Minimum Wage and Real Efforts

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June 2021

PRELIMINARY DRAFT

1 Introduction

Effects of minimum wage policy on the labor market have long been of interest to economists. The standard neoclassical theory treats binding minimum wages as price floors, with minimum wage increases leading to inefficiencies in the form of excess supply of labor, and therefore unemployment. This unemployment can be at the extensive margin (i.e, a reduction in the number of employed workers), or on the intensive margin (i.e, a reduction in the number of labor hours demanded by a firm from its existing pool of employees). This result crucially depends on the assumption of perfectly competitive labor markets. Manning [2011] posits that minimum wage increases can actually lead to increases in employment when the labor market is monopsonistic. A large body of empirical work [Card and Krueger, 1993, Dube et al., 2010, Cengiz et al., 2019] has contributed to this debate, and neither hypothesis is conclusively proven or rejected, though the evidence so far does lie in favor of minimum wage increases not having the effects that are predicted by the classical model.

On the labor supply side, the consequences of minimum wage increases may be more ambiguous. In the classical model, wage increases increase labor supply as long as the

substitution effect of increasing hours worked dominates the income effect of having gained higher wages. In the context of minimum wages, this ambiguity is somewhat vestigial, since one typically does not expect minimum-wage workers to be on the backward-bending part of their labor supply curve. The efficiency wage hypothesis suggests that workers earning more than the expected market wage (which would happen in the context of a binding minimum wage), would contribute more hours worked on account of the difference between their expected wage (or reservation wage) and their earned wage [Akerlof, 1982, 1984, Akerlof and Yellen, 1990, Fehr et al., 1993]. This is in contradiction to a standard principal-agent wage setting model, wherein the employer offers an employee their minimal acceptable wage, and the employee exerts minimal required effort. [Akerlof, 1982] refers to this departure from the theoretical prediction through the mechanism of reciprocity- employers paying more than expected wage and employees exerting more than expected effort- as the gift exchange mechanism.

In this paper, we attempt to study how the gift exchange mechanism can interact with minimum wage policies. A binding minimum wage policy can induce an employee to exert greater effort, by the efficiency wage hypothesis. However, a minimum wage policy could also have the impact of increasing a worker's expected or reservation wages, as demonstrated by Falk et al. [2006]. The aggregate effect would therefore be determined by the degree to which one mechanism outweighs the other. To explore this question further, we propose a simple model of gift exchange induced by repeated interactions between employer and employee, wherein increases in the minimum wage are an exogenous shock to the employee's reservation wage. We find a set of testable predictions regarding the two mechanisms from this model. Furthermore, we design a laboratory experiment to empirically verify the predictions of the model. Our experiment consists of two parts. First, employers and employees are randomly matched to each other in each

round. In this case, there is no opportunity to build reputations[1]. Second, employers and employees are matched randomly only once throughout the session. We try to induce the gift exchange and see how workers' efforts change while in a long-term relationship with firms.

There are several advantages of using laboratory experiments in studying the economic effects of labor market institutions. Firstly, in all experiments, institutions are exogenously changed under a controlled environment. This makes it possible to observe a labor market before the minimum wage is introduced, and after it has been imposed exogenously, holding everything else constant. Additionally, it allows us to test the effect of the removal of a minimum wage policy. Secondly, lab experiments provide a unique opportunity to observe some hidden behaviors, such as individual's reservation wage; and spite and sabotage to unfairness.

This paper would broadly contribute to two strands of literature. First, while there are several experimental papers that study gift exchange [Fehr et al., 1993, Rigdon, 2002, Hannan et al., 2002, Abeler et al., 2011], and experimental papers that study minimum wage policies as experimental treatments [Falk et al., 2006, Falk and Huffman, 2007, Brink et al., 2021], we believe we are the first to study experimental gift exchange environments with minimum wage policy treatments. This is an important question since it has implications regarding the welfare effects of minimum wage policies. Secondly, we contribute to experimental literature on using real effort tasks [Benndorf et al., 2004, Charness et al., 2018], and specifically to a relatively unexplored area of real effort tasks in gift exchange setups [Gneezy and List, 2006, Brüggen and Strobel, 2007].

[1]In this respect, our results try to replicate those reported by Ernst Fehr and his colleagues (Fehr, Kirchsteiger, and Riedl 1993; Fehr, Kirchler, Weichbold, and Gachter 1998) and Hannan and coauthors (2002) in a series of experiments. If "requested effort level" along with the wage offer, then the reference will be posting nonbinding effort requests increases workers' overall effort level (Fehr, Kirchsteiger, and Riedl 1996; Fehr and Gachter 1998; Hannan, Kagel, and Moser, 2002)

The remainder of this manuscript is organized as follows. In Section 2 we describe a theoretical anchor for our experiment and derive a set of testable predictions. In Section 3, we discuss the experiment design and the hypotheses we are testing. In Section 4 we discuss the preliminary results we get from two pilot studies. Section 5 describes the issues uncovered in the pilot studies and outlines the next steps.

2 Model for Gift Exchange and Minimum Wage

2.1 Neo-Classical Benchmark

We model a simple principal-agent setup, with an employer making a wage offer to an employee, and the employee choosing the amount of effort she puts into a task. The employer cannot enforce any desired level of effort from the employee. The timing of events involves the employer first making a wage offer to the employee, which the employee may accept or reject. If the employee rejects, both players get a payoff of 0. If the employee accepts the offer, she gets the wage offered by the employer, and exerts a costly effort, the amount of which is chosen by her and cannot be enforced by the employer.

This setup can be solved by backwards induction. Formally, the employee's problem is:

$$\max_{e} \; w - c(e), \text{ subject to } e \geq \underline{e} \tag{1}$$

with $c(.)$ being an increasing and convex function denoting the cost of effort for the employee. This problem has a trivial solution of chosen effort $e^* = \underline{e}$, i.e the employee will always exert minimal effort. Knowing this, the employer incorporates this in their problem:

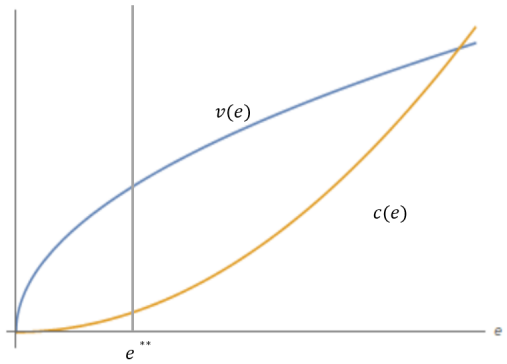
$$\max_{w} \; v(e^*) - w, \text{ subject to } w \geq \underline{w} \text{ and } e^* = \underline{e} \tag{2}$$

where $\underline{w}$ is the minimal acceptable wage offer for the employee (and hence the participation constraint faced by the employer), and $v(.)$ is an increasing and concave function of effort. This, too, has a trivial solution of $w^* = \underline{w}$. Therefore, the sub-game perfect Nash equilibrium for this game involves the employer offering to an employee her minimal acceptable wage, and the employee choosing the minimal required amount of effort.

2.2 Optimal Effort and Gift Exchange

The socially optimal level of effort is obtained by maximizing the social planner's objective function, as given below:

$$\max_{e} \; v(e) - c(e) \tag{3}$$



The socially optimal level of effort e^{**} is given by $v'(e^{**}) = c'(e^{**})$. We assume that that employee's minimal effort $\underline{e} < e^{**}$, and is therefore sub-optimal from the perspective of the social planner.

This framework can be thought of as a sub-optimal Nash equilibrium in a Prisoner's Dilemma setup, with the employer offering the employee her minimal acceptable wage $\underline{w}$, and the employee offering minimum required effort $\underline{e}$ as dominant strategies. A gift exchange setup can be thought of as a tit-for-tat equilibrium in a repeated version of this game, where the employer's actions involve offering a wage w^{**} (cooperate), or offering minimal acceptable wage $\underline{w}$ (defect), and the employee's actions involve offering socially optimal effort e^{**} (cooperate), or offering minimal effort $\underline{e}$ (defect). The Folk Theorem tells us that a tit-for-tat equilibrium, which involves both players starting with the cooperate strategy and then following each other's moves, can exist for a repeated version of this game[2]. For the tit-for-tat equilibrium to sustain itself, an optimal wage w^{**} is characterized by the following bounds:

$$c(e^{**}) - c(\underline{e}) + \delta\underline{w} \leq w^{**} \leq \delta\left(v(e^{**}) - v(\underline{e})\right) + \underline{w} \tag{4}$$

Here, δ is the discount factor for employer and employee for payoffs from each subsequent stage of the game. It is clearly observable that any increase in $\underline{w}$ (which would happen with the implementation of a minimum wage) would therefore require the employer to increase w^{**} in a manner that the lower bound on w^{**} is maintained.

2.3 Extending to the Experiment

While the model gives us a fairly clean set of testable predictions (formally stated in Section 3.4), it is not an entirely accurate representation of our experiment design. There are two crucial differences. Firstly, the model assumes an infinite number of interactions between the same employer and employee. In our experiment, we have a portion of the subject pool wherein employers and employees are randomly matched in each round. We do this to check for whether a gift exchange environment materializes as a other-

[2]Tit for Tat isn't sub-game perfect; the strategy is not optimal off the equilibrium path

regarding behavioral response, and not as an incentivized response. Furthermore, the experiment involves a finite number of rounds. While this changes the theoretical prediction for the sub-game perfect Nash equilibrium, we expect the experimental environment to mimic the infinite round case more closely, since we do not expect our subjects to be as forward-looking as is necessary to induce the finite-round subgame perfect Nash equilibrium. Secondly, we assume an increasing and convex cost of effort function in the model. While this would be reasonably straightforward to replicate in a chosen effort experiment, it would be fatuous to assume so in a real effort experiment, Indeed, inferring implied costs of effort from subjects' effort choices, and relating that to potential departures from theoretical predictions would be one of the novelties of using real effort tasks for this experiment.

3 Experimental Design

3.1 The Word Encoding Task

Our experiment is designed to create an environment that allows us to induce a gift-exchange mechanism with a real effort task. In the experiment, workers perform a word encoding task. For each task, all 26 letters of the alphabet are randomly assigned a three-digit number and displayed in a shuffled order in an encryption table. Subjects will be given fifteen randomly chosen letters and they need to find the corresponding three-digit number for as many letters as they can from the encryption table. The effort is measured by the number of letters subjects correctly encode in a given amount of time (forty seconds). The encryption table is made non-selectable so that they need to manually enter the numbers instead of copying and pasting. We choose this task since it did not require any prior knowledge, the effort is easily measurable and the task is tedious so that it entails a positive cost to the subjects and the output is meaningless to the experimenter.

3.2 Experimental Game

In each experiment session, we recruit 24 subjects. Subjects are randomly divided into two different groups: workers and employers. Each worker is randomly matched with an employer at the beginning of the experiment. They can only conclude a contract with their matched pair. Employers have identical revenue functions, which are increasing in workers' efforts. To hire a worker, the employer can submit a wage offer w to the matched worker. Workers only know whether if they receive a wage offer.

Simultaneously, the worker sets her minimal acceptable wage $\underline{w}$, which is the lowest wage she is willing to accept, before observing the wage offer from the employer. This method is used to elicit worker's underlying wage expectations. This is an important variable in the context of our model since we are interested in the change in effort level when the wage offer was higher than expected.

If the actual wage offer from the employer is greater than or equal to the minimal acceptable wage of the worker (i.e. $w \geq \underline{w}$), then the worker is hired and both the worker and the employer are directed to the real effort task stage. Workers perform the word encoding task for 40 seconds. After the task is over, they are directed to a screen that shows the payoff; the worker receives w, and the employer observes the worker's effort and receives the payoff according to the revenue function below. If the actual wage offer was lower than the minimal acceptable wage (i.e. $w < \underline{w}$), the worker and employer both get 0 payoff.

$$\Pi_{Firm} = \begin{cases} 0, & \text{if no worker is employed} \\ 100 + 30e - w, & \text{if the worker is employed and input efforts e} \end{cases}$$

$$\Pi_{Worker} = \begin{cases} 0, & \text{if} \quad w < \underline{w} \\ w, & \text{if} \quad w \geq \underline{w} \end{cases}$$

Both the workers' and employers' payoff functions are common knowledge among the subjects. Employers are informed of both their and workers' payoffs but workers are only informed about their payoffs. The round is repeated for 20 rounds and the information of the full history of the worker's effort and the wage offer is presented on both the employer's and the worker's screen.

3.3 Treatments and Sequences

We aim to study the economic effects of implementing or removing a minimum wage policy on effort provision and wage offers. Each session contains two treatments. One is a treatment without a minimum wage (NO) and one with a minimum wage (MW). In any session, both treatments are played for ten rounds. In minimum wage treatment, the minimum wage is set at 220; i.e. employers cannot offer wages lower than 220 in MW treatment. We also implement two different treatment sequences to study the order effects. In the IMPLEMENT sequence, subjects first start with 10 rounds of NO and then 10 more rounds of MW. The order of the treatments is reversed in the REMOVAL sequence.

3.4 Hypotheses

Hypothesis 1. *Worker's effort is increasing in the difference between wage offer and minimal acceptable wage.*

Hypothesis 2. *The implementation of minimum wage policy will lead to a higher minimal acceptable wage.*

Hypothesis 3. *The wage offer should increase so as to maintain optimal efforts in response to higher minimal acceptable wage with the implementation of minimum wage policy.*

4 Preliminary Results from Pilot

4.1 Wage and Reservation Wages with Removal and Implementation of Minimum Wage Policy

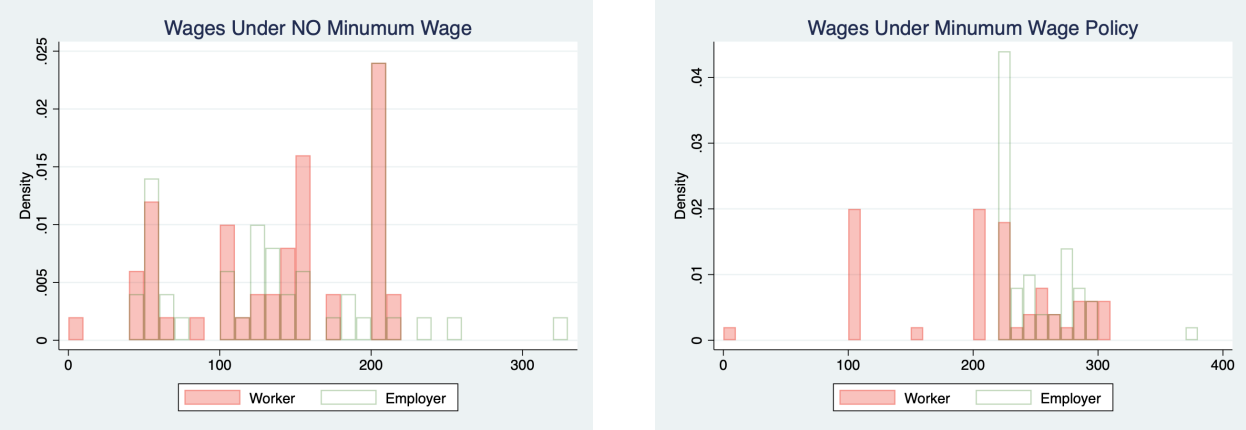


Figure 1: IMPLEMENT Sequence Pilot

Figure 1 presents the histogram of the wage offer and the minimal acceptable wage in the pilot session of the IMPLEMENT sequence. Under NO, the wage offers and the minimal acceptable wages are dispersed across zero to 300. When the minimum wage policy is imposed (MW), wage offers increase to the level above 220 (legally binding) and also the minimal acceptable wages also gather above 200 level. We can see workers adjusting their minimal acceptable wage according to the minimum wage policy even though the payoff for the unemployment hasn't changed.

Figure 2: Removal Sequence Pilot

Figure 2 presents the histogram of the wage offer and the minimal acceptable wage in the pilot session of the REMOVAL sequence. The results show that under MW, wage offers and the minimal acceptable wages are all gathered around 250. When the policy is removed (NO), unlike the result from Figure 1, workers and employers tend not to lower their minimal acceptable wages and wage offers. It seems that the minimum wage policy is setting the subjects a standard for the wage and this is hard to be lowered even after the removal of the policy.

5 Conclusion and Next Steps

In this paper, we try to test out the effect of minimum wage on worker's real efforts in a laboratory setting. We have run two pilot sessions and reported the results in Section 4 However, due to the technical issue we encountered and that the total number of effort tasks has an upper limit, the results at this stage are not very conclusive. We are working on increasing the quantity or difficulty of the effort tasks. Furthermore, we try to seek a more appropriate revenue function. As described in the experimental design section, we also plan on doing some sessions for random matching in each round and see if the same results persist without a long-term relationship between employers and employees.

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