# Implications of Schedule Irregularity as a Minimum Wage Response Margin

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***Abstract:*** *Empirical research on minimum wages has historically focused on employment effects, with the implicit assumption that workers who remain employed under a minimum wage regime are better off. This paper develops a simple model and a stylized example to highlight the importance of an underappreciated margin: how a minimum wage might affect the regularity of workers' schedules. Our analysis illustrates a novel line of intuition for how a minimum wage can reduce welfare even if, as in our example, it increases wages, productivity, and output, without decreasing employment.*

**Key Words:** Minimum Wages; Amenities; Productivity

**JEL Codes:** J2; J3

## I. Introduction

There is growing evidence that non-wage attributes play a central role in determining workers' valuations of jobs (Sorkin, 2018). Papers by He, Neumark, and Weng (2018) and by Mas and Pallais (2017), for example, provide experimental evidence on how workers value the structure of their schedules, which is our primary margin of interest. Empirical research studying the effects of minimum wages on non-wage job attributes has not addressed such margins. Until very recently, this research has

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focused on compensation in the form of fringe benefits (Kaestner and Simon, 2004; Clemens, Kahn, and Meer, 2018; Marks, 2011).

Two empirical papers have recently addressed the question of whether minimum wages affect productivity through an effort margin. In distinct contexts, Coviello et al (2018) and Ku (2018) find that workers' effort rises in response to binding minimum wage increases. The primary mechanism, in both cases, is an increased risk of job loss among affected workers.

Effects of minimum wages on effort can be connected to classic "efficiency wage" models (Shapiro and Stiglitz, 1984; Akerlof, 1984; Rebitzer and Taylor, 2015). A key feature of these models is that worker effort is endogenous to wages. Monitoring frictions can lead to effort levels that are lower than might be socially efficient.

In contrast with this implication of efficiency wages, we highlight that increases in productivity driven by the minimum wage can be inefficient. Their implications for social welfare may thus be negative. Further, the novel mechanism we emphasize is likely quite relevant to real-world labor markets.

In what follows, we present a simple model and a stylized example to demonstrate that the welfare implications of a minimum wage change cannot be inferred from data on its effects on wage rates, productivity, employment, and total hours alone. Importantly, the example we sketch is realistic. Our results can be interpreted as a "proof of concept" that simple adjustments to workers' schedules can be important for assessing a minimum wage increase's effects on workers' welfare.

## II. A Simple Model

Assume that a single worker negotiates with a set of potential employers over both a wage and the way his job is structured — e.g., the pace of work or the degree to which his schedule is regular. Different scheduling regimes correspond to different levels of "effort." In what follows, we consider a

particular type of effort that generates what we refer to as a "productive disamenity" from the job. Specifically, productive disamenities are effort-increasing features of the structure of a job that generate higher levels of output from workers, but are unpleasant for them. For example, they might make time at work more mentally or physically taxing, involve higher risk of injury, or be less convenient for the worker.

By way of notation, let output per hour, a, be an increasing and concave function of the productive disamenities, a(e) with $a' > 0$ and $a'' < 0$. Let the disutility of work be an increasing and convex function of those disamenities, v(e) with $v' > 0$ and $v'' > 0$. The firm's profit is $\pi = p \times a(e) - w$, where p is the exogenous price of the firm's output. Let the worker's utility be linear in the wage and decreasing in the disamenity, or $u = w - v(e)$. For simplicity, let the utility of the firm's owner be linear in profit. Surplus generated by the employment arrangement can be described by $p \times a(e) - w + w - v(e) = p \times a(e) - v(e)$.

The surplus maximizing level of disamenity is the $e^*$ such that $p \times a'(e^*) = v'(e^*)$. Because firms must compete for workers, the equilibrium is for firms to choose this $e^*$ and pay the worker the full value of her output, which results in zero profit. Firms that pay less will lose workers to other firms offering (still profitable) wages closer to, but not greater than, $p \times a(e^*)$. Firms that pay more will have negative profits. So long as $p \times a(e^*) - v(e^*)$ exceeds the value of the worker's non-work option, the worker will be employed.

Suppose now that the government introduces a minimum wage that exceeds $p \times a(e^*)$. The wage associated with the surplus maximizing disamenity level is now illegal. This need not result in a loss of employment, however, as a higher disamenity requirement can bring $p \times a(e)$ in line with the new wage requirement. Let the required disamenity level be $e^{min} > e^*$. Now note that $e^{min}$ is necessarily such that $p \times a(e^*) - v(e^*) > p \times a(e^{min}) - v(e^{min})$. The new equilibrium thus has the following properties of interest:

- Employment is unchanged so long as $p \times a(e^{min}) - v(e^{min})$ exceeds the value of the worker's non-work option.
- Productivity and output increase.
- The worker's utility is unambiguously reduced.

This is a striking set of implications with respect to conventional wisdom surrounding minimum wage analyses. It is often simply assumed that productivity increases are a desirable potential effect of minimum wages. More importantly, their welfare effects are almost universally assumed to be positive if they result in wage increases in the absence of statistically detectable employment declines.

Note that a fuller description of the labor market would introduce heterogeneity across workers in the valuation they place on the non-work option. If some workers are initially on the margin between work and non-work, then a minimum wage increase can lead them to exit the labor market by distorting their employment arrangements. The key point is that the effort margin's presence will tend to blunt the effect of a minimum wage increase on employment.

## III. A Stylized Example

How might this work in the real world? This section offers a stylized, realistic example showing how a minimum wage could increase output, productivity, and wages, while also lowering worker utility by leading firms to change the way workers' jobs are structured.

Suppose that a restaurant faces the question of how many workers it needs for each of several shifts. The key feature of demand for the business's output is that it is stochastic. That is, during some shifts demand is "high" and during others it is "low" or "intermediate." An event in the establishment's neighborhood might result in an evening of high demand, for example, while an event elsewhere might

result in low demand. The key assumption is that the manager does not know with certainty what demand will look like in advance of a shift.

Table 1 presents a numerical example that describes the potential output of the 1st, 2nd, and 3rd workers during high, intermediate, and low demand shifts. There is high output associated with all three workers when demand is high, with two workers when demand is intermediate, and with one worker when demand is low. We assume that the firm, in all cases, has a fixed cost equivalent to $20 per shift.

**Table 1: Hypothethetical Example Illustrating the Effects of Irregular Work Schedules on Revenue and Worker Utility**

| | | Number of Workers | | | Number of Workers | | |
|---|---|---|---|---|---|---|---|
| | | **1** | **2** | **3** | **1** | **2** | **3** |
| **Demand** | **Probability** | **Marginal Product** | | | **Total Output Net of Fixed Cost of 20** | | |
| High | 0.3 | 30 | 28 | 26 | 10 | 38 | 64 |
| Int. | 0.4 | 28 | 26 | 4 | 8 | 34 | 38 |
| Low | 0.3 | 26 | 8 | 2 | 6 | 14 | 16 |

**Scheduling Regimes**

| **Regular (Two On All Shifts)** | | **Irregular (Employer Driven)** | |
|---|---|---|---|
| **Output Net of Fixed Costs** | | | |
| **Total** | **Per Worker** | **Total** | **Per Worker** |
| 29.2 | 14.6 | 34.6 | 17.3 |

**Disutility from Work**

| | | | |
|---|---|---|---|
| **Fixed Schedule** | 5 | **Emp. Driven** | 10 |

**Worker's Net Utility If Pay Equals Net Revenue Per Worker**

| | | | |
|---|---|---|---|
| **Fixed Schedule** | 9.6 | **Emp. Driven** | 7.3 |

Workers can be scheduled either on regular shifts or irregular "employer-driven" shifts. If the employer must commit to shift size in advance, the example is structured such that two workers will be scheduled for each shift. Averaged across all shifts, expected output net of fixed costs is 29.2, or 14.6 per worker. Expected output could be increased through irregular shifts. Specifically, during high demand shifts an extra worker could be called up while during low demand shifts a worker could be sent home. Under these "irregular" shifts, expected output is 34.6, or 17.3 per worker.

Predictable, regular schedules can have value to workers. Key aspects of workers' lives, including childcare and social engagements, often require advance scheduling. Irregular call-ups make scheduling other aspects of life difficult. While intuitively obvious, it is worth noting this assumption finds validation in some of the empirical research discussed above. We thus assume that disutility from work is larger when shifts are on call, at the behest of the employer. Specifically, we assume the utility cost of effort is equivalent to $5 per shift with fixed schedules and $10 with irregular schedules. If this differential cost is less than the gain in per worker output that comes from employer-driven shifts, regular shifts are surplus maximizing.

Absent a minimum wage, an equilibrium in this example is for the firm to hire workers on regular shifts and pay them $14.60 per shift. The firm's profit is 0 and each worker's utility is 9.6. Now note that a minimum wage of $15 per shift renders this equilibrium illegal. Further, if the firm pays $15 per shift and leave workers' schedules the same, it would incur losses. Zero profit can be restored, however, by adopting irregular shifts. Under irregular shifts, firms have zero profit when paying a wage of $17.30 per shift. Crucially, each worker's utility is reduced by this change. No firm would adopt this arrangement in the absence of the regulation, because their workers would be poached by firms offering regular schedules and a wage of $14.60. Our example thus illustrates the more general implications of the simple model from the previous section.

Data from the American Time Use Survey (ATUS) provide evidence that employer-driven schedules are empirically relevant. In 2017 and 2018, the ATUS asked workers with irregular schedules a question that sheds light on whether their schedules are driven by their preferences or the preferences of their employers. In these data, we find that roughly 20 percent of workers in low-wage occupations have irregular schedules. Among these workers, just over half have irregular schedules that are driven by their employers. Among these individuals, we observe that employer-driven schedules are modestly more likely in states with high minimum wages than in states with low minimum wages. Finally, we

highlight that in a longer panel of data we see evidence that more basic aspects of workers' schedules are quite strongly correlated with changes in minimum wage rates. Specifically, we see that the last decade's minimum wage changes quite strongly predict declines in workers' time spent at work in data from both the ATUS and the Current Population Survey.

Data from the ATUS and CPS provide evidence that is consistent with the view that minimum wage increases affect worker schedules. Further, the issue of schedule regularity has grown in prominence in recent years. So-called "fair workweek laws" and "predictive scheduling laws" are hotly debated in U.S. governments at all levels. As more data become available, economists will be able to study this link in greater depth.

## IV. Conclusion

Minimum wages can affect more than the level of employment. They can also affect the way jobs are structured. Under realistic scenarios, minimum wages can lower worker welfare, even when they increase wages, productivity, and output, without decreasing employment. Our simple model and stylized example demonstrate that this collection of effects is quite plausible. Further research is needed to quantify this margin of adjustment's empirical relevance.

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