b}{\theta}\right]^{\alpha}\right\} Q_G = \frac{\varepsilon\alpha}{\alpha-1}\left\{\frac{b}{\varepsilon}\right\}^{\alpha} \quad (26)$$

3.2.2 Government

As before, we assume that the government runs a balanced budget. Its revenue arises from taxing the aggregate wage income in the private sector - which is equal to the wage rate (ϖ) times the effective labour units supplied to the private sector ($\frac{\varepsilon\alpha}{\alpha-1}\left\{\frac{b}{\varepsilon}\right\}^{\alpha}$), plus the taxation of profits. Its expenditure is the net (i.e. after tax) payments of the minimum wage to each of the public sector employees. We assume that the government pays the same wage rate per effective unit of labour as private sector firms, and that it is meritocratic in the sense that it hires only those with ability $e_i \geq \varepsilon$.[24] Note that the number of unemployed workers is equal to $1 - \left\{\frac{b}{\varepsilon}\right\}^{\alpha}$. Thus, the government budget constraint is:

$$\tau\left\{\varpi\frac{\varepsilon\alpha}{\alpha-1}\left\{\frac{b}{\varepsilon}\right\}^{\alpha} + \frac{\delta}{2}\left(\frac{\gamma-\varpi}{\delta}\right)^2\right\} = \varpi\left\{1 - \left[\frac{b}{\theta}\right]^{\alpha}\right\} Q_G + \left(1 - \left\{\frac{b}{\varepsilon}\right\}^{\alpha}\right)\varphi y \quad (27)$$

3.*2.3 General Equilibrium*

Equations (9), (22), (26) and (27) can be solved to determine the values of $\theta, \varepsilon, \varpi, ,$ and τ, and then the rest of the endogenous variables can be determined. We again note that although the system is block-recursive, it is non-linear, and no analytic solution can be derived. Nevertheless, we can draw some useful results by comparing the perfectly competitive (PC) with the minimum wage (MW) case.

3.3 Comparison

We now proceed to compare the equilibrium outcomes in the MW and PC cases. Since it is impossible to derive closed-form solutions, we resort to numerical calculations.

[24] Assuming that the government may hire less able workers and thus increase the cost of providing Q_G may be an interesting extension of our analysis.

3.3.1 Parameter values

Table 1 reports the baseline parameter values for policy, technology and preferences used to obtain the values of the endogenous variables.

In accordance with the relevant empirical studies we set the baseline value of parameter a, which determines the shape of the Pareto distribution and is a measure of income inequality among workers, equal to 2, and its "extreme" values to 1.5 and 2.5. We note that for $a = 2$, the Gini coefficient, whose value for the Pareto distribution is $G = \frac{1}{2a-1}$, is equal to 0.33, which is very close to the average estimates for the values of labour income inequality among full-time workers observed in OECD economies (see, for example, Koske. Fournier and Wanner, 2012).[25] Parameter b, which stands for the lowest ability among households, can be chosen arbitrarily so that the model's equilibrium values of the endogenous variables match well with actual economies; we set it to 1.[26]

Among the rest of the parameter values, of particular importance is the difference between the values of Q_P and Q_G. Since both of these values are indices of how consumers perceive the quality inherent in the privately and publicly provided varieties of the VDP, one way to get a handle on a meaningful difference between them is to choose them in such a way so as to have the percentage of the population opting out of the consumption of the freely provided public variety being close to what we observe in many countries. For example, the percentage of the population among OECD countries choosing to pay in order to avail themselves of the privately provided variety is often below 10 percent.[27] With this in mind, we initially set $Q_P = 3$, and $Q_G = 0.5$, so that at the initial constellation of parameter values the percentage of workers consuming the privately provided variety of the VDP is 6.4 percent.[28] As argued in the previous section, we initially set parameters γ and δ so

[25] The "extreme" values for a (i.e. 1.5 and 2.5) correspond also to the lowest and highest estimates among OECD countries for the Gini coefficient of labour income inequality among full-time workers in this study.

[26] This is just a normalization; different values of *b* would not affect the qualitative nature of the results.

[27] The percentage of students in privately *managed* elementary and secondary schools is in many OECD countries below 10 percent (e.g. 10 percent in Sweden,9 percent in the United States, 6 percent in the United Kingdom, 5 percent in Germany – see, http://www.oecd.org/pisa/50110750.pdf). Note that this figure includes schools managed by religious organizations which are sometimes funded by the government and do not charge substantial or any fees. Regarding health care no easily comparable data are available, as some patients may use public hospitals for some operations and go private in other cases.

[28] Note that if we assume that firm owners are included in our calculations, the share of the population consuming the privately provided variety would possibly be about 10 percent.

that $\gamma = 3\delta$, and normalize them to $\delta = 1$, and $\gamma = 3$; parameter φ is set at 0.5 – implying a moderately generous social welfare support for the unemployed. Finally, we initially consider a minimum wage (per unit of time) that is a moderate 10 percent above what the minimum ability worker would earn in the PC case (i.e. $y = \lambda(bw) = \lambda w = 1.1w$).

3.3.2 Results

3.3.2.1 Baseline Case

The consequences resulting from adopting a "moderately" binding minimum wage which is (per unit of time) 10 percent higher than what the worker with the lowest ability would earn in the PC case, are shown in the first line of Table 2. With $Q_G = 0.5$, the introduction of the MW results in a rise in the pre-tax wage *rate* (per effective unit of labour) from 1.64 to 1.7207 (a rise by about 5 percent), which in turn prices the least able workers out of employment, generating an unemployment rate equal to 9.02 percent. (We note that the unemployment rate is the percentage of persons/workers that are unemployed, and this must be distinguished from the percentage of *effective* labour units which are priced out of employment; given that the persons with the lowest endowment of effective labour units are unemployed, the percentage of effective labour units which are priced out of employment would be about 4.6 percent.) Given that the generosity of the unemployment benefits parameter φ is set at 0.5, all unemployed workers will have an after-tax income and utility which will be lower than in the PC case. Among the workers at the top of the ability distribution only 6.36 percent (=1-0.9364) would choose to buy the privately supplied variety of the VDP (whose quality index is: $Q_P = 3$) in the PC case; this proportion drops to 5.83 percent in the MW case. This is a consequence of two forces: first, the emergence of unemployment requires a rise in the tax rate from 18.26 percent in the PC case to 21.74 percent in the MW case, thus reversing much of the rise in the pre-tax wage *rate* (per effective unit of labour) from 1.64 to 1.7207, which is generated by the imposition of the minimum wage; the after-tax wage *rate* rises by from 1.3405 to 1.3466 (a rise by about 0.5 percent), and second, the rise in the cost of producing (and the price of) Q_P due to the rise in the wage *rate*. [29]

[29] Note that the cost of producing the public variety will also rise after the introduction of the MW due to the rise in the wage rate, thus the tax rate will increase for this reason as well.

Among the workers that remain employed (the 90.98 percent), some workers will be better off under the MW regime, while some others will be worse off. To understand how workers of different ability will fare after the introduction of the MW, we start by dividing the employed workers in three distinct groups.

The first group contains those workers (of moderate-to-high ability) that remain employed after the introduction of the MW, and continue to consume the freely provided Q_G. These workers, provided that the after-tax wage *rate* rises,[30] will clearly be better off with the MW since their consumption of the homogeneous good rises and continue to consume the freely provided Q_G. This group represents 84.62 percent of all workers, and its size is equal to the difference between the percentage of workers that were consuming Q_G in the PC case (93.64) and the percentage that become unemployed in the MW case (9.02). We note that this group always[31]contains the worker with median ability, and that all members of this group will always be unanimous in their preferences regarding the introduction of the MW. Given that the preferences of this group (due to its size) are pivotal for the political viability of the MW, in what follows we shall call this group the *median-ability* group. Thus, examining the utility of the worker with median ability in the PC and MW cases will be sufficient to determine the preferences of the median-ability group, and to infer whether there is a majority among workers in favour of the MW regime.

The second group contains the workers of very high ability that purchase the private variety of the VDP before and after the introduction of the MW (i.e. these are the workers whose ability is at least 4.1401 in Table 2). For these workers, their utility will be:

$V_{PC} = \sqrt{w[e\ (1 - t_{PC}) - \beta Q_P]Q_P}$, in the PC regime, and,

$V_{MW} = \sqrt{\varpi[e(1 - t_{MW}) - \beta Q_P]Q_P}$, in the MW regime.

Whether V_{MW} is larger or smaller than V_{PC} it depends only on the income that is left after purchasing Q_P. Thus, it depends on the sign of the expression Δ, defined as $\Delta = \varpi[e(1 - t_{MW}) - \beta Q_P] - \ w[e\ (1 - t_{PC}) - \beta Q_P]$. This expression can be re-

[30] Although we cannot establish this analytically, we have not been able to find a single case under plausible parameter values for which this is not true.

[31] This is because we assume that the percentage of workers purchasing the privately produced variety of the VDP (Q_P) is a small percentage of all workers.

written as $[\varpi(1-t_{MW})-(1-t_{PC})w]e+\beta Q_P(w-\varpi)$, which can be either positive or negative. Assuming that the after-tax wage *rate* in the MW case is higher than in the PC case, the value of Δ is increasing in e. Thus, it is possible that among workers of very high ability (i.e. those choosing to consume Q_P under both cases), only those of exceptionally high ability will prefer the imposition of a MW. This is understandable since the imposition of the MW raises the cost of acquiring Q_P by the same amount for all workers (i.e. by $\beta Q_P(\varpi-w)$), but the total increase in nominal wage income due to the higher wage *rate* will be higher for higher ability workers. Thus, among the 5.83 percent of workers which choose to buy the privately supplied variety of the VDP in the MW case, 5.82 percent (among all workers) will be against introducing the MW, and only the remaining 0.01 percent will be in favour of the MW. We note that it is possible for a worker to be against the introduction of the MW even when her after-tax nominal wage income rises.

The third group of workers contains those with high ability that switch from consuming Q_P to consuming Q_G after the introduction of the MW. (In the baseline case with $Q_G=0.5$, these are the workers with ability (*e*) between 3.9638 and 4.1401.) The reason that the *dividing* level of ability θ (i.e. the ability level above which workers/households will prefer to pay in order to acquire Q_P, whereas households with ability smaller than θ will avail themselves of the freely offered Q_G) rises after the MW is imposed, is that the rise in the (price, and) cost of producing Q_P rises in proportion to the rise in the (gross) wage *rate*, whereas the after-tax nominal wage income rises by a smaller proportion due to the rise in the tax rate. Thus, the worker who was previously indifferent between purchasing Q_P and using Q_G, will now be induced to switch to consuming the freely available Q_G, since, as argued in the previous paragraph, if the level of ability is not very high, the rise in after-tax income will be smaller than the rise in the cost of Q_P. As a result, this group of workers will also be against the introduction of the MW; its size is equal to 0.53 percent of all workers (i.e. the difference between the percentage that were using Q_G before (93.64) and after the introduction of the MW (94.17)).

In aggregate, the workers which are against the MW are equal to the sum of unemployed (9.02 percent), the 5.82 percent among the second group, and the third group (0.53 percent), i.e. it is equal to 15.37 percent. Those being in favour of introducing the MW are the sum of the median-ability group (84.62 percent) and the

0.01 percent among the second group (those of exceptionally high ability), i.e. it is equal to 84.63 percent. If citizens express their policy preferences on the basis of their personal welfare alone, the MW would garner a winning coalition comprising the moderate- to high-ability workers, and the exceptionally high-ability workers. This non-monotonic relationship between worker ability and policy preferences regarding MW can partly match with what Stigler (1970) termed Director's Law – according to which public interventions are made for the primary benefit of the middle classes, and financed with taxes which are borne in considerable part by the rich and the poor.[32]

Block A of Table 2 examines whether the political viability of the MW depends on how large it is relative to the PC benchmark. The baseline result assumed the imposition of a MW (per unit of time) that is a moderate 10 percent above what the minimum ability worker would earn in the PC case (i.e. $y = \lambda(bw) = \lambda w = 1.1w$). As the (gross) markup (λ) of the minimum wage (per unit of time) over what the minimum ability worker would earn in the PC case increases, the popularity of the MW decreases, and eventually receives no political support when λ=1.20. This is a consequence of the progressively higher unemployment rate that a higher λ generates, implying larger increases in the tax rate and a drop in the after-tax wage rate. The rise in the tax rate is due to three factors. First, to the rise in unemployment and the need to finance the provision of unemployment benefits, second, to the assumed proportionality between the level of the minimum wage and the unemployment benefit, and, third, to the rise in the cost of producing Q_G since the wage rate increases.[33]

We note the contrast in this finding, i.e. that even small markups of the minimum wage over what the minimum ability worker would earn in the PC case (λ=1.20) would receive no political support for the MW, to the finding in Section 2 that the MW would receive widespread political support even for far larger markups in the absence of in-kind redistribution.

[32] The matching is imperfect since in our model the exceptionally able workers (the top 0.01 percent) would be better-off with the MW.

[33] We note that although the political popularity (i.e. the share workers that prefer the MW regime over the PC one) of the MW drops as λ increases from 1 to 1.2, the utility of the median-ability worker initially rises as λ increases from 1 to 1.1, and then declines. The two effects are compatible with each other, since the drop in political popularity is (mainly) driven by the reduction in the size of the median-ability group due to the transfer of the lowest ability members of this group to the rank of unemployed as λ increases.

Block B portrays how the generosity of the unemployment benefit system – as captured by parameter φ - affects the desirability of the MW (baseline: $\varphi = 0.5$). The political support for the MW increases when the unemployed receive less support, since this allows for a smaller increase in the tax rate relative to the PC case. However, the MW would receive no political support if the unemployment benefit system became mildly generous ($\varphi = 0.6$). Again, this result should be contrasted with the case of no in-kind redistribution, in which case even when φ is larger than 1 the MW would be preferred by either all or a large majority of workers.

Finally, the influence of (in)equality in the distribution of ability – as captured by parameter α – is portrayed in Block C (baseline: $\alpha = 2, b = 1$). Since changing α affects the mean ability in the economy ($\mu = \alpha b/(\alpha - 1)$) if b remains unchanged, in order to isolate the effects of changes in the distribution of ability we allow b to adjust whenever α changes so as to keep mean ability constant. We observe that the degree of inequality in the distribution of ability has no appreciable influence on the desirability of the MW.

3.3.2.2 The influence of in-kind redistribution

Table 3 reveals how the extent of in-kind redistribution – as measured by the quality of the publicly provided variety – affects the political viability of the MW institution. For ease of comparison we include the baseline case with $Q_G = 0.5$. We first note that as Q_G rises from 0.1 to 0.5, there is large majority of workers (about 84 percent) in favour of introducing the MW. However, when Q_G rises to 0.6 (and above)[34] there will be no worker that will be better-off with the MW. Naturally, as Q_G rises, the proportion of workers choosing to avail themselves of the (free) publicly provided variety rises from about 88 percent when $Q_G = 0.1$ (in both the PC and MW cases) to about 98 percent when $Q_G = 1$ (in both cases). As expected, the tax rate needed to finance this rise in the quality of the publicly provided variety rises sharply from less than 5 percent (in both cases) to over 40 percent (in both cases), with the tax rate being higher in the MW case.

In addition to its effect on the tax rate, a higher Q_G implies an increased demand for effective units of labour by the government, reducing the effective units of labour available for hiring by private sector firms (both homogeneous good- and

[34] In fact, the crucial value of Q_G above which the MW receives no support from any worker is 0.55.

VDP-producers), thus resulting in a positive relationship between Q_G and the wage rate (this holds in both the PC and the MW case). However, the rise in the wage rate is more than fully offset by the rise in the tax rate, thus resulting in a negative relationship between Q_G and the after-tax wage rate (in both cases). This is a desirable feature of our model since otherwise the government could make most of the workers better-off by engaging in ever higher, and higher, doses of redistribution through further rises in Q_G. (In such a case, employed workers belonging to the median-ability group would be better-off since they would be able to consume higher quantities of the homogeneous good and to avail themselves of the higher quality of the publicly provided VDP.) However, it is still possible for utility to increase as Q_G increases up to some point, since the decline in the after-tax wage income can be offset (in utility terms) by the rise in Q_G. Indeed, Table 3 reveals that utility of the median-ability[35] worker (i.e. a worker who is always employed and consumes the government-provided variety of the VDP) keeps rising until Q_G rises above 1 (maximum utility is reached when Q_G =1.15 in the PC case, and when $Q_G = 1.2$ in the MW case).

Figure 1 (based on Table 3) reveals that once the level of Q_G is not far too small relative to the level which maximizes the utility of the median-ability agent under PC, the median-ability worker (as well as all workers belonging to the median-ability group which comprises far more than 50 percent of all workers) would experience a reduction in her utility from the introduction of the MW. This implies that when an adequate amount of politically viable redistribution is undertaken via the public provision of private goods, adding a less efficient redistributive device (like the minimum wage) to the policy arsenal can be welfare reducing. In contrast, when, the initial equilibrium involves too little redistribution, the introduction of the MW can be a useful "complement" for the lack of adequate redistribution (from the point of view of the majority of employed workers).

4. Conclusion

The paper has argued that the absence of efficient redistribution mechanisms, like in-kind transfers, from the policy landscape increases the political support for the MW institution, whereas their strong presence renders the MW institution politically non-viable. Moreover, it has shown that the smaller is the presence of efficient

[35] The median-ability worker should not be interpreted as the *median-voter* in our model.

redistribution mechanisms, the higher is the level of the minimum wage that can be preferred by the majority of workers. These features of the model not only match well with the actual policy/institutional environment across Europe, but also capture well the debate on the other side of the Atlantic regarding whether the MW and the Earned Income Tax Credit are substitutes or complements. Our results suggest that they are complementary policy measures when in-kind redistribution is not extensive and substitutes when it is able.

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Appendix: To be inserted.

Table 1: Baseline parameterization

Parameters	Description	Value
β	Measure of relative efficiency in the private sector	0.9
b	Lowest ability among households	1
a	Shape parameter of the Pareto distribution	2
γ	Technology parameter in the production function of the homogeneous good	3
δ	Technology parameter in the production function of the homogeneous good	1
λ	Measures the gross markup (i.e. the percentage by which the income of the lowest-ability worker would increase if he remained in employment after the introduction of the minimum wage)	1.1
φ	Measure of the generosity of the social welfare support for the unemployed	0.5
Q_p	Quality of the VDP good provided by the private sector	3

Table 2: Comparison of PC and MW

					θ		τ		Labour Market				% of workers that use the public good		% of workers which are better off under MW
					PC	**MW**	**PC**	**MW**	w	$\bar{w}$	ε	u (%)	**PC**	**MW**	
Baseline solution					3.9638	4.1401	0.1826	0.2174	1.64	1.7207	1.0484	9.02	93.64	94.17	84.71
A	λ		1.05		3.9638	4.0488	0.1826	0.1998	1.64	1.6814	1.0242	4.66	93.64	93.90	89.18
			1.15		3.9638	4.2383	0.1826	0.2355	1.64	1.7581	1.0727	13.10	93.64	94.43	80.54
			1.20		3.9638	4.3440	0.1826	0.2541	1.64	1.7937	1.0972	16.93	93.64	94.70	0
B	φ		0.4		3.9638	4.1178	0.1826	0.2132	1.64	1.7214	1.0480	8.95	93.64	94.10	85.01
			0.6		3.9638	4.1630	0.1826	0.2217	1.64	1.72	1.0488	9.09	93.64	94.23	0
C	a	b	1.5	0.67	3.9635	4.0773	0.1825	0.2054	1.6518	1.7070	0.7096	8.94	93.10	93.39	84.62
			2.5	1.2	3.9642	4.1761	0.1827	0.2242	1.6109	1.7068	1.2459	8.95	94.96	95.57	86.04

Table 3: The influence of in-kind redistribution

Q_g	θ		τ		Labour market				% of workers that use the public good		Utility of the median-ability agent		% of workers which are better off under MW
	PC	MW	PC	MW	w	$\bar{w}$	ε	u (%)	PC	MW	PC	MW	
0.1	2.8808	2.9383	0.0304	0.0494	1.4133	1.4875	1.0451	8.45	87.95	88.42	0.4402	0.4472	84.28
0.2	3.0898	3.1661	0.0637	0.0863	1.4619	1.5374	1.0460	8.60	89.53	90.02	0.6222	0.6303	84.07
0.3	3.3338	3.4345	0.1001	0.1265	1.5159	1.5929	1.0468	8.75	91	91.52	0.7608	0.7683	84
0.4	3.6215	3.7545	0.1397	0.1702	1.5754	1.6541	1.0476	8.89	92.38	92.91	0.8756	0.8812	84.17
0.5	3.9638	4.1401	0.1826	0.2174	1.64	1.7207	1.0484	9.02	93.64	94.17	0.9736	0.9758	84.71
0.6	4.3755	4.6104	0.2287	0.2680	1.7097	1.7925	1.0492	9.15	94.78	95.30	1.0578	1.0552	0
1	7.2296	8.0598	0.4398	0.4975	2.0325	2.1251	1.0521	9.65	98.09	98.46	1.2689	1.2289	0
1.5	20.0084	27.9928	0.7301	0.8071	2.5030	2.6075	1.0559	10.31	99.75	99.87	1.1971	1.0330	10.31

Figure 1: Utility of the agent with median ability