Worker History and Labor Markets: The Role of Costly Information

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Abstract

To make an appropriate wage offer, employers need to know an employee's work history. Existing experimental literature in agency theory provides employers with their employees' work records at no cost. I extend this research by placing a price on the information to develop a more realistic case. Through experimental evidence, I find employers absorb the cost of obtaining history, and do not shift the burden of the fee onto the employees in the form of lower wages. If employers have access to employees' history, they offer wages that are positively correlated with the employees' work ethic. However, when they are not presented with a history, the employers base wages on their own experiences.

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1 Introduction

Before an employer offers a job to a potential employee, he attempts to obtain information about the candidate. This could involve requesting reference letters, conducting background checks, or administering tests during an interview. With the acquired information, an employer can infer the level of work the employee is willing to provide and offer an appropriate wage.

This paper describes a laboratory experiment to study the role of information about workers' past employment history in wage determination. Past experimental research has treated the work history of employees as an exogenous variable, providing the material to employers at no cost. I construct an experiment which makes employee work history (consisting of past wages and effort levels) endogenous by giving employers the option of paying to receive such information, in order to build a more realistic case. Information rarely comes at no cost, and subjects can choose the price to pay for the amount of information they wish to receive. The aim of this study is to determine when employers will choose to pay to receive their employee's work history, how employee effort will change with the availability of costly employment information, and how employers choose wages when the employee's history is not available. Furthermore, this experiment also asks whether social efficiency is higher under costly or costless history.

The existing labor market experimental literature gathered that regardless of the clarity of the employee's past effort, the threat of knowledge will benefit both employees and employers. However, these results operate under the assumption that information is freely available. Letting the information be accessible only at a cost, a narrative closer to realism, may modify these results.

Bartling, Fehr, and Schmidt (2012) and Douthit, Kearney, and Stevens (2012) both offer costless screening to employers, the latter with noise and the former without. Bartling, Fehr, and Schmidt (2012) question when it is profitable to offer high discretion jobs (higher wages, less monitoring). Through an experiment that offered perfect information of an employee's history at no cost, it was discovered that high-paying, high-discretion jobs are only profitable if employees can be screened. The introduction of screening generates incentives for the employees to increase effort in order to improve their reputations, leading to a higher salary.

Douthit, Kearney, and Stevens (2012) consider cheap talk. In a repeating single-period experimental setting where production is observable but is a noisy indicator of effort, communication of a promised level of effort results in higher pay for the agent, higher effort, and higher expected profit for the principal than the control group with no communication. When the principal and agent interact over multiple periods, reputation building is ineffective, but cheap talk continues to yield superior outcomes. The results of the above two experimental papers support the principal-agent model in Stevens and Thevaranjan (2010), which incorporates some level of moral sensitivity on the part of the agent that allows the principal to rely on a previously agreed-upon level of effort.

Similar experimental research on the inclusion of the history of players has been conducted for other settings, most commonly the prisoner's dilemma. Duffy and Ochs' (2008) experiment shows that cooperation only appears in fixed-pairing treatments; in random-matching treatments a cooperative norm does not form. Duffy, Xie, and Lee (2013) corroborate the conclusion that history influences cooperation, finding that cooperation is more prominent with a longer available history. Camera and Casari's (2009) experimental results deduce that collaboration in an anonymous environment can be increased with monitoring and punishment. Therefore, regardless of the setting studied (simultaneous or sequential, prisoner's dilemma or principal-agent), contribution increases with monitoring.

The findings of this experiment, which determine the way the cost of information impacts cooperation and profits, are relevant for public policy. If costless information results in the highest productivity, then it would be profitable for an institution, like the government or a private firm, to subsidize the distribution of employment history to decrease the individual cost all employers currently have to pay when searching for new workers.

The paper is organized as follows. A theoretical model is presented in Section 2. Section 3 describes the experimental set-up, followed by its hypotheses in Section 4. The analysis of the data is provided in Section 5. Section 6 concludes.

2 Model

In this standard moral hazard scenario, there are two types of players: employees and employers. An employer can offer two types of wages, ($\underline{w}$ and $\bar{w}$, where $\underline{w} < \bar{w}$) and an employee can exert two levels of effort ($\underline{e}$ and $\bar{e}$).

In each period, the utility functions take the following form:

$$u_{employer} = K + B(e) - w - s\mathbb{1}_{\text{CostlyHist}}$$
$$u_{employee} = w - c(e).$$

K is the endowment an employer receives at the beginning of each period. A wage offer to the employee cannot exceed the endowment. $B(e)$ is a concave revenue function of the employer, which is based on the employee's effort level. The employee history is costly only in one treatment (CostlyHist), where it is denoted by the exogenous variable s. $c(e)$ is a convex cost function an agent faces with a chosen effort level.

The game consists of m players, who are randomly and anonymously rematched in every period.[1] Subjects complete a total of n periods. The total utility received by the players is the sum of their payoffs from n periods:

$$U_{employer} = \textstyle\sum_{i=1}^{n}(K + B(e_i) - w_i - s\mathbb{1}_{\text{CostlyHist}})$$
$$U_{employee} = \textstyle\sum_{i=1}^{n}(w_i - c(e_i)).$$

Table 1 displays the payoff matrix for one period of the binary game.

[1]In order to simulate an interaction with a new opponent, players are randomly assigned to a new pair. The identity of the new match is kept anonymous, to eliminate any bias unrelated to the information provided in the game.

Table 1: Payoff Matrix

		Employer: $\bar{w}$	Employer: $\underline{w}$
	$\bar{e}$	$K+B(\bar{e})-\bar{w}-s\mathbb{1}_{\text{CostlyHist}}$ $\bar{w}-c(\bar{e})$	$K+B(\bar{e})-\underline{w}-s\mathbb{1}_{\text{CostlyHist}}$ $\underline{w}-c(\bar{e})$
Employee	$\underline{e}$	$K+B(\underline{e})-\bar{w}-s\mathbb{1}_{\text{CostlyHist}}$ $\bar{w}-c(\underline{e})$	$K+B(\underline{e})-\underline{w}-s\mathbb{1}_{\text{CostlyHist}}$ $\underline{w}-c(\underline{e})$

Both the employer and employee can choose which level of wage and effort to employ in this sequential-move game. Each period consists of the following stages. In the first stage (which only applies to the treatment with costly history), the employer chooses whether to pay to obtain an employee's work history (which consists of the employee's past effort and wages). In stage 2, the employer offers a wage. The employee will learn the wage offer, and in the third stage choose an effort level based on the provided information. Lastly, both sides are shown their payoffs for the period. In this binary scenario, the model reduces to a sequential Prisoner's Dilemma.

2.1 Finite Game

I will first examine a finite game. In a one period game, the bottom right cell $(\underline{e}, \underline{w})$ is the Nash Equilibrium. Both parties will enjoy higher profits if they play the top left strategy $(\bar{e}, \bar{w})$, but by backwards induction, that allocation cannot be obtained by rational players, because each player can benefit from a unilateral deviation to lower inputs.

Next, consider a finite, two-period game where players are matched with new partners after each period. The equilibrium in the two-period game has the stage game Nash equilibrium repeated in each period. Rational players will use backwards induction and will select the $(\underline{e}, \underline{w})$ equilibrium. I will explain the reasoning under different treatments.

Consider three scenarios with the following variable: the employer is offered no employment history of the employee, the employer is able to observe the employee's history at no cost, and the employee's history can be viewed at a cost. If the employer is provided with no employee history, a backwards induction solution is to for the participants to choose $(\underline{e}, \underline{w})$

in every period, since every period can be thought of as a one-shot game.

A scenario with costless history yields the same result. In the second stage of the second period, the employee will always select low effort; there is no punishment for not contributing the higher effort. Knowing this, the employer will offer a low wage in the first stage of period two. This is the optimal solution despite the employee's choice of effort in the first period. If the employee knows his goodwill gesture of a high effort in period one will not be rewarded by a high wage in period two, he will not select to provide a high effort. Lastly, by this predicted chain of events, the employer will offer a low wage to the employee in period one.

Since the employer knows the employee's dominant strategy is to select $\underline{e}$ in the second period, he has no reason to pay a cost to purchase the employee's history before making a wage offer in period two, which leads to the same solution to the game with costly history as that in the above scenario with costless history. This result will apply to all finite games, regardless of the number of periods.

2.2 Indefinite Game

This paper next considers an indefinitely-repeated game, where players participate in an unknown number of rounds. A scenario where an employee's history is not shown to the employer has the same outcome as the finite game. Due to random pairing, no history is formed, therefore each period can be treated as a one-shot game, with a strategy of $(\underline{e}, \underline{w})$ being the equilibrium.

When the employers are provided the employee's history at no cost, the Pareto efficient strategy $(\bar{e}, \bar{w})$ can be maintained in each round under specific conditions. The effort the employees exert in the present round impacts their future payoffs because they are screened by their future employers. Since, in each round, their wage is given to them before they decide on their choice of effort, the only incentive to provide anything other than low effort is to increase their future earnings. Due to information being freely provided to all employers, the result would be the same for cases of paired or random matching.

Consider the following grim trigger strategy. Employees and employers choose $\bar{e}$ and $\bar{w}$, respectively, assuming that this has happened in every preceding period. If either player deviates, then players choose $\underline{e}$ and $\underline{w}$ forever.

On the equilibrium path, an employee obtains the following payoff:

$$\sum_{t=0}^{\infty} \delta^t(\bar{w} - c(\bar{e})) = \frac{(\bar{w} - c(\bar{e}))}{1-\delta}$$

Future payoffs are discounted by a factor of δ to express traditional time preference or uncertainty about the length of the game. A deviating employee obtains the following payoff:

$$(\bar{w} - c(\underline{e})) + \sum_{t=1}^{\infty} \delta^t(\underline{w} - c(\underline{e})) = (\bar{w} - c(\underline{e})) + \frac{\delta(\underline{w} - c(\underline{e}))}{1-\delta}$$

Hence, a cooperating equilibrium can be maintained if the payoff from cooperating is greater than the payoff from defecting:

$$\frac{(\bar{w} - c(\bar{e}))}{1-\delta} \geq (\bar{w} - c(\underline{e})) + \frac{\delta(\underline{w} - c(\underline{e}))}{1-\delta} \Leftrightarrow \delta \geq \frac{(\bar{w} - c(\underline{e})) - (\bar{w} - c(\bar{e}))}{(\bar{w} - c(\underline{e})) - (\underline{w} - c(\underline{e}))} = \frac{c(\bar{e}) - c(\underline{e})}{\bar{w} - \underline{w}} > 0$$

As long as the discount factor is above that threshold, the employees will benefit in offering a high effort level.

Unlike the employee, the employer does not need to consider his future payoffs when choosing a wage. The employee he is matched with in each period will only see the wage selection of the current period. If the game is sequential and repeated, and it is assumed a grim-trigger strategy will be implemented in the case of deviation, it is not rational for an employee to offer a high effort in return for a low wage; therefore, if cooperation has been upheld up to that point, the employer will not be able to receive high effort if he deviates first. If he wants to maintain the Pareto efficient equilibrium, he will always offer a high wage. However, the employer should only offer a high wage if he believes he can receive a high effort in return. The employer will be able to form his belief about the employee after viewing the employee's history. Therefore, the employer's strategy will be to offer a high wage if he sees high effort in the employee's history, and a low wage if the employee is seen to have exerted low effort in the past.

The above model can be used to determine the equilibrium in the treatment that provides an employee's work history at no cost. With costly history, the indicator variable is activated and the utility function of the employer becomes $U_p = K + B(e) - w - s$. The introduction of costly history does not enter the utility function of the employee, so it will not affect the employee's threshold value of δ to maintain cooperation.

I modify the model by making costly information mandatory for the employer. Costly history will decrease all the payoffs of the employer by the cost of purchasing the history, which is be denoted s.[2] The uniform decrease in utility will not change the employer's optimal strategy in a sequential move game. The employer will maintain the same strategy to only offer a high wage if he sees his employee has reciprocated with high effort in the past.

The experiment conducted for this paper gives employers the option of paying to obtain the work history of their employees. Consider another scenario, where the employer is not always required to pay to receive information, and can opt out of receiving an employee's history. If his future employers cannot see his effort history, the employee has no incentive to exert $\bar{e}$. By backwards induction, the employer is best off not providing $\bar{w}$, leading to an equilibrium strategy of $(\underline{w}, \underline{e})$. With history, as provided in the proof above, $(\bar{w}, \bar{e})$ can be sustained if the players value their future earnings.

Past experiments have found that when history is not available, each round is played like a one-shot game, where players defect and cooperation is not built up over time. That is due to the lack of a need to create a reputation. Duffy, Xie, and Lee (2013) find that with the choice of costly screening, cooperation between players increases, even if screening is not

[2]For mathematical simplicity, I assume a boundary on the cost of history such that the utility of the employer is always non-negative.

implemented in every round.

I will determine the conditions under which the employer will choose to pay the cost to receive an employee's history. Consider the following utilities:

$$p(K + B(\bar{e}) - \bar{w}) + (1 - p)(K + B(\underline{e}) - \underline{w}) - s \geq K + B(\underline{e}) - \underline{w}$$

The left side of the above inequality is the expected utility the employer will receive if he chooses to purchase access to the employee's history in a given period. Employers believe the proportion of employees willing to cooperate is p, and the proportion of defecting employees (those who exert low effort regardless of wage) is $(1 - p)$. If the employer chooses to pay to receive the history, with probability p he will see that he is matched with who he believes is a reciprocating employee, will offer him a high wage, and receive high effort in return.[3] With probability $(1 - p)$, the employer is matched with an uncooperative employee, for whom he will offer a low wage in return for a low effort. In addition, he will need to pay the cost to obtain the history. If the employer does not pay for the information, he will offer a low wage and receive low effort; without the availability of history, it is optimal to offer a low wage.

I solve the above equation for the condition under which the expected utility of the employer is higher when he pays for the information than when he does not.

$$p[(B(\bar{e}) - \bar{w}) - (B(\underline{e}) - \underline{w})] \geq s$$

As long as the cost of obtaining history is below this value, employers will always pay to obtain the history. And given that the employees value the future enough (based on their δ), they will always exert high effort in return for a high wage. According to this model, effort, wage, and utilities of both employees and employers will increase with the offers of both both costless and costly history, in comparison to a lack of history.

[3] I am assuming that employees are maintaining the behavior consistent with their history.

I have proven that in theory, cooperation can be achieved in an indefinitely repeated game. In the finite agency problem, defection in every subgame is the dominant strategy of rational players, based on backwards induction. However, that solution has been found to not always apply, specifically if the players' assumptions are altered.

Andreoni and Miller (1993) conducted an experiment testing the model of Kreps and Wilson (1982), and found that cooperation can be achieved in finitely repeated games if players believe there is a chance their opponents may be altruistic. If a player is altruistic, he may receive extra utility (that is labeled as 'warm glow') from cooperating, or may play a tit-for-tat strategy. Due to this belief, players can cooperate for some time in the finite game, in order to build reputations before the game resorts to mutual defection.

When an employee's history is not present, and players have no information about their opponents, in both the finite and indefinitely repeated games the optimal strategy is to always defect, since no reputations can be constructed. However, in scenarios that provide players' histories, altruism can be signaled, and it is possible to sustain cooperation in finite games. The tit-for-tat strategy that was discussed in Andreoni and Miller's (1993) paper that makes cooperation possible is similar to the grim trigger strategy assumed in the model of this paper. Therefore, if players believe their opponents are willing to cooperate for some time, then the finite game can be played as the indefinitely-repeated game for a period before it unravels. Providing employee history is the signal that can uphold collaboration. In that case, the decisions based in the indefinitely repeated game are mirrored in the decisions of the finite game.

3 Experiment

This experiment was conducted in a computer lab, using the ZTree software (Fischbacher 2007). Subjects were recruited via an email sent to the undergraduate students at UC Irvine. Participants were randomly split into two groups: employees and employers.

The revenue and cost functions of both types of players, presented in Table 2, are obtained from Charness and Kuhn (2007).[4]

$$u_{employer} = 4.5 + B(e) - w + s\mathbb{1}_{\text{CostlyHist}}$$

$$u_{employee} = w - c(e)$$

The participants are informed that the experiment consists of three treatments, ten periods each. Employers are given 4.5 lab dollars in each period, and decide how much to pay their employee. In each period, the employer moves first by offering his employee a wage. After seeing their wage offer, the employee then decides how much effort to supply to the job. The cost to the employee to provide each amount of effort and the revenue it generates for the employer is provided in Table 2. The table is set up such that high effort is efficient, as it maximizes the sum of utilities.

Table 2
Effort Costs and Revenues

Effort Level	Cost to Employee	Revenue Produced by Employee
Zero (0)	0	0
Low (1)	0.10	2.80
Medium (2)	0.30	4.20
High (3)	0.60	5.40

In an attempt to equate average earnings between the two roles, the conversion rate is different between the types of players; employers are paid $1 for 15 lab dollar earned, and employees are paid $1 for 6 lab dollar. The players are aware of the conversion rate for their type, but not that of their opponents.

The players are told that in every period of every treatment, each employer is randomly matched with an employee. The experiment follows a within-subject design, with all subjects

[4] The cost of history, s, is only included in the treatment with Costly History.

in each session participating in three treatments:[5]

1. No History: No employee history offered.

2. Costly History: Employer is offered the opportunity to purchase costly history of the employee before making a wage offer.

3. Costless History: Employee's history is provided to the employer at no cost.

The variable in the treatments is the availability of employee history. The NoHist treatment offers the employer no prior information about the employee he is matched with. In the CostlyHist treatment, the employer has the option to pay to screen each new employee before presenting him with a wage offer. The employer will need to pay 0.5 lab dollars in each period that he chooses to request a new employee's history. The CostlessHist treatment provides that information freely to the employers.

The information regarding the employee's past work history consists of the employee's past effort levels, along with the wages he was offered, in an an attempt to mimic a résumé. This material helps the employer assess what level of effort to expect, so he can offer an appropriate wage and maximize his own utility.

After seeing the offered wage, the employee will choose a nonnegative effort level to contribute to the job. Payoffs are then computed based on the linear utility functions of the principal and the agent. Each treatment lasts 10 periods to set a clear time limit on the experiment. This means that each player is randomly paired ten times in each treatment. The subjects are paid for each period based on the conversion rate for their role.

In addition to the three treatments, this experiment includes a risk-aversion assessment question (administered at the beginning of each session), and finishes with a questionnaire. The results of the risk assessment question are not shown to the subject until the end of

[5] A within-subject design was chosen instead of a between-subject design because the treatments are relatively short.

the session, when the participants are shown their payoffs for all parts of the experiments. Subjects are paid based on their risk elicitation choice. Altogether, subjects' payoffs were composed of five parts: $7 show-up payment, an amount based on their risk preference, and a payment for each of the three treatments.

Five sessions were conducted at the Experimental Social Science Laboratory at University of California, Irvine, with a total of 68 participants. A brief summary of subject demographics is provided in Table 3. The average earnings were $19.44, which included the $7 show-up payment, and 55 percent of the subjects were female.

Table 3: Summary Statistics

Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Age	19.941	2.585	2	23
Gender	0.559	0.5	0	1
Payoff	19.449	1.928	15.9	25.1

4 Hypotheses

The focus of this paper is to examine the differences in wages, effort levels, and utilities across the three treatments. Based on the model and previous studies, it is expected that the availability of history moves the players to the Pareto efficient equilibrium of higher wages and efforts. Therefore, I formulate the following hypotheses:

Hypothesis 1: $e_{NoHist} < e_{CostlyHist} = e_{CostlessHist}$

Hypothesis 2: $w_{NoHist} < w_{CostlyHist} = w_{CostlessHist}$

Hypothesis 3: $u_{NoHist} < u_{CostlyHist} = u_{CostlessHist}$ for employee

Hypothesis 4: $u_{NoHist} < u_{CostlyHist} < u_{CostlessHist}$ for employer

I predict that when employers do not view the history of employees, both types of players will defect to offering low wages and efforts, as they are not working on building reputations. With history, employees will be incentivized to produce more effort, and since the cost of obtaining the worker history does not fall on the employee, their efforts should be consistent in the two treatments with costly and costless screening.

I expected the employers to absorb the cost of history and not transfer it to employees in the form of a decrease in wages. The cost of history is not large enough in this experiment to dispute this hypothesis; if the history cost is increased, that may be reflected in wages. Finally, the hypothesis for the profits follows the hypotheses for the efforts and wages.

To establish a prediction for when employers will pay to obtain employee history, I will use the highest and lowest wages and efforts to plug in to the threshold equation for purchasing history:

$$p[(B(\bar{e}) - \bar{w}) - (B(\underline{e}) - \underline{w})] \geq s$$

$$\Leftrightarrow p[5.4 - 4 - 0 + 0 \geq 0.5] \Leftrightarrow p \geq 0.357$$

Employers will pay to view employee history if they think at least 35.7 percent of the employees are willing to cooperate.

5 Experimental Results

The results are presented in the order of the hypotheses listed above.[6]

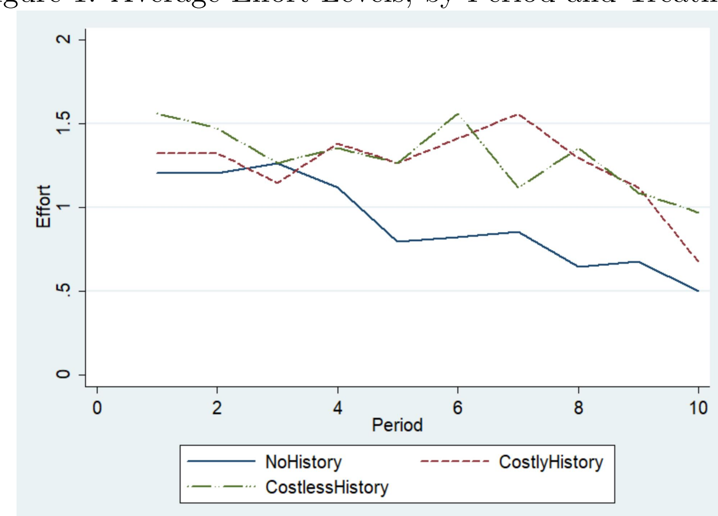
Result 1: Effort levels are higher in the treatments with history (both costly and costless) than in the treatment without employee history.

I begin my analysis with the first hypothesis by examining the difference in effort levels across the three treatments. Figure 1 displays the progression of the average effort levels chosen in each period, graphing each treatment separately. All lines follow a similar decreasing trend; this pattern is believed to be tied to the wages, and is further described under

[6] Treatments shall be referred to by the variable condition: NoHist, CostlyHist, and CostlessHist.

the results of hypothesis 2. The average efforts in CostlyHist and CostlessHist appear to be higher than the effort levels in NoHist. Effort levels in CostlyHist and CostlessHist cross, and when the average is computed, the difference between them is not significant. After approximately the first three periods, average efforts in CostlyHist and CostlessHist separate from and are consistently higher than NoHist. There are two possible explanations for the paths of the effort levels. First, it takes a few rounds for subjects to get accustomed to a treatment. After they do, they put in more effort in the treatments with employee history. Second, the effort levels follow the wage offers, as the curves of the effort levels form a similar shape to the wages of the corresponding treatment.

Figure 1: Average Effort Levels, by Period and Treatment



To verify the above observations, I run an ordered probit regression of efforts on wages and dummy variables for the three treatments. The results are presented in Table 4. All regressions cluster on the 34 employees (half of the subject pool, since subjects were assigned to one of two roles) to generate robust standard errors.[7] Columns 1 and 2 use CostlyHist as a default variable, and vary by the period fixed effects used in the regressions. Column 1 clusters on the ten periods of each treatment, while column 2 takes order effect of treatments into consideration and clusters on the thirty total periods in each session.

[7]All regressions include subject fixed effects.

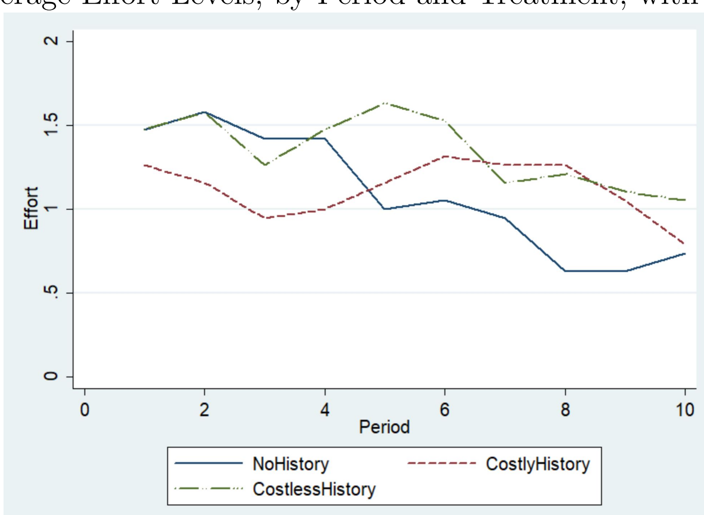
Table 4 displays the finding that wage has a significantly positive impact on the effort level. This is explained by reciprocity; employees respond in kind to their employers if they receive fair wages. Since employees are second movers, they are not taking on risk when they contribute high effort.

The next variables of interest are the treatment dummies; the regressions show that effort levels in CostlessHist do not significantly differ from CostlyHist. This can be explained by the threat of exposure. In CostlyHist, employees do not know when their history is observed, but the possibility is always present. When faced with the risk of their actions being revealed, people lean towards observing rules.

Compared to CostlyHist, effort in NoHist shows a significant decrease, but only in column 1. This result follows the theory, because NoHist can be treated as a one-shot game where reputation-building is not a necessity. Therefore, shirking does not have costly consequences.

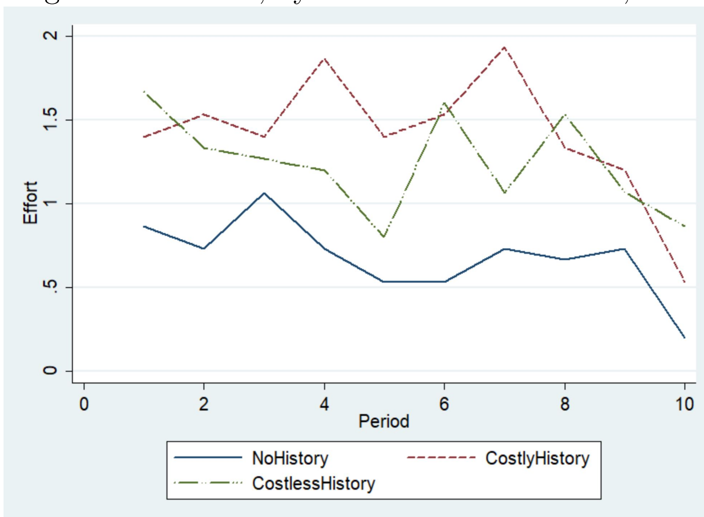
Column 3 differs by setting NoHist as the default treatment to differentiate NoHist from CostlessHist. As a result, effort levels in CostlessHist are higher than in NoHist. This is consistent with the theory and the above explanation that history encourages cooperation.

Figure 2: Average Effort Levels, by Period and Treatment, with No Hist First



Column 4 adds dummy variables to extract an order effect. Figures 2 and 3 separate the data by the order of the treatments. In the sessions presented in Figure 2, NoHist was

Figure 3: Average Effort Levels, by Period and Treatment, with No Hist Last



completed first by the subjects, and CostlyHist and CostlessHist alternated in order; in Figure 3, NoHist was executed last. Based on the difference in these graphs, an order effect appears to develop, which I attempt to capture in column 4.

The effort level of NoHist was significantly higher at the 10% level when NoHist was completed first, versus last. The opposite holds true for CostlessHist, which showed lower effort levels as a first treatment than as a last treatment. Lastly, there is no significant change between treatments performed in the second or third place.

I hypothesize that effort in NoHist was smallest when it was completed last (Figure 3) due to the subjects learning the game. When the subjects played NoHist first, the efforts were initially higher than in the other two, latter treatments, which is inconsistent with theory. Not only do the effort level decrease with each period, the negative effect carries over to the next treatments. This implies that regardless of the treatment, altruism is present at the start of the game, and decreases with time.

I use the similar explanation of subjects taking some time to become acquainted with the game to explain the increase in effort in CostlessHist when it is a played last. It is possible that subjects did not fully comprehend the game when they began the session.

The remainder of Table 4, column 5, adds the subjects' risk assessment to the regression.

This regression show that risk-seeking and risk-averse subjects chose lower effort levels than risk-neutral players. Across the three sessions, only one employee was risk-seeking, so I am hesitant to believe the coefficient associated with risk-seeking subjects due to its small sample size. I will acknowledge the coefficient identified with risk-averse players, because the number of those individuals is a respectable proportion of the subject pool. The result that risk-averse employees exert less effort than risk-neutral employees is puzzling, since the employees are the second movers. They have the advantage of having no uncertainty in their payoffs after they make their move. It could be that risk-averse players are more passive and are trying to maximize the payoff of the present periods by minimizing their contribution.

Another caveat to consider is the validity of the risk assessment. Due to budget constraints, only a small amount of funding could be allocated to extract the risk factor of the subjects.[8] To more accurately elicit the risk behavior a subject, the stakes would need to be higher.

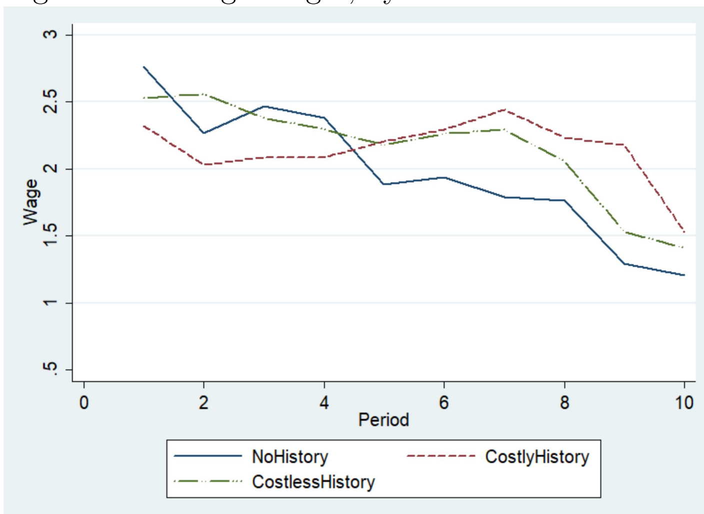
Result 2: No difference in wages is found between any of the treatments. However, the ordering of the treatments affects wages, prompting employers to make higher offers in the beginning of the session.

Hypothesis 2 compares wages between the three treatments. Figure 4 graphs the average wages by period, separated by treatment. Like the graph of the effort levels, there is a decline in wages as each treatment progresses. Contrary to theory, a distinct differentiation of wages between the treatments cannot be confirmed. Wages in NoHist are the highest initially, but wages for all three treatments converge as the game progresses. An OLS regression of the wages can be found in Table 5.

Similarly to Table 4, columns 1 and 2 of Table 5 vary by the period fixed effects included in the regressions, and column 3 sets NoHist as the default variable. In these first three

[8] Earnings from the risk assessment ranged from \$0.80 to \$5.00.

Figure 4: Average Wages, by Period and Treatment



regressions, the wages do not diverge across the treatments.

Since there is no significant difference between wages of CostlyHist and CostlessHist, the cost to obtain history does not compress the wages. This implies that the employers absorb the cost of obtaining history, subtracting it from their profits.

Akin to the effort levels, I believe the ordering of the treatments impacts wages as well, so I separate the wages by the treatment order in Figures 5 and 6. In Figure 5, NoHist was always presented first to the subjects, and the ordering of CostlyHist and CostlessHist alternated in sessions. It is possible that the subjects started off offering high, generous wages, but the offers decreased with time when they were not reciprocated with high efforts. In Figure 6, NoHist was played last, and its wages are the lowest, as predicted by theory.

Like Table 4, Table 5 includes treatment order dummies. The regression supports the findings from Figures 5 and 6: NoHist resulted in higher wages when it was performed first, confirming an order effect.

The last column of Table 5 includes the risk assessment of the players. Only two employers self-selected into the risk-seeking category. The regression results tell us that higher risk aversion leads to higher wages. Since employers make the first move in this sequential-move game, they stand to lose more.

Figure 5: Average Wages, by Period and Treatment, with No Hist First

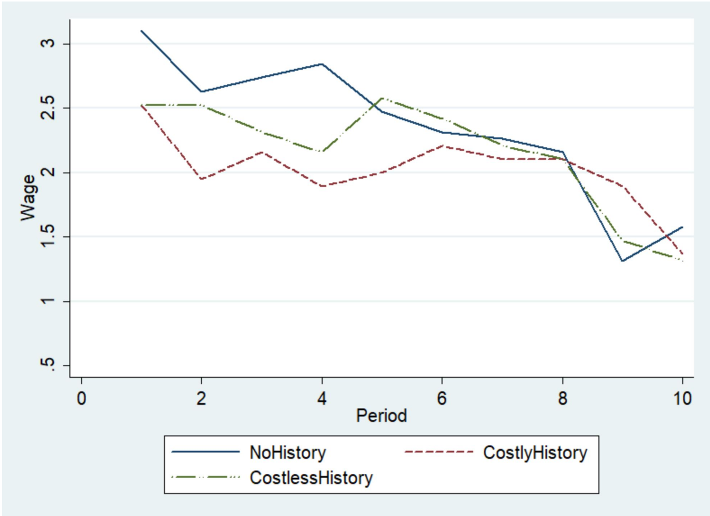
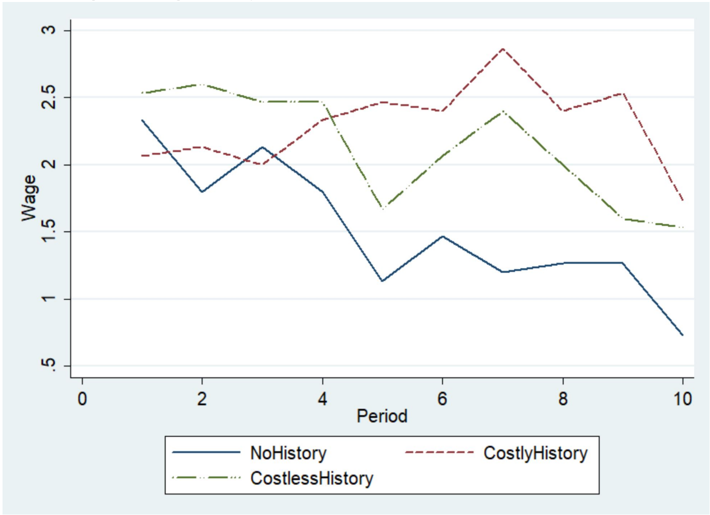


Figure 6: Average Wages, by Period and Treatment, with No Hist Last



Result 3: When presented with employee history, employers use the information to adjust their wage offers. If they do not have access to an employee's records, employers base wage offers on their own experience with past employees.

The investigation further explores the effect of placing a cost on employee history. As predicted, employers did not always purchase history of their employees when provided with the opportunity; in this data, employers chose to buy history 37 percent of the time in CostlyHist. The data did not appear to show any pattern for purchasing history.

Figure 7: Frequency of Employers Paying for Employee History

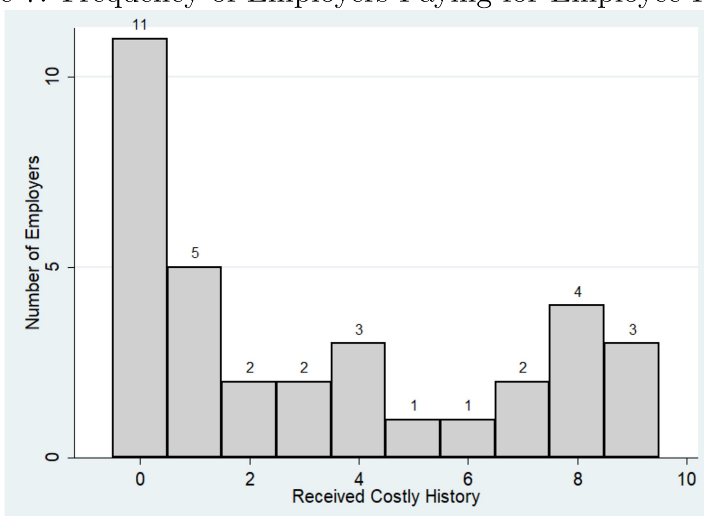


Figure 7 summarizes the number of times the employers chose to pay to receive history in CostlyHist. For example, eleven employers chose to never pay to receive history, five employers only paid to receive history one time, and another two employers only chose to pay twice. On the other end of the table, seven employers paid 8 or 9 times for information. In all, there does not appear to be a pattern for the number of times employers chose to pay to receive information.

In CostlyHist, employees chose an effort level of zero 32 percent of the time. If I assume cooperation is returning an effort level greater than zero, then employees cooperated 68 percent of the time, which exceeds the requirement of 35.7 determined by the model. This makes purchasing employee history the optimal action for the employers.

Table 6 provides an examination of the impact of purchasing employee history on wages of the employers in CostlyHist.[9] I include a dummy variable that is called 'purchase history', which takes a value of 1 if an employer chose to pay to receive the employee's history and 0 otherwise. In CostlyHist, the employer's choice to purchase history had no significant impact on the wage offered to the employee. This implies that the cost to purchase history was deducted from the employer's profit, and not the wage, an explanation consistent with Table 5.

To delve further into the effects that work history has on wage and employer profits, I filter the data to only include observations where employee history was observed, and present the results in Table 7. I keep all the data from CostlessHist, and the periods from CostlyHist in which employers chose to pay for history. Period 1 is omitted in both treatments due to it lacking access to employee history.

Columns 1 to 3 regress wages on a treatment dummy (only one is included, since NoHist is omitted), and the lagged effort variables. These columns differ by the number of lagged variables that are included in each regression. Column 1 only takes into consideration the lagged effort from one previous period. Column 2 takes into account the lagged efforts from the last two periods, and column 3 from the last 3 periods. In all three scenarios, there is significant change to wages based on the past effort; the better the work ethic of the employee, the higher the wage offer he will receive. Only the most recent past work matters, as the significance disappears by the third lagged period. As I found earlier in Table 4, there is no significant difference between wages of CostlyHist and CostlessHist, meaning there exists a lack of a distinction between the wage offers of periods where employers pay to receive employee history versus where they are supplied with the history for free.

Column 4 analyzes the difference in profits between the two treatments, conditional on

[9]Table 6 includes subject and period fixed effects.

only using observations which include employee history. Profits in CostlyHist are lower than in CostlessHist by 0.38 lab dollars. The screening cost is 0.50 lab dollars, so the similar magnitude implies that the difference in profits could be due to that cost of history.

Column 5 creates a new dependent variable for profit. It adds a constant 0.50 to all observations where the employer paid to screen, to compensate for the cost. The objective is to compare the profits between the two treatments while adjusting for the cost of history. It is shown that with this modification, a difference in profits between CostlyHist and CostlessHist cannot be confirmed. Therefore, by elimination, the difference in non-adjusted profits may be due to the screening cost, as the wages and effort levels do not differ.

The discovery that employee history impacts future wages is consistent with previous findings. At the end of the experiments, subjects were asked to fill out a questionnaire. One of the questions asked the students to describe their strategy. The hypothesis that the ordering of the treatment matters is consistent with the free response answers of the employers. Several subjects who were assigned to play employers wrote that they started off paying high wages, but when employees did not reciprocate, they deviated to lower wages.

From Table 7, Graph 2, and the survey results gathered from the subjects, I find that wages decreased with time when the employers thought they were not being compensated enough by their employees. Even though there was no available history in NoHist, the wage offers declined with each period. Why would wages decrease if the employers did not have employee history to reference? My conjecture is that employers base their wages on their own history.

To test this question, I regress wages in periods where no employee history was provided (NoHist and the observations in CostlyHist where employers chose not to obtain history) on the employers' own prior round history, presented in Table 7. The results found were curiously significant; the efforts the employer received in the past periods influenced his wage offer to his new employee. So the new employee was rewarded or punished not based on his own record, but on the experience of the employer. This means that employers form assumptions about new employees, whether that information is correct or not.

Table 9 regresses the wages of employers who viewed employee records (CostlyHist and CostlessHist) on the employers' own prior round history. No significance was found, meaning that when employers were given correct information, they utilized it properly. But when they were not provided with information, they did not update their beliefs, keeping them based on their own history.

This finding explains why the graphs are all downward sloping. In NoHist, wages were the highest in the beginning, employers were optimistic. But when they experienced low efforts in return, they chose to decrease their wage offers in the future rounds, even though they had no information on the new employee. Due to random matching, once an employee deviates, it contaminates the subject pool, causing the choices of all participants to spiral down. Since wages decrease, efforts decrease as well, and the population gets trapped in a downward spiral.

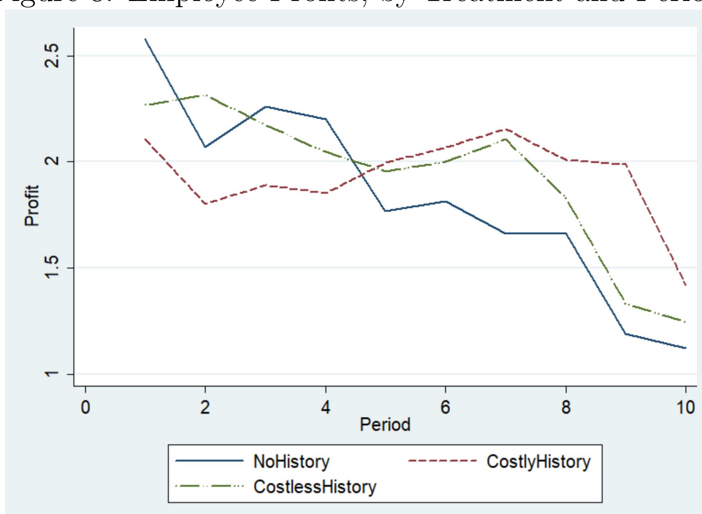
When given the past history of an employee, employers correctly used the information to offer wages that reflect an employee's work ethic. They did not make incorrect decisions based on their own experience. But when they had nothing to change their beliefs, they created their own priors, and made wage offers based on that knowledge. This means that subjects always attempt to use the information they have, even if its application is inaccurate.

Result 4: I do not observe a significant difference between any of the treatments in the profits of the employees.

The third hypothesis I am testing is ranking the employees' profits in the different treatments. Figure 8 displays the graph of the average employee profits, each treatment demonstrated by a separate line. Initially, profits from NoHist seem to be the highest, and CostlyHist the lowest, but mid-way through the treatment, the profits blend together. This is remarkably consistent with the graph of the wages. Wages were considered the lowest in

CostlyHist (though there is no significance), and the employee profits closely followed them. Since wages make up a larger portion of the employees' profits than the cost of their work, this result is expected. The lack of variation in wages across the treatments leads to the absence of diversity in profits. Despite the high effort levels in CostlyHist and CostlessHist, the employees' selections of effort contributions were not large enough to overcome the magnitude of wages.

Figure 8: Employee Profits, by Treatment and Period

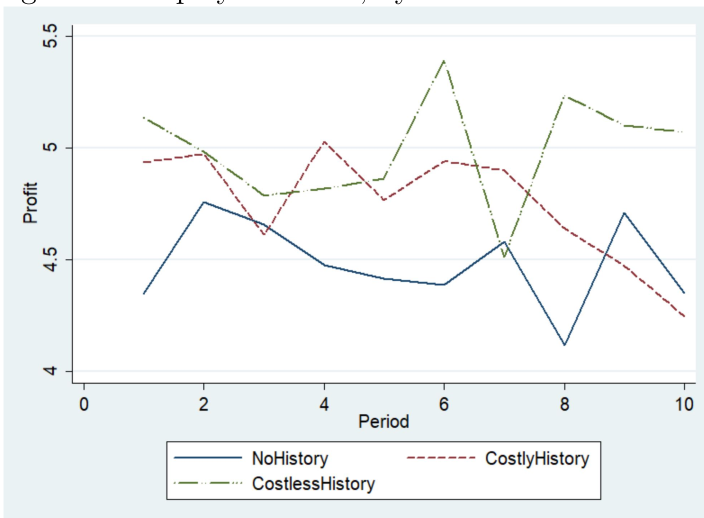


The regressions of employee profits are presented in Table 10. Columns 1 and 2 vary by the default treatment in the regressions. The results do not show significant variation in employee profits between any treatments, a finding which does not support the theory.

Result 5: Employers receive the highest profits in the treatment with costless history. Since wages do not experience a significant difference between treatments, that means that employers absorb the cost to receive costly information.

Table 11 (supplemented by Figure 9) examines employer profits to test the last hypothesis. The columns once again differ by the default treatment dummy. CostlessHist is found to produce the highest profit. Because wages do not greatly differ across the treatments, I am

Figure 9: Employer Profits, by Treatment and Period



confident that profits in CostlyHist are lower than CostlessHist due to the price of work history. No significant difference is found between NoHist and CostlyHist, which I justify by the order effect (referenced in Tables 4 and 5).

Like hypotheses 2 and 4 predicted, the wages do not change with the addition of a fee on work history, as the employers absorb that cost, which decreases their profits. If employers could be subsidized for the fee when searching for new employees, their profits would be the same as in the case with costless history, which is an incentive for a new policy to store employment information in one database. Time spent collecting information would be decreased if it was kept in one virtual location. Websites like LinkedIn and Job Openings for Economists are examples of the trend.

6 Conclusion

In this paper, I study the how placing a cost on the employee's work history affects wages, efforts, and profits, in order to add realism to current experimental literature. The addition of the fee, like predicted by theory, did not affect wages; employers absorbed the cost, which decreased their profits. With time, the employees put in more effort into the treatments where their employment history was available, as opposed to the treatment where their history was unobserved, in an attempt to build favorable reputations. Because employees were second movers, the fluctuations in their decisions closely followed the wages they were offered.

Employers used the employees' work history when it was provided, to offer appropriate wages based on their past performance. However, when employers did not have a history, they offered wages based on their own prior round interactions; employers rewarded or penalized their new employees based on their old employees' work ethic. In both scenarios, with or without history, employers formed assumptions about their employees, whether they were correct or not. Wages declined in all treatments due to employers not receiving fair efforts in return for their wages. Once subjects started defecting, it caused a downward trend in both wages and efforts that affected the entire subject pool.

The take-away from this experimental study is that subjects benefit when history of an opponent is provided, so that people are not paying for the mistakes of others, and a socially efficient outcome can be achieved if the cost of acquiring history is subsidized.

7 Tables

Table 4: Efforts Across Treatments

	(1)	(2)	(3)	(4)	(5)
	Effort	Effort	Effort	Effort	Effort
NoHist	-0.394*	-0.424		-1.131*	-0.394*
	(0.167)	(0.246)		(0.526)	(0.167)
CostlessHist	0.0735	0.0402	0.467*	-0.0492	0.0735
	(0.106)	(0.158)	(0.187)	(0.427)	(0.106)
CostlyHist			0.394*		
			(0.167)		
Wage	0.774***	0.802***	0.774***	0.775***	0.774***
	(0.141)	(0.144)	(0.141)	(0.144)	(0.141)
NoHist_first				0.632	
				(0.368)	
CostlyHist_second				-0.444	
				(0.424)	
CostlessHist_first				-0.616**	
				(0.235)	
CostlessHist_second				0.0987	
				(0.465)	
RiskSeeking					-0.507***
					(0.0885)
RiskAverse					-0.903***
					(0.0918)
cut1					
Constant	0.225	0.106	0.619*	-0.0141	0.225
	(0.202)	(0.332)	(0.242)	(0.362)	(0.202)
cut2					
Constant	1.187***	1.091**	1.581***	0.953*	1.187***
	(0.264)	(0.366)	(0.333)	(0.419)	(0.264)
cut3					
Constant	2.251***	2.182***	2.645***	2.024***	2.251***
	(0.369)	(0.456)	(0.426)	(0.488)	(0.369)
Session Period Effects	No	Yes	No	No	No
Observations	1020	1020	1020	1020	1020

Note: Robust standard errors, adjusted for clustering on 34 individual employees, are in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5: Wages Across Treatments

	(1) Wage	(2) Wage	(3) Wage	(4) Wage	(5) Wage
NoHist	-0.165	0.115		-0.112	-0.165
	(0.215)	(0.289)		(0.673)	(0.214)
CostlessHist	0.00882	0.201	0.174	0.351	0.00882
	(0.149)	(0.231)	(0.217)	(0.649)	(0.148)
CostlyHist			0.165		
			(0.215)		
NoHist_first				0.855*	
				(0.376)	
CostlyHist_second				0.668	
				(0.626)	
CostlessHist_first				0.157	
				(0.225)	
CostlessHist_second				0.577	
				(0.636)	
RiskSeeking					-0.133***
					(6.18e-15)
RiskAverse					0.600***
					(5.76e-15)
Constant	2.935***	3.044***	2.771***	2.296***	1.885***
	(0.142)	(0.324)	(0.164)	(0.635)	(0.0992)
Session Period Effects	No	Yes	No	No	No
Observations	1020	1020	1020	1020	1020
Adjusted R^2	0.318	0.357	0.318	0.353	0.281

Note: Robust standard errors, adjusted for clustering on 34 individual employers, are in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 6: Impact of Costly History on Wages in CostlyHist

	Wage
Purchase History	0.0559
	(0.308)
Constant	2.581***
	(0.140)
Observations	306
Adjusted R^2	0.452

Note: Robust standard errors, adjusted for clustering on 34 individual employers are in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7: Wages and Profits With History

	(1) Wage	(2) Wage	(3) Wage	(4) Profit	(5) NewProfit
CostlyHist	0.0268	0.114	0.127	-0.381*	0.1187
	(0.184)	(0.174)	(0.191)	(0.1688)	(0.1688)
EffortLag1	0.543***	0.445***	0.404***		
	(0.0746)	(0.0802)	(0.0891)		
EffortLag2		0.350***	0.380***		
		(0.0616)	(0.0625)		
EffortLag3			0.0848		
			(0.0727)		
Constant	1.429***	0.999***	0.681**	5.123***	5.123***
	(0.177)	(0.226)	(0.237)	(0.0713)	(0.0713)
Observations	417	374	328	417	417
Adjusted R^2	0.435	0.482	0.498	0.937	0.937

Note: Robust standard errors, adjusted for clustering on 34 individual employers, are in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Employers' Own Prior Round History in NoHist and CostlyHist

	(1)	(2)	(3)
	Wage	Wage	Wage
CostlyHist	0.170	0.0865	0.108
	(0.212)	(0.188)	(0.186)
EffortLag1	0.506***	0.480***	0.423***
	(0.0963)	(0.0886)	(0.0759)
EffortLag2		0.278***	0.271***
		(0.0669)	(0.0715)
EffortLag3			0.175**
			(0.0527)
Constant	2.399***	2.134***	1.969***
	(0.146)	(0.164)	(0.181)
Observations	501	442	386
Adjusted R^2	0.559	0.602	0.620

Note: Robust standard errors, adjusted for clustering on 34 individual employers, are in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Employers' Own Prior Round History in CostlyHist and CostlessHist

	(1)	(2)	(3)
	Wage	Wage	Wage
CostlyHist	0.0594	0.140	0.202
	(0.203)	(0.191)	(0.216)
EffortLag1	0.0342	0.0176	0.0230
	(0.0850)	(0.0787)	(0.0848)
EffortLag2		0.152*	0.156
		(0.0744)	(0.0865)
EffortLag3			-0.00913
			(0.0571)
Constant	2.023***	1.695***	1.571***
	(0.195)	(0.267)	(0.245)
Observations	417	374	328
Adjusted R^2	0.283	0.276	0.277

Note: Robust standard errors, adjusted for clustering on 34 individual employers, are in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Employee Profits Across Treatments

	(1)	(2)
	Profit	Profit
NoHist	-0.0953	
	(0.151)	
CostlessHist	-0.00147	0.0938
	(0.143)	(0.157)
CostlyHist		0.0953
		(0.151)
Constant	2.350***	2.254***
	(0.137)	(0.140)
Observations	1020	1020
Adjusted R^2	0.131	0.131

Note: Robust standard errors, adjusted for clustering on 34 individual employers, are in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Employer Profits Across Treatments

	(1)	(2)
	Profit	Profit
NoHist	-0.161	
	(0.148)	
CostlessHist	0.485**	0.646**
	(0.144)	(0.169)
CostlyHist		0.161
		(0.148)
Constant	4.633***	4.472***
	(0.219)	(0.170)
Observations	570	570
Adjusted R^2	0.036	0.036

Note: Robust standard errors, adjusted for clustering on 34 individual employers, are in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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