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expect a double dividend? A theoretical exercise from a
supply-side view

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Distributional effects of minimum wages: can unions expect a double dividend? A theoretical exercise from a supply-side view

by

Michael Öllinger, Christoph Ostermair, and Friedrich L. Sell

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Abstract

In this short communication, it is recalled that unions traditionally follow a policy of pushing higher average wages and at the same time propose a compression of the structure of wages and salaries, which follows the theory of some sort of equity. Considering a steep downfall of union density in many, if not all, OECD countries, the actual good condition for minimum wage policy comes as no surprise. Despite the fact that unions do not like the intervention of labor market policy at the cost of tariff autonomy, it can be shown that minimum wages are capable of serving both the above-discussed objectives of unions, but only the average wage rate cannot be increased. In addition, the distribution of wages will decrease, *ceteris paribus*. However, it is not clear whether minimum wages will be able to increase the overall wage quota in the economy. Here, this fact is theoretically explored in depth.

JEL Categories: J51, J38, J41, J58

Keywords: strategy of unions, wage dispersion, average and minimum wages, wage quota

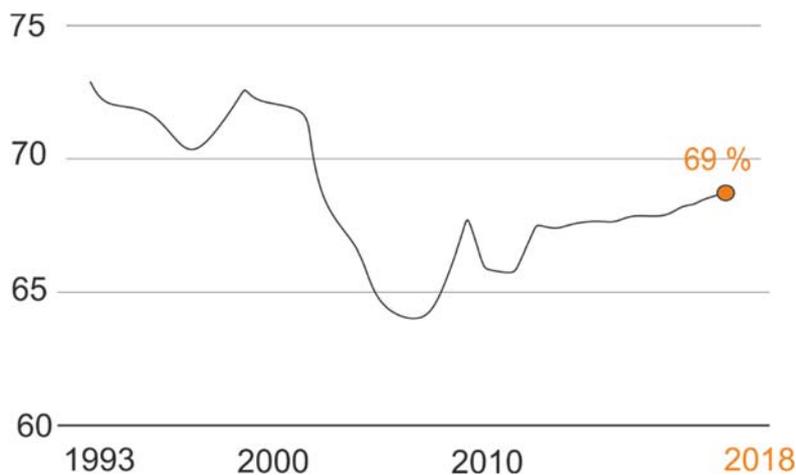
Distributional effects of minimum wages: may unions expect a double dividend? A theoretical exercise from a supply-side view

1. Introduction

Unions have a policy of pushing higher average wages and simultaneously propose a compression of the structure of wages and salaries, which is based on the theory of some sort of equity. Considering a steep downfall of union density in many, if not all, OECD countries, the actual good condition for minimum wage policy is not surprising. Despite the fact that unions do not like the intervention of labor market policy at the cost of tariff autonomy, one can easily show that minimum wages are capable of serving both of the above-discussed objectives of unions. However, the fact that whether minimum wages can also help to increase the overall wage quota in the economy appears to be much less clear. At the same time, wage quota is considered a core variable while discussing the eternal conflict between labor and capital.

Beyond these general observations, one finds some remarkable conventional facts from today's Germany: as shown in Figure 1, the (uncorrected) wage quota has increased since 2011.

“Wage quota”



“Gross domestic product”

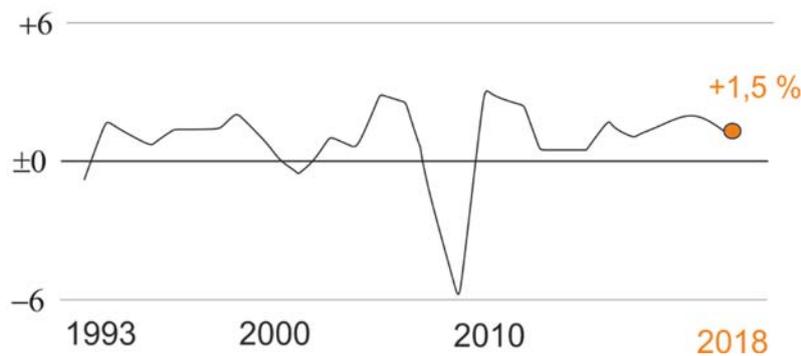


Figure 1: Recent values of GDP growth and of the wage quota in Germany. Source: destatis

At the same time, the German economy has experienced a remarkable upswing or mild boom in the last nine years, which, according to economic experts, is going to stop in 2019. Collectively, these two facts seem to contradict the standard prediction of business cycle theory: the latter would expect the wage quota to decrease (increase) during an upswing or boom (downturn or recession) in the economy. Recently, on January 1, 2015, Germany has introduced a statutory or binding, nation-wide minimum wage of 8.50 Euro per hour, which has been increased two times since then.

Table 1: Statutory nation-wide minimum wage in Germany

01.01.2015–31.12.2016	8.50 €
01.01.2017–31.12.2018	8.84 €
01.01.2019–31.12.2019	9.19 €
01.01.2020–31.12.2020	9.35 €

Source: own compilation

According to Figure 1 and Table 1, it can be concluded that an increase in the minimum wage rate does not impede a rise in the overall wage quota in the German economy. However, this cannot be considered clear evidence, of course. Considering the recent implementation of the minimum wage in Germany, an empirical investigation on how the wage quota is affected by the new minimum wage legislation was carried out. However, there are already interesting empirical investigations about the employment effects. Köppl-Turyňa et al. (2018, 2019) (see also the literature cited therein) stated that the minimum wage has negative repercussions on the marginal employment when compared with a scenario without the minimum wage (ibid. p. 41). In addition, it was observed that the impact on the total employment is at most slightly negative according to the majority of related studies (ibid).

Furthermore, the following questions arise: Can a theoretical approach be helpful? How and in which direction might the minimum wage rate influence the wage quota? Therefore, the main objective of this short contribution was to answer these questions from a theoretical point of view.

This paper is organized as follows. In the next section, some other recent contributions on this topic are briefly discussed. In the following section, analytical and graphical analysis of the impact of minimum wages on the density function of wages and salaries is presented. Here, the primary focus is on the effects of minimum wages on the average wage rate and the standard deviation of wages/salaries. Thereafter, some simple algebraic equations on the wage sum and the total nominal income quota are presented, which finally help in the discussion on the impact of higher average wages or minimum wages on the wage quota. In the last section, a short summary of the findings and a perspective of future research works are presented.

2. What does the recent literature say?

The majority of contributions on this subject have empirically analyzed the impact of minimum wages on some measures of overall inequality of the economy or society which are taken into consideration. For instance, some of the cases are as follows: contributions of Escobar Toledo (2014) on Mexico; Groisman (2014) on Argentina; Butcher, Dickens, and Manning (2012) on the UK; Bosch Mossi and Manacorda (2010) on Mexico; and Chun and Khor (2010) on Indonesia. In addition to these contributions, the theoretical papers of Belser and Rani (2015), Manning (2011), and Adam and Moutos (2006) are either related to the issues of employment problems and possibilities or these papers set up an institutional and sociological framework. In some of the papers, the subject is also presented from a historical perspective. All of these studies have shed in-depth light on this subject and have their own merits, but most of them have not explicitly considered the important aspect of the distribution of wages and salaries before and after the introduction of minimum wages. For example, the most important exceptions are—by no means exhaustive—the contributions of Teulings (2003), Neumann and Wascher (2010), and Christl et al. (2018). Christl et al. (2018) estimated “the sensitivity of employment to changes in minimum wages for young workers” (ibid, p. 447), which reveals an important though the incomplete picture of the labor market. Broadly speaking, the results thus obtained confirm the hypothesis that when the minimum wages are set too high, one contributes to high(er) unemployment among young workers (ibid, p. 426). In both theoretical and empirical papers, Teulings reports that a decrease in the minimum wage contributes to an increase in “the standard deviation of log wages” (ibid, p. 828). He also reports that “the impact of minimum wages is concentrated in the lower half of the distribution” (ibid). This conforms to the subjects and results of this study, which are addressed in the subsequent sections. On the subject of minimum wages, Neumann and Wascher (2010) have presented the most comprehensive and widely accepted monograph. This book also demonstrates many well-established results on the distributional aspects of minimum wages such as “the evidence indicates that in the industrialized countries the minimum wages of the lowest-skilled workers

create a spike in the wage distribution at the minimum” (ibid, p. 115). Since then, labor economics has observed significant progress: Köppl-Turyna et al. (2019) have successfully analyzed the empirical concept of a nonlinear employment function independent of the minimum wage rate. However, the employment-maximizing minimum wage is not necessarily the one that maximizes the wage quote as long as there is no certainty about the absolute and relative impact on the price level as well as the output (both are considered determinants of the denominator in the wage quota formula).

However, Sauer (2018, p. 89) reports that “literature conveys little information about the impact the minimum wage has on macroeconomic aggregates”, e.g., the wage quota. This aspect of minimum wages is discussed later in this paper. As far as it is well known, this is the first contribution that explicitly discusses the minimum wages from the perspective of the macroeconomic distribution of incomes. This also applies to Belser (2016), who reported that the “puzzle of the labor share” (pp. 257–259) corresponds to a different section than “minimum wages, collective bargaining, and wage inequality” (pp. 253–257). This also applies to the studies that explain the impact of minimum wages on the Gini coefficient (Puente 2018), e.g., a lower (higher) Gini coefficient is compatible with numerous and different sizes of the wage quota.

3. The effect of minimum wages on the distribution of wages and salaries

In a representative economy, the density function of wages and salaries can be approximated rather accurately by using a lognormal distribution of incomes:

$$(1) \quad w = \exp(X) \text{ with } X = N(\mu, \sigma^2)$$

Then, the expected or likewise average wage rate is expressed as follows (see Beichelt and Montgomery 2003, pp. 46–48):

$$(2) \quad E(w) = w_{ar} = \exp\left(\mu + \frac{1}{2}\sigma^2\right)$$

Differentiating this expression from left to right yields

$$(3) \quad dw_{ar} = (d\mu + \sigma \cdot d\sigma) \cdot e^{(\mu+1/2\sigma^2)}$$

In the most casual case of a lognormal distribution of wages, a higher dispersion of wages increases the average wage rate, *ceteris paribus* (see Beichelt and Montgomery 2003, pp. 46–48). Lognormal distribution of wages is presented in Figure 2.

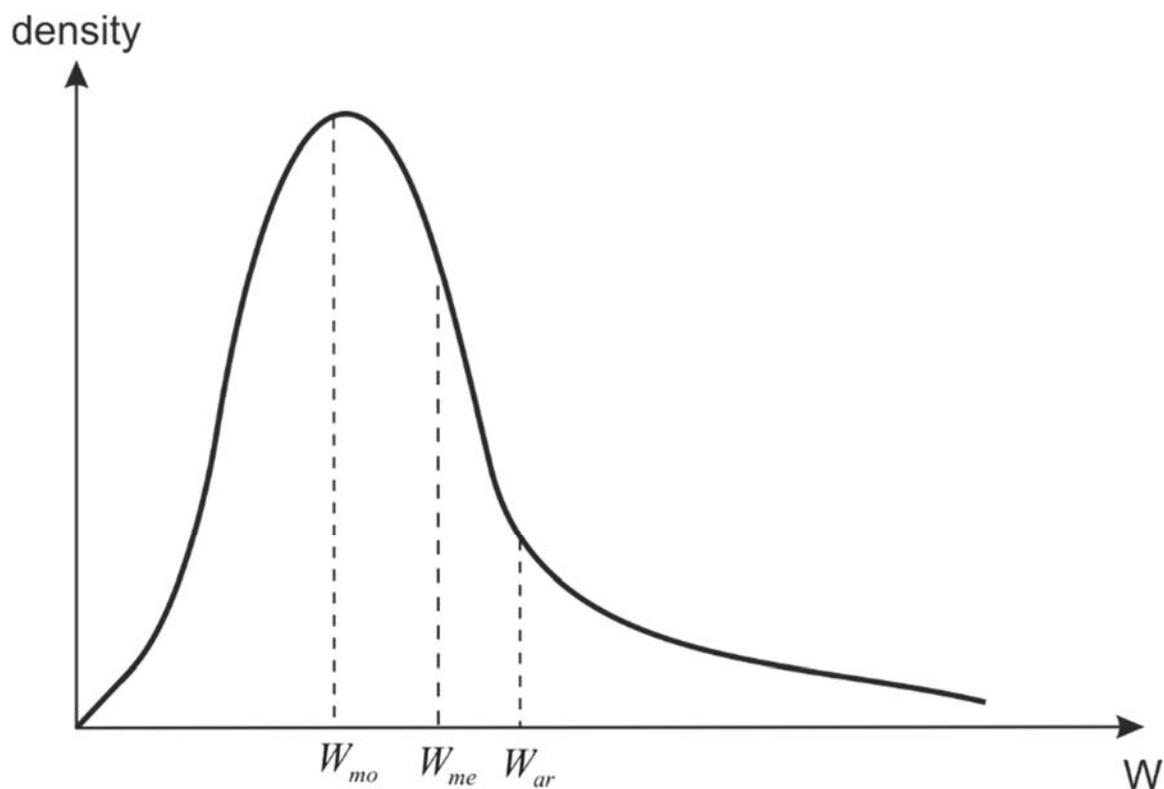


Figure 2: The log-normal distribution of wages; Source: authors

In an earlier report by Öllinger and Sell (2017), all of the most important properties of lognormal distributions of wages/salaries are analytically explained. The main results are summarized in Table 2 as follows (AWR: average age rate; MOD: modus; MED: median):

Table 2: The impact of a higher (lower) dispersion of wages on distribution parameters

σ	AWR	MOD	MED
$\sigma \uparrow$	\uparrow	\downarrow	./.
$\sigma \downarrow$	\downarrow	\uparrow	./.

Source: own compilation

Given such a distribution pattern, the statutory minimum wage rate of 8.50 € per hour, introduced in German on January 1, 2015, is used as an example in order to determine the effect of introducing minimum wages. In this case, two scenarios may emerge. The first one evenly distributes the “lost density” sort over the rest of the density function, as shown in Figure 3. On the other hand, the second one concentrates on the compensating density to the area on the right side of the minimum wage, as shown in Figure 4. This result implies that the employees earning more than the minimum wage want to maintain the same salary gap with the lower wage group which they already had before the minimum wage rate had been introduced.

In both scenarios, it is important to note that the average wage rate increases ($dw_{ar} > 0$) and the standard deviation decreases ($d\sigma < 0$). Moreover, Brown (1999, p. 2150) distinguishes five effects of minimum wages on the wage distribution (which do not contradict our own hypothesis) in detail as follows. (1) “The loss of low-wage jobs would make the measured wage distribution more equal.” (2) Some of the workers “who would otherwise earn less are now paid up to the minimum wage”—without losing their job. (3) The “wages of low-paid workers who are not covered by the minimum wage policy may be increased or reduced” (ibid): this scenario does not apply to our study as the German minimum wage is statutory and has 100% coverage. (4) Wages of workers who are paid “just above the minimum wage” may increase, as shown in Figures 3 and 4. (5) “The effects on well-paid workers are small” (ibid), if, one may say, they are discernible at all.

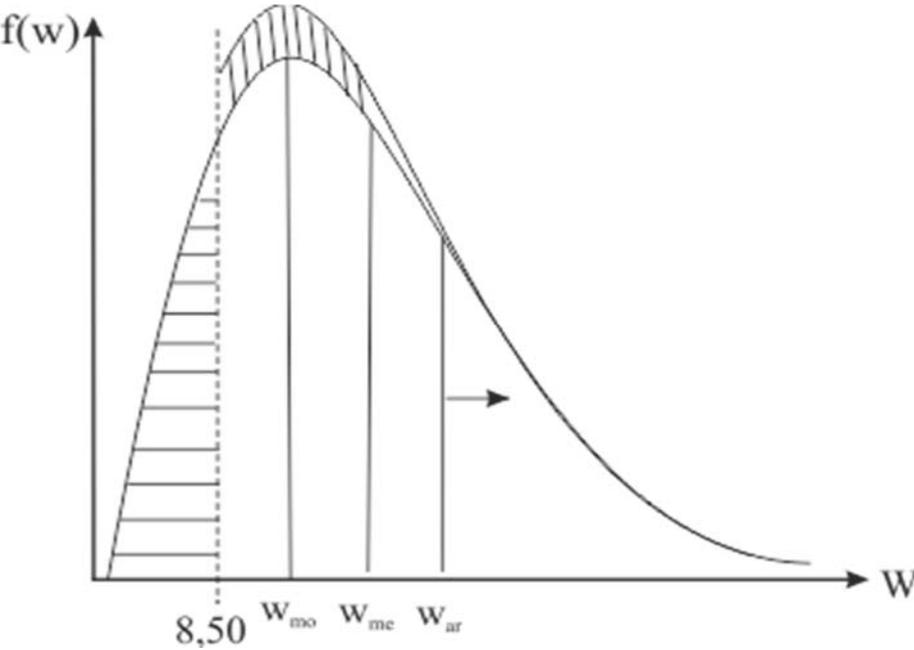


Figure 3: The subsidiary effect of a minimum wage rate, Case a. Source: authors

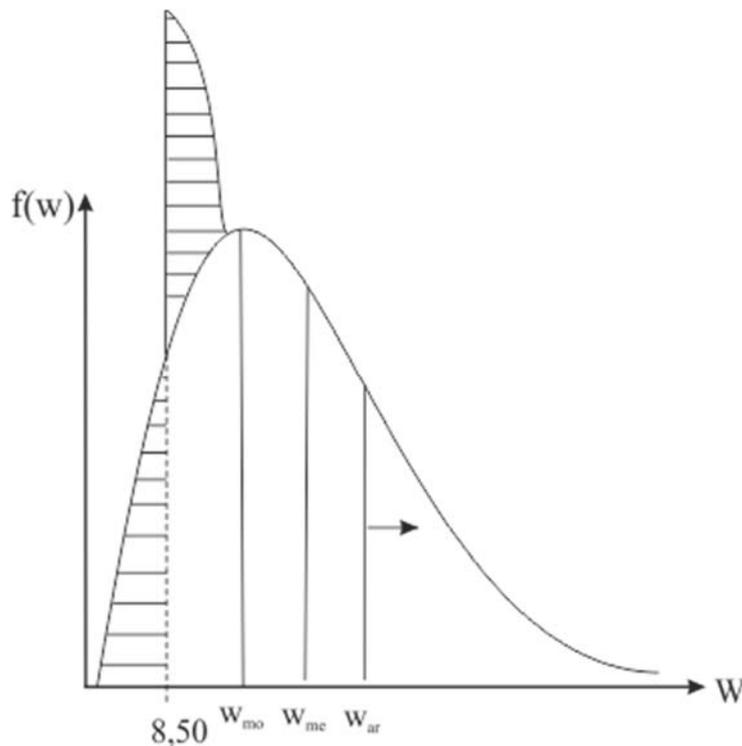


Figure 4: The subsidiary effect of a minimum wage rate. Case b. Source: authors.

These results are supported by a number of recent empirical studies. According to Bossler and Möller (2018, p. 17), “there is substantial evidence of significant positive wage and earning effects in the low tail of the wage distribution.” According to Eamets and Tiwari (2018, p. 42), “the minimum wage has exhibited substantial spillover effects on wages in the Estonian economy” and “the increases in the minimum wage has helped to minimize wage inequality and has particularly benefited low-paid workers.”

On the whole, the above discussion presents good results. However, other questions that also required to be answered are as follows. What are the other goals that are important for unions? Can the minimum wage rate increase the wage quota? In other words, can a decrease in the dispersion of wages/salaries in conjunction with an increase in the average wage rate—effects that we have shown to arise after the introduction of minimum wages—positively affect the wage quota? Let's explain these questions systematically.

4. What determines the wage sum and the total nominal income?

We proceed systematically and first investigate the likely effects on the wage sum and the nominal income. We begin our answer with the following definition:

$$(4) \quad W = w_{ar} \cdot L$$

Considering the lognormal distribution of wages and salaries, the results obtained above imply that the total wage sum is a function of the dispersion of wages (see Sell 1999, pp. 80–81):

$$(5) \quad W = W(w_{ar} \cdot L(w_{ar}, \sigma))$$

Differentiating Equation (5) from left to right yields

$$(6) \quad dW = L \cdot dw_{ar} + w_{ar} \cdot \left(\frac{\partial L}{\partial w_{ar}} dw_{ar} + \frac{\partial L}{\partial \sigma} d\sigma \right)$$

The effects of the average wage rate and the standard deviation of wages and salaries on employment are expressed in the following equations:

$$(7) \quad L = L(w_{ar}, \sigma); \text{ with } \frac{\partial L}{\partial w_{ar}} < 0 \text{ and } \frac{\partial L}{\partial \sigma} > 0$$

$$(8) \quad dL = \frac{\partial L}{\partial w_{ar}} dw_{ar} + \frac{\partial L}{\partial \sigma} d\sigma < 0 \text{ for } dw_{ar} > 0; d\sigma < 0$$

It is believed that demand for labor is the shorter market side and hence employment will decrease when average wages are increased. At the same time, it is also assumed that a higher dispersion of wages and salaries is capable to better match the distribution of talents and qualifications. This implies that a policy of unions that increases the average wage rate and at the same time decreases the dispersion of wages and salaries will reduce employment, *ceteris paribus*.

Now consider the following rather standard explanation of nominal income:

$$(9) \quad Y = P \cdot f(e \cdot L, K) \quad \text{with } e = e(w_{ar}, \sigma) \text{ and } \frac{\partial e}{\partial w_{ar}} > 0; \frac{\partial e}{\partial \sigma} > 0$$

Here, we follow the efficient wage hypothesis (effort is a positive function of the average wage rate w_{ar}), whereas we abstain from endogenizing the price level, P , i.e., production (f) is a function of effort (e) times employment (L) and of capital (K). Moreover, it is observed that the effectiveness of efficient wages is somehow reduced if all (or nearly all) companies in the economy follow this wage strategy. The positive impact of a high standard deviation of wages (σ) on effort (e) indicates a wage structure that corresponds, as good as possible, the distribution of talents and capabilities and hence helps boost the effort.

Hence, the total differentiation of the effort function yields

$$(10) \quad de = \frac{\partial e}{\partial w_{ar}} dw_{ar} + \frac{\partial e}{\partial \sigma} d\sigma$$

Moreover, the total differentiation of the nominal income yields

$$(11) \quad dY = P \cdot df + dP \cdot f$$

where

$$(12) \quad df = \frac{\partial f}{\partial eL} \cdot \left(\left(\frac{\partial e}{\partial w_{ar}} dw_{ar} + \frac{\partial e}{\partial \sigma} d\sigma \right) \cdot L \right) + \frac{\partial f}{\partial eL} \cdot \left(\left(\frac{\partial L}{\partial w_{ar}} dw_{ar} + \frac{\partial L}{\partial \sigma} d\sigma \right) \cdot e \right) + \frac{\partial f}{\partial K} dK$$

Hence,

$$(13) \quad dY = P \cdot \left(\frac{\partial f}{\partial eL} \cdot \left(\left(\frac{\partial e}{\partial w_{ar}} dw_{ar} + \frac{\partial e}{\partial \sigma} d\sigma \right) \cdot L \right) + \frac{\partial f}{\partial eL} \cdot \left(\left(\frac{\partial L}{\partial w_{ar}} dw_{ar} + \frac{\partial L}{\partial \sigma} d\sigma \right) \cdot e \right) + \frac{\partial f}{\partial K} dK \right) + dP \cdot f$$

5. How does less wage dispersion or a higher average wage rate affect the wage quota? Some simple algebraic equations

The following equation should be considered to calculate the wage quota by the unions:

$$(14) \quad \frac{W}{P \cdot f} = \frac{w_{ar} \cdot L}{P \cdot f} = \frac{W}{Y}$$

The determinants of changes in the wage quota are expressed by the total derivative as shown below:

$$(15) \quad d\left(\frac{W}{Y}\right) = \frac{dW}{Y} - \frac{W}{Y^2} dY = \frac{Y \cdot dW - W \cdot dY}{Y^2}$$

As the denominator will always be positive, the change in the wage quota depends on the following equations:

$$(16) \quad Y \cdot dW - W \cdot dY \text{ or}$$

$$(17) \quad Y \cdot \left(L \cdot dw_{ar} + w_{ar} \cdot \left(\frac{\partial L}{\partial w_{ar}} dw_{ar} + \frac{\partial L}{\partial \sigma} d\sigma \right) \right) - W \cdot \left(P \cdot \left(\frac{\partial f}{\partial eL} \cdot \left(\left(\frac{\partial e}{\partial w_{ar}} dw_{ar} + \frac{\partial e}{\partial \sigma} d\sigma \right) \cdot L \right) + \frac{\partial f}{\partial eL} \cdot \left(\left(\frac{\partial L}{\partial w_{ar}} dw_{ar} + \frac{\partial L}{\partial \sigma} d\sigma \right) \cdot e \right) + \frac{\partial f}{\partial K} dK \right) + dP \cdot f \right)$$

Rearranging the terms gives the following equation:

$$(18) \quad d\sigma \cdot \left[Y \cdot \frac{\partial L}{\partial \sigma} \cdot w_{ar} - P \cdot W \cdot \frac{\partial f}{\partial eL} \left(\frac{\partial e}{\partial \sigma} \cdot L + \frac{\partial L}{\partial \sigma} \cdot e \right) \right] + dw_{ar} \cdot \left[-W \cdot P \cdot \frac{\partial f}{\partial eL} \cdot \left(\frac{\partial e}{\partial w_{ar}} \cdot L + \frac{\partial L}{\partial w_{ar}} \cdot e \right) + Y \cdot \left(L + w_{ar} \cdot \frac{\partial L}{\partial w_{ar}} \right) \right] - W \cdot \frac{\partial f}{\partial K} \cdot P \cdot dK - W \cdot f \cdot dP$$

Hence, the change in the wage quota depends on the following factors: change in the wage dispersion, the average wage rate, the capital stock, and the price level. As can be clearly seen from Equation (18), the effects of higher capital stock and a higher price level on the wage quota are found to be negative. It is interesting to note that a rising price level will negatively compensate for the achievement of purchasing power by minimum wage legislation among the less qualified workers. This is known as the so-called *minimum wage paradox* according to Sell and Reinisch (2010), i.e., the more the minimum wages boost the total demand the stronger will be the above-mentioned effect. However, the effects of increasing wage dispersion and an increasing average wage rate exhibit ambiguous results.

With regard to wage dispersion, the terms $Y \cdot \frac{\partial L}{\partial \sigma} \cdot w_{ar}$ and $P \cdot W \cdot \frac{\partial f}{\partial eL} \left(\frac{\partial e}{\partial \sigma} \cdot L + \frac{\partial L}{\partial \sigma} \cdot e \right)$ are positive so that the associated subtraction could be positive or negative, which depends on that which term is greater. Therefore, wage dispersion could show a positive or a negative effect when the wage quota is changed. A closer look at the deciding variables makes it clear why they influence the overall effect in the respective directions. The higher the Y and w_{ar} , it is more likely that wage dispersion shows a positive effect on the wage quota. A higher value of Y implies that Y shows less potential to further increase. Therefore, the quota $\frac{W}{Y}$ as a whole is more likely to increase with a higher wage dispersion. A higher w_{ar} would potentially limit the positive effect of wage dispersion on effort by using the saturation effect, thereby decelerating the growth of Y , which in turn more likely gives a higher $\frac{W}{Y}$.

On the contrary, higher values of P , W , $\frac{\partial f}{\partial eL}$, $\frac{\partial e}{\partial \sigma}$, L , and e more likely show that wage dispersion has a negative effect when the wage quota is changed. A higher value of W implies that W shows less potential to further increase. Therefore, by using a similar argument as with regard to Y , the quota $\frac{W}{Y}$ as a whole is more likely to decrease with a higher wage dispersion. In addition, a stronger effect of $e \cdot L$ on production implies a higher growth of Y because an increase in wage dispersion boosts effort and thereby the nominal income. This in turn leads to a decrease in the quota $\frac{W}{Y}$. A higher value of L implies that an increase in wage dispersion shows less potential to further increase the labor participation rate and therefore the overall wage sum. Hence, $\frac{W}{Y}$ as a whole is less likely to increase with a higher wage dispersion. Furthermore, a stronger effect of wage dispersion on effort implies a higher production and thereby a higher nominal income, which would again decrease the quota $\frac{W}{Y}$. The influence of the price level and effort on the overall effect of wage dispersion on the wage quota remains to be discussed. In

this case, it is not possible to take into account a priori considerations without further information.

Moreover, a stronger effect of wage dispersion on labor demand, i.e., higher $\frac{\partial L}{\partial \sigma}$ shows an ambiguous effect on the mode of action of wage dispersion. This may be interpreted as the counter-rotating effect that results from the fact that the accompanied increase in labor demand increases the wage sum on the one hand, but also increases the nominal income on the other hand.

Considering the effect of an increase in the average wage rate, it is not clear whether the term $-W \cdot P \cdot \frac{\partial f}{\partial eL} \cdot \left(\frac{\partial e}{\partial w_{ar}} \cdot L + \frac{\partial L}{\partial w_{ar}} \cdot e \right)$ is positive or negative as $\frac{\partial e}{\partial w_{ar}} \cdot L$ is positive and $\frac{\partial L}{\partial w_{ar}} \cdot e$ is negative. The same applies to the term $Y \cdot \left(L + w_{ar} \cdot \frac{\partial L}{\partial w_{ar}} \right)$, where $\frac{\partial L}{\partial w_{ar}}$ is negative, while the remaining variables are positive. Moreover, the overall effect is unclear, depending on which term is greater. Altogether, the overall effect of the average wage rate on the wage quota is more likely positive as the value of e is greater. This results from the fact that higher e shows less potential for an increase in effort and hence higher Y , which in turn more likely gives higher $\frac{W}{Y}$.

On the other hand, the effect of higher average wages is more likely negative as the values of $\frac{\partial e}{\partial w_{ar}}$ and w_{ar} are greater. The former shows a stronger effect of an increase of w_{ar} on effort, which implies a higher production and hence a higher nominal income, which thus reduces $\frac{W}{Y}$. The latter shows that a higher average wage rate more likely causes a greater reduction in the labor demand, which implies the higher average wages as already shown and hence causes a lower total wage sum.

On the contrary, the impact of W , P , $\frac{\partial f}{\partial eL}$, L , Y , and $\frac{\partial L}{\partial w_{ar}}$ on the effect of an increase of w_{ar} on the wage quota shows ambiguous results. Moreover, the term $W \cdot P \cdot \frac{\partial f}{\partial eL}$ could have both a positive and a negative effect, depending on whether the value of the term $\frac{\partial e}{\partial w_{ar}} \cdot L + \frac{\partial L}{\partial w_{ar}} \cdot e$ is positive or negative. On the other hand, L , Y , and $\frac{\partial L}{\partial w_{ar}}$ affect the total equation once positively and once negatively.

6. Summary and Conclusions

In this paper, we present both clear, i.e., undisputable results, as well as less clear, i.e., ambiguous results. Moreover, it is shown that the implementation of a statutory and nationwide minimum wage, such as in Germany in 2015, increases the average wage rate and at the same time reduces the dispersion of wages and salaries. Hence, the minimum wage helps in achieving the traditional goals of unions. On the whole, the above discussion presents unambiguous results.

However, the fact that whether unions can earn a second dividend by minimum wage legislation is less clear and quite doubtful. In principle, such a second dividend depends on the possibility of raising the wage quota (to dampen the profit quota) by minimum wages. In order to evaluate this possibility, a static macroeconomic equilibrium model is set up, which primarily emphasizes on the supply-side effects of minimum wages. Not surprisingly, many differential effects and channels of influence related to minimum wages are required to be identified. Even if all mathematical derivatives follow economic inferences, the total result comes out to be ambiguous. This applies to both the nominator and the denominator of the wage quota. In order to illustrate the case for the nominator of the wage quota which is the wage sum, a higher average wage rate (pushed by minimum wage legislation) shows an ambiguous effect on the wage sum. On the one hand, it directly increases the wage sum by the wage factor. On the other hand, it decreases the wage sum by minimizing labor demand and hence reducing the nominator of the wage quota. Moreover, many additional effects that are well known in labor market economics further complicate the results.

Finally, it may be concluded that unions might not have a double dividend when policymakers are invited to follow the policy of minimum wages. On the one hand, both the average wage rate can be increased and the dispersion of wages can be decreased at the firm as well as the industry level, *ceteris paribus*. However, reducing the dispersion of wages and increasing the average wage rate at the same time do not help in increasing the overall wage quota in order to obtain better results.

In this contribution, it is important to note that we have primarily emphasized the effects that wages have on the wage quota, which are well established in the supply side of the economy. Moreover, minimum wages also exhibit their impact on the determinants of overall demand such as consumption, investment, government expenditures, and net exports, but they show ambiguous results with a positive as well as a negative sign. On the one hand, employees who retained their job after the introduction or increase of the minimum wage may receive more remuneration than that they were paid before. On the other hand, former employees who lost jobs because of the introduction or increase of the minimum wage may receive less remuneration than that they were paid before.

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