



HAL
open science

Training Without Certification :An Experimental Study

Nadège Marchand, Claude Montmarquette

► **To cite this version:**

Nadège Marchand, Claude Montmarquette. Training Without Certification :An Experimental Study. 2008. halshs-00333521

HAL Id: halshs-00333521

<https://shs.hal.science/halshs-00333521>

Submitted on 23 Oct 2008

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Centre National
de la Recherche
Scientifique

GATE
Groupe d'Analyse et de Théorie
Économique
UMR 5824 du CNRS



DOCUMENTS DE TRAVAIL - WORKING PAPERS

W.P. 08-23

**Training Without Certification :
An Experimental Study**

Nadège Marchand, Claude Montmarquette

Septembre 2008

GATE Groupe d'Analyse et de Théorie Économique
UMR 5824 du CNRS
93 chemin des Mouilles – 69130 Écully – France
B.P. 167 – 69131 Écully Cedex
Tél. +33 (0)4 72 86 60 60 – Fax +33 (0)4 72 86 60 90
Messagerie électronique gate@gate.cnrs.fr
Serveur Web : www.gate.cnrs.fr

Training Without Certification : An Experimental Study

Nadège Marchand*, Claude Montmarquette[†]

January 2008

Abstract

Our study considers the question of training in firms using an experimental laboratory approach. We investigate the following questions : What conditions, excluding external certification, will bring workers and employers to cooperate and share a rent generated by the workers' training? What conditions will induce workers to accept the training offer, for employers to initially offer the training and to reward the trained workers in the last stage of the game? We analyse the impact of the size of the rent created by training and the existence of an information system on employer reputation rewarding trained employees. Reputation does matter to induce cooperation, but in the absence of external institutions, coordination on the optimal outcome remains difficult.

Keywords: general and specific trainings in firms, accreditation, cooperation and reputation, experimental economics.

JEL: C91, I-129.

*GATE-CNRS UMR 5824 - Université Lyon 2, 93, chemin des Mouilles, B.P.167, 69131, ECULLY, France. marchand@gate.cnrs.fr.

[†]University of Montreal and CIRANO-2020 University street, 25th floor, Montreal, (Quebec) Canada H3A 2A5. montmarc@cirano.qc.ca. (corresponding author).

[‡]We thank Nathalie Viennot-Briot for her able assistance in conducting this research. This research was partly financed by an INE Skill Research Initiative-SSHRC-Industry Canada grant, a Québec FQRSC grant, and the *Bell-Caisse de dépôt et placement Chair in Experimental Economics*. Financial support from *Le Centre d'étude sur l'emploi et la technologie, (CETECH)* is also acknowledged for initiating this work. The usual disclaimer applies.

1. Introduction

Firms' investment in training is considered essential to innovation and economic growth. In the context of trade liberalization and market globalization, a well trained labor force represents an important hedge over competitive international and national firms.

Becker's seminal paper (1962) on training by firms in a competitive labor market, suggested a clear distinction between general and specific training occurring outside the education system. General training increases workers' productivity, but it can be mobilized in different contexts and by different firms. Firms anticipating that workers could leave and that other firms can poach their trained workers have no incentive to provide and finance general training. It is therefore left to employees to support the costs of their general training. In contrast, specific training, is a training that is entirely devoted to a particular production system and it can't be easily redeployed outside it. The firm as the sole beneficiary of this type of training will contribute to its funding.¹ However, empirical studies by Lowenstein and Spletzer (1999), Garcia, Arkes and Trost (2002), and Booth and Bryan (2007) showed that employers support the cost of general training.

Acemoglu and Pischke (1999a, 2000), even in the context of a competitive labor market, argued that firms financing of general training is possible if firms have a monopsony power following the training of their workers.² This monopsony power arises from the asymmetric information obtained with the training on the workers' level of ability, which is not available to other employers in the labor market. General training is offered by employers when the expected earnings from the training of high ability workers are large enough to compensate losses due to the training of low ability workers and with the latter being invited to leave the firm.

Autor (2001) used a similar argument to show that training provided by temporary help employers is general. He argued that free general skill training induces workers' self selection and allows firms to screen workers' ability. He found strong empirical support for his model using surveys of the Bureau of Labor Statistics on temporary help workers.

Booth and Zoega, (2000) considered that the complexity of the task justifies the funding of general training by firms. Leuven, Oosterbeek Sloof and van Klaveren (2005) proposed a model where a reciprocal worker may be willing to give the firm the full return on its

¹Note that an important part of specific training is produced informally like "learning by doing or learning by observing". This training is not valued by any types of certification and will not be discussed in this paper.

²Acemoglu and Pischke (1999b) justified that general training is financed by firms operating in imperfect labor markets. In those markets, the firms can benefit from their employees' general training in paying them below their marginal productivity by exploiting wage compressions of regulated labor markets and from costs that restrict the workers' mobility. Peraita (2001) found, however, little empirical evidence in the highly regulated labor markets of Spain to support that model.

general training investment. Using a representative survey of the Dutch population aged 16-64, they found that workers with high self reported sensitivity to reciprocity have 15 percent higher training rates than workers revealing a low sensitivity to reciprocity. However, reciprocity can be either a direct or an indirect mechanism. Direct reciprocity implies that: ‘I trust you because you were trustworthy with me before’ (Axelrod, 1984). Therefore, it relies on repeated interactions between the same pair of employer and worker. In contrast, if the training offer to a worker is not repeated by the employer, either the worker accepts and the training is completed or the training is rejected. In this last case, the employer loses money and he will not repeat his offer to the same worker. Thus, the training game relies more on indirect reciprocity: ‘I trust you because you were trustworthy with others before’.

With respect to specific training, one important empirical question is whether such training can be entirely specific? Training with computers and technical equipments can be specific to a firm, but being competent in one software or with a single technical unit is in more than one case sufficient to generate computer and technical skills that can be used outside the firm. Thus, the training firm and the worker are likely to share the costs of the training as well as the surplus or the rent associated with it. Kessler and Lülfsmann (2006) have showed the existence of an incentive complementary between employer-sponsored general and specific training. Whether employees or workers should invest in firm specific training is a question that has been studied with an experimental protocol by Oosterbeek, Sloof and Sonnemans (2007). They found that when the outside wage is high and there are turnover costs, the employers invest more than the workers do.

In this paper, we analyze the training of workers in firms using an experimental laboratory approach. The following question is studied: What conditions, excluding external certification, will induce workers to make costly efforts to complete the training offered by firms and for the employers to accept rewarding those efforts by sharing the rent generated by the training? In our model, the worker’s cooperation depends on the trust towards his employer in the last stage of the game keeping or not his promise to share the rent. To enforce cooperation, reputation building requires an institution that tracks and disseminates information about players’ past actions. When lacking institutions and in the context of players not interacting repeatedly, the effectiveness of reputation relies on indirect reciprocity by knowing about one another’s past actions.³

In a treatment without information on the previous decisions of the employer, the worker has no means to learn about the employer’s reputation. We consider two treatments with information, where the worker is informed whether the last promise by his current employer was actually paid. These treatments reflect, in reality, the reputation of a firm, which nourishes the worker’s trust or mistrust about the current employer sharing

³See Bolton, Katok and Ockenfels (2005) for a similar attempt in online reputation mechanism.

the rent generated by the training. In one information treatment, the participants know that they play 25 periods as in the no information treatment. In the second information treatment, the number of periods played is unknown to the participants but randomly chosen. This feature introduces the dimension of risk associated with the duration of firms, which is generally not known a priori.

All treatments involve two types of workers : a productive high ability worker and a less productive low ability worker. The rent generated by the training is larger for high ability workers.

In our model, training is a mix of general and specific training (see Booth and Byran, 2005, for an empirical support of this idea). It is general as the outside wage is affected by some trained workers leaving the firm. The training is partly specific since without a certification program, it is difficult for the trained worker to be recognized by the market.

The experimental laboratory approach offers an alternative to surveys in studying the training of workers. Empirical studies on training offers, even in surveys matching 'employers and employees data, pose tremendous difficulties in identifying the strategic behavior of both firms and workers. Baron, Berger and Black (1999) using a matched survey of employers and employees found that firms report 25% more training than workers do.

The paper is organized in five sections. In section 2, we present our training model, its resolution, a numerical application and the experimental design. Then, we present our predictive theoretical benchmarks in section 3. Our experimental results are reported and analyzed in section 4. In section 5, we conclude.

2. The theoretical game

Our basic economic model is based on Acemoglu and Pischke's (2000) paper introducing two modifications to their original model. First, we assume that the current employer knows the ability type of the worker at the beginning of the game. This information is discovered in at least two ways. Holding a diploma works as a signal of the worker's ability (Spence 1973). The employer may observe previous production spells from, for example, periods of internship. The second modification allows the employer to propose a pay bonus to the worker in order to enforce the worker's decision to accept the training offered.

2.1. The model

The economy is composed of a large number of firms and workers. The productive ability of the workers, noted h , is heterogenous and divided in two types, $h = \eta_i$ with

$\eta_2 > \eta_1 = 1$. In the population there are respectively p_1 workers of type 1 and p_2 workers of type 2.

The output, y , of a worker depends on his ability and his training:

$$y = \alpha^{e\tau} h,$$

If the worker offer a training $\tau = 1$; $\tau = 0$ otherwise. If the worker has exerted the effort associated with the training $e = 1$; $e = 0$ otherwise. We assume a cost γ supported by a firm offering a training in period one. The worker accepting the training incurs an effort cost of $c > 0$. The production function is not firm specific.

The model consists of two periods. Workers produce nothing in the first period. The production level in the second period depends on the previous decisions. If $\tau = 0$, or $e = 0$, the untrained workers produce η_i with $i = 1, 2$. With training, the worker's production is $\alpha\eta_i$ depending on his type. Thus the return to training is $\alpha - 1 > 0$. We assume that the production of y induces a desutility cost $f > 0$ for the worker.

In the first stage of the game, the employer, knowing the worker's type, decides whether or not to offer training to the worker. If the employer decides not to offer training, ($\tau = 0$), the game is over. With $\tau = 1$ the employer endures a cost γ , and we move to the second stage of the game. In the second stage, the worker must decide to accept or refuse the training offer. The training offer consists in a bonus P promised to the worker. If the worker refuses ($e = 0$), the game is over. If the worker accepts the training ($e = 1$), he endures an effort cost c . In the last stage of the game, the employer decides to transfer or not to transfer to the trained worker the bonus P .

The payoffs of the employers/workers are reported in the game tree presented below.

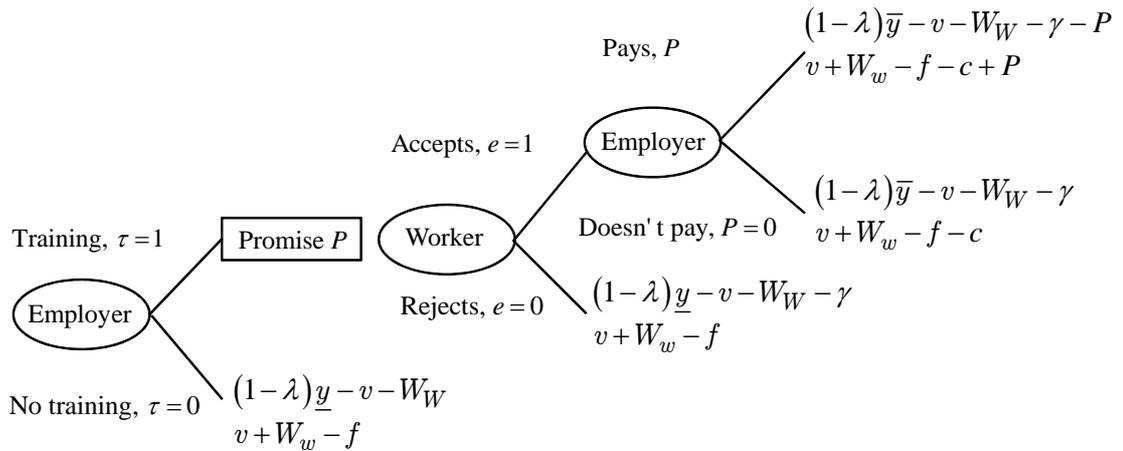


Figure 1: The training game tree

In figure 1, \underline{y} corresponds to the output of untrained workers and \bar{y} is the output of trained workers. λ is the fraction of workers who leave the firm, corresponding to an exogenous turnover rate. The (outside) wage on the labor market assuming that no worker accepts the training offer (or exerts the effort associated with the training) is:

$$v = \frac{p_1 + p_2 \lambda \eta_2}{p_1 + p_2 \lambda} > 1$$

This wage is higher than the production of the workers with low ability since a fraction of high ability workers leave the firm. The firm is forced to pay the same wage to the remaining workers, thus its layoff policy is to offer a wage $v = 1$ to low ability workers, a decision that will motivate them to leave the firm. The outside labor market is competitive so firms have to pay a first period training wage to ensure zero profit. In $t = 1$, the firms due to their monopsony power make expected profits of :

$$\Pi^e = (1 - \lambda) [p_2(\eta_2 - v)]$$

Firms will pay up front wages such that $\Pi^e - (W_w + W_e) = 0$. W_w is the wage offered to workers for their participation at period $t = 0$, and the employers receive W_e . The expected profit is shared between employers and workers according to a specific rule. The payoffs of both players at all stages of the game follow from the discussion. For example, the net payoff of the worker who receives no training corresponds to his wage rate v plus his share W_w of the profit minus his desutility cost f .

2.2. Numerical application and the experimental design

To distinguish between the low and high ability workers, we assume in the experimental protocol that the ability of the workers' population, noted η , follows a log-normal distribution. With the mean of $\log \eta$ set to 0 and its standard deviation equal to 0.5, we obtain a mean to median ratio of abilities equal to 1.1331 (a value corresponding to a mean to median ratio of incomes observed in many countries). From this distribution, we define four types of workers (see in Appendix, Table A1 for the relative distribution of worker's ability level). For simplicity, we disregard the 20% lowest and the 20% highest levels of ability. Our reasoning is that the firms will neglect the rent produced by the training of workers of the lowest level of ability as the expected net return on training is too low. For the highest ability workers, either the marginal return on their training is considered too low or the firms will always offer them a training ($\tau = 1$).

Outputs of workers depend on their ability level and the players' decisions (see Appendix, table A2). We assume a turnover labor market rate of 5% ($\lambda = 0.05$). All workers support a desutility cost $f = 50$. The total cost of training ($\gamma + c = 15$) is shared with $\gamma = 5$ charged to the employer and $c = 10$ to the worker. The equilibrium labor market

wage, v , obtained with this specification is 60.⁴ The expected profit ($\Pi^e = 54$) is shared between the employer ($W_e = 40.5$) and the worker ($W_w = 13.5$).⁵ These values reported in table 1 yield the numerical payoffs of workers and employees corresponding to Figure 1 for all treatments.

Table 1: Payoffs of employers and workers

Decision nodes	employer		high and low ability workers
	low ability	high ability	
$\tau = e = 1; P > 0$	$35.5 - P$	$101 - P$	$13.5 + P$
$\tau = e = 1; P = 0$	35.5	101	13.5
$\tau = 1; e = 0$	-2.5	41.2	23.5
$\tau = 0$	2.5	46.2	23.5

We adopt a 3×2 design of treatments with the following strategic variables: information available to the worker (*Information* vs. *No Information*), the ability level of the worker (*Ability* vs. *No Ability*) and the number of periods (*Fixed* vs. *Random*). We use the symbol *IE* for information treatments where the number of periods of play is chosen randomly. More specifically, for these treatments, the participants were informed that the number of periods to be played is randomly determined by the computer over the interval $[5, 45]$ with each number in the interval having the same chance to occur. At the end of period 5 and for all the subsequent periods, the participants will be informed whether the session continues or is over (see instructions in Appendices). To minimize the number of sessions to run and to be able to compare the results from the two information treatments, we have selected the expected number of 25 periods to be played by all participants.

Treatments	Information / Nb. of periods		
Ability level of worker	No / Fixed	Yes / Fixed	Yes / Random
low : $\eta = 80$	<i>NANI</i>	<i>NAI</i>	<i>NAIE</i>
high : $\eta = 126$	<i>ANI</i>	<i>AI</i>	<i>AIE</i>

In each treatment, the participants play 25 periods in a stranger protocol pairing.

3. Game theoretical solutions and predictions and the experimental procedure

3.1. Solutions and predictions

We use backward induction to derive the equilibrium behavior of the employer and the worker's optimal training decisions in our different treatments. Consequently, we start the analysis of the game at the last stage and present the employer's reward policy of

⁴ $v = \frac{p_0\eta_0 + (p_1\eta_1 + p_2\eta_2 + p_3\eta_3)\lambda}{p_0 + (p_1 + p_2 + p_3)\lambda} = 60.208 \simeq 60$.

⁵ $\Pi^e = (1 - \lambda)[p_1(\eta_1 - v) + p_2(\eta_2 - v) + p_3(\eta_3 - v)] = 54.15 \simeq 54$ which is divided between the employer ($W_e = 40.5$) and the worker ($W_w = 13.5$) such that $\Pi^e - (W_w + W_e) = 0$.

a trained worker. Then, we look at the worker's optimal training decision. Finally, we determine the optimal choice of training offer by the employer in stage 1.

In the *No Information* treatments, the employer cannot commit irrevocably to pay P (the amount promised) to the worker in the last stage of the game. Therefore, the promise works as a cheap talk and the worker who accepts the training offer will not receive P . Knowing that he will never be rewarded for the costly choice of training acceptance, the worker will never accept any offers. Consequently, no employer will make the costly choice of offering a training. This result is independent from the ability level of the worker: the unique Nash equilibrium predicts no training offers by employers and no training acceptance by workers. The theoretical results hold for all periods as interaction is anonymous and one-shot, therefore the 25 periods are repetitions of static games and not a dynamic game giving rise to further equilibria. In other words, the stranger protocol pairing implies a random-matching that allows us to eliminate reputation effects. Thus, we should observe no trained workers in treatments *ANI* and *NANI*.

Let us now consider the information treatments with a finite and an infinite horizon game. Given the worker is informed about the status of the last promise by his current employer, he knows, before making a decision, whether the last worker who accepted an offer received P . Since the number of rounds is fixed and known by the players for information treatments I , players face a finitely repeated game. With the number of periods fixed, cooperation cannot be sustained and the backward induction principle implies that the employer will not reward the trained worker in the last stage of the last round. The worker will reject the training offer in round 25, and the employer will not offer a training in that last round. Game theory predicts that the non-cooperating equilibrium strategy played in finitely repeated interactions is the same as in the one-shot game (Selten, 1978).⁶

In the random number of periods treatments, *IE*, the employers are in an infinitely repeated game, which ends after a random number of repetitions, and therefore reputation building may enforce cooperation among players. However, models based on sub-game perfection imply that enforcing cooperation requires information about reputation that is recursive in nature; one needs to know not only one's partner's past action but also one's partner's partners' past actions, and so on.

⁶Although a fixed number of rounds should lead to a unique perfect sub-game equilibrium, some participants may not explicitly take into account the last period of play in their strategic considerations as mentioned in Osborne and Rubinstein (1994, see paragraph 8.2 in chapter 8). Thus, cooperation may arise from Information treatments but it should decline over time (i.e. when the end is imminent). However, in a famous paper, Kreps et al. (1982) demonstrate that if each player assesses a positive probability that his partner is 'cooperative' if the other cooperates, then sequential equilibria exist wherein perfectly rational players cooperate in finitely repeated games until the last few stages. Note that in our design, this explanation can't hold because of the limited information disseminated among players.

As motivated in Bolton, Katok and Ockenfels (2004, 2005), available information is unlikely to be this extensive, implying a rather limited domain on which informal reputation systems can be effective. In practice, only partial information about others' reputation is typically available. Models relaxing the sub-game perfection principle suggest that cooperation can be sustained on quite modest amounts of information; perhaps solely on information about a partner's recent past, information that is relatively easy to observe. With reputation effects, the structure of the game is modified. Assuming that employers take into account the effect of their current behaviors on the other workers' future behavior, the payment of P in the first round may generate cooperation (i.e. training acceptance by workers and rent sharing by employers). If the employer can commit to pay a compensation refunding the cost of training plus epsilon to the worker (i.e. $P = 10 + \epsilon$), he should accept such offers. As the employer will meet a succession of workers, the payment of the promise in the first round corresponds to a costly signal sent to workers in the next rounds. In case of payment, the employer signals to their future workers that he will reward trained workers or at least that he did so. Thus, the employers who paid P signal their willingness to cooperate with workers who accept their offers. In consequence, the next workers will be more likely to accept his promise and received P . As a result, some employers may develop a good reputation. Whereas defection of the employer implies no cost in the current round ($P = 0$), the employer sends a negative signal to all the future workers in doing so. Thus, a worker who observes that his current employers didn't paid P to the last trained worker shouldn't accept his offer.

To sum up, the absence of external institution to enforce promised payments makes cooperation impossible between players in the *No Information* treatments, disregarding their ability level. In the *Information* treatments with a finite horizon game, neither the information condition, nor the ability level (i.e. the size of the rent) should influence the players' behaviors. Therefore, we should observe no training offer -no acceptance and no honored offer- for the high and low ability treatments for both the *No Information* and the *Information* treatments with a fixed number of rounds. The situation differs with the information treatment with an infinite horizon game, *IE*. With a random number of periods, reputation building should enforce cooperation among players. More training should be offered and accepted, particularly for the *Ability* treatment where the payoffs are more important. Training offers honored by employers should be observed in the *IE* treatments, particularly in the *Ability* treatment.

3.2. The experimental procedure

The computerized experiment involved 12 sessions of 18 participants playing 25 independent periods for a total of 5600 observations, or 900 observations per treatment. After each round, participants were randomly rematched by pairs within their initial group of 6 without switching roles. A participant is usually confronted with 6 different partners

in an irregular fashion. We did not inform the participants about the restrictive matching procedure that allowed us to get 6 independent observations for each treatment for the non parametric analysis of the data. Participants, mostly students of economics or business administration from the University of Montreal, were invited by leaflets and e-mails to register for the experiment. They were seated at visually isolated terminals where they found the written instructions (see in Appendix for an English translation of the instructions for one treatment).⁷ The instructions were read by the instructor and the participants were invited to privately ask for clarifications. All participants had to complete a comprehension questionnaire. The experiment started when all questions were correctly answered by all participants.

Basic information feedback was the same in all treatments. The worker was first told if the employer made him an offer of not. If the worker accepted the offer, he was informed in the last stage of the game if the employer had respected his promise P or not. Profit for the period and cumulated earnings were given to the participants. In treatments with *Information*, the worker got additional information about the value of the last paid promise by his current employer.

The computerized experiment was programmed and conducted with the software *Z-tree* (Fischacher 2007). In all sessions we used the same conversion rate for ECU (Experimental Currency Unit) : 1 ECU = 2 Canadian cents. Including the show-up fee, participants have earned an average of 22 Canadian dollars. A session lasted about 90 minutes including reading the instructions and running the comprehension questionnaire.

4. Results

Average earnings of employers and workers by treatments are reported in table 2. For the *Information* treatment with known 25 periods of play and the *No Information* treatment, the employers' payoffs are higher on average than the theoretical predictions.⁸ The earnings are higher for the high ability workers, A , while more in line with the theory for the low ability workers, NA .

⁷In the experiment, the employer was named player A and the worker player B .

⁸As mentioned earlier, for convenience, the ability level is noted A (NA) for high (low) ability workers. NI is for no information treatments. The information treatments with 25 fixed periods corresponds to I . For the information treatments with expected 25 periods we add a suffix E for expected. Therefore, the AIE treatment stands for Ability and Information treatment with Expected 25 periods.

Table 2: Average earnings per round in ECU

Treatment	Employers' earnings		Workers' earnings	
	actual	predicted	actual	predicted
<i>AI</i>	66.91	46.2	31.61	23.5
<i>AIE</i>	63.48	> 46.2	30.58	> 23.5
<i>ANI</i>	59.35	46.2	25.11	23.5
<i>NAI</i>	6.92	2.5	23.77	23.5
<i>NAIE</i>	6.60	> 2.5	23.47	> 23.5
<i>NANI</i>	6.37	2.5	22.09	23.5

The results for the information treatment with a random number of periods, *IE*, is in line with the theory.

Thus, in general, participants and, in particular, those associated with the high ability workers are more cooperative than the theory predicts as they succeed to create the rent associated with training. To investigate their behavior, we analyze the dynamic of the game: the employers' training offer, the workers' decisions to accept or not the offer, and the employers' decisions in the last phase of the game to reward or not the trained workers.

4.1. Aggregate results and the dynamic of the game

In contradiction with the theoretical predictions, in the *NI* and *I* treatments, the employers offer a significant amount of training in the first period.⁹ This result is maintained for experienced participants up to period 20, except for the *ANI* treatment, where the number of offers is insignificant after round 20. We also note an end-game effect characterized by the rejection of a significant number of offers in the last period (round 25).

In more than 83% of all cases, the employers offer training. The light columns of figure 2 indicates that the number of training offers differs between treatments, but the difference between *AI* and *NAIE* is the only significant one (U robust rank order test).¹⁰ Figure 2 also indicates that an important number of workers are trained with percentages ranging from 73% in the *AI* treatment to 28% in the *NANI* treatment. The *AI* treatment is statistically superior to *NAI*, *NAIE*, and *NANI*, and *AIE* dominates *NAIE*, and *NANI* confirming the empirical literature that high ability workers receive more training than low ability workers.

⁹Based on Binomial tests.

¹⁰The tests were done with Stata, under the name of Flinger-Policello Robust Rank Order Test. Two-tails tests unless specified.

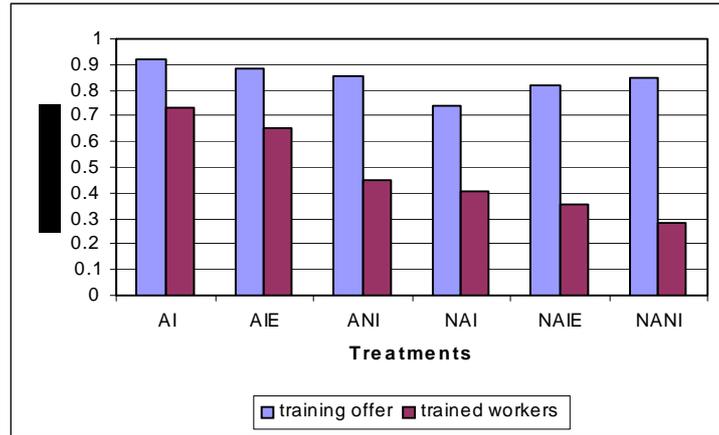


Figure 2 : Frequencies of trained workers and training offers.

The large proportions of offers for the low ability workers in the inform treatment with a random number of periods, *NAIE*, and in the low ability no information treatment, *NANI* relative to the low ability inform treatment with a fixed number of periods, *NAI*, although statistically insignificant, suggests that employers try to exploit the employees poor control of the situation. Interestingly, however, the employees appear to be aware of this and massively reject the training offer.

In table 3, we report random effect probit models on the role of treatments to explain the probability that a training (promise) is offered by the employer and the probability that the worker accepts the training. The results basically confirm the non parametric tests. Relative to the no information no ability treatment, the information treatment with fixed period and with high ability workers increases both probabilities. With the information treatment with 25 periods expected, the results differ according to the ability: employers are more likely to offer more training to low ability workers, while high ability workers are more likely to accept the training offers. Low ability workers refuse to be fooled while high ability workers believe that they have a better chance to get to their share of the rent with employers honoring their promises.

Table 3: Treatments and the probability of training offers (promises) by employers and the probability of workers accepting the training
(Random effects probit models)

Variables and incidental param.	promises	acceptation
	with balanced data	with unbalanced data
Non Inform x No Ability	Ref.	Ref.
Inform x Ability	0.8049 ^a (0.2800)	1.3713 ^a (0.2846)
Inform x No Ability	0.2045 (0.2840)	0.1880 (0.2619)
Non Inform x Ability	0.2697 (0.2846)	0.4431 ^c (0.2616)
Inform (Expected 25 periods) x Ability	0.3123 (0.3262)	1.1001 ^a (0.2943)
Inform (Expected 25 periods) x No Ability	0.5350 ^b (0.2726)	0.2132 (0.2874)
Constant	1.3848 ^a (0.1889)	-0.6616 ^a (0.2147)
ρ	0.6226 ^a (0.0436)	0.3114 ^a (0.0410)
Log Likelihood: Constraint value	-1167.01	-1579.48
Log Likelihood: Binary Probit value	-1135.69	-1454.48
Log Likelihood: Random effects probit value	-854.90	-1323.02
Number of observations	2700	2280

Note: Statistically significant at 1%; b: Statistically significant at 5%; c: Statistically significant at 10%. Two tail tests.

4.2. Employers' training offers

In Table 4, the determinants of training offers by treatments are investigated with random effects probit models. The endogenous, exogenous and predetermined variables used in the regressions are specified in the Appendix (see Table A3).

Let the latent variable T_{it}^* represents the utility for the employer i to offer at period t a training to a worker. This decision is explained by a vector of observable variables z_{it} , the corresponding parameter vector δ , a random individual component η_i , and a random variable ε_{it} :

$$T_{it}^* = z_{it}\delta + \eta_i + \varepsilon_{it}, \quad i = 1, \dots, n, \quad t = 1, \dots, T.$$

The two random elements are independent and follow a normal distribution. The latent variable T_{it}^* is unobservable, but we do observe the i individual employer in period t offering or not a training to the worker. Thus, we use the auxiliary variable P_{it} ,

$$P_{it} = \begin{cases} 1, & \text{if } T_{it}^* > 0, \\ 0, & \text{otherwise.} \end{cases}$$

Two specifications are considered. In column (1), only the variables associated with the experimental design are used. We have a '1st period' dummy variable to signal willingness to cooperate between employers and the workers before the participants enter in the dynamic of the game. The dummy 'Last five periods' captures an end game-effect, if it exists. The variable 'Period' tracks the dynamics of the game and the learning process of the participants. 'High ability' is a dummy variable, with the reference variable being the 'Low ability worker'. For both the employer and the worker, there is a risk that the other will not cooperate. For the employer, it is costly to have an offer rejected, particularly, in the low ability treatment. The dummy variables 'Last offer by employers was rejected' and the crossed variable 'Last offer rejected*High ability' could explain the next period behavior of the employer in offering a training.

The results from column (1) relate to incentive variables. In column (2), we add the participants' characteristics as controlled variables: gender and dummies for graduate students and students in economics or in related fields (business, mathematics, computer science), which might perform better in experiments involving aspects of game theory. The variable 'Previous participant' informs if the subject has participated in a laboratory experiment in the past. Finally, a dummy variable distinguishes the risk-seeking participants.¹¹

For simplicity, we only comment the statistically significant parameter estimates of column (2). The probability to offer training decreases significantly over time, converging toward the theory. However, in contradiction with the theory, we note the strong statistically negative coefficient with the first period dummy variable in the inform treatment with expected 25 periods. The worker's level of ability makes no difference when the participant has no information, in line with the theory, but the probability of an offer increases for high ability workers in both information treatments (with less impact when the last offer of the employer was rejected in the information treatment with expected 25 periods). For the information treatment with fixed periods, this result contradicts the theoretical prediction of a neutral effect of the ability on the employers' behavior. Men offer less training than women in the inform fixed periods treatment. Risk-seeking participants show a higher probability of offering training.

¹¹This variable was obtained in the following manner: when the participants are asked to pick a computer number, they are privately invited to choose a show up fee of \$5 or a chance to earn \$11 with a 50% probability or \$0 with a 50% probability. For those choosing the lottery, a coin toss decides their earnings at the end of the experiment. It seems reasonable to suggest that the participants who choose the lottery are more risk-seekers than those choosing the guaranteed \$5. However, we recognize that this measure of risk attitude is largely imprecise considering that attitude toward risk is contextual.

Table 4: Determinants of employers offering a training
(Random effects probit model)

Variables and incidental param.	Non Inform		Inform		Inform	
			25 Periods known		Expected 25 periods	
	(1)	(2)	(1)	(2)	(1)	(2)
1st period	0.2085 (0.4268)	0.2096 (0.4919)	0.0502 (0.6204)	0.1072 (0.5301)	-0.9183 ^a (0.2890)	-0.9089 ^a (0.3256)
Last 5 periods	0.0806 (0.2551)	0.0794 (0.3218)	-0.0421 (0.3969)	-0.0498 (0.3916)		
Period	-0.0536 ^a (0.0110)	-0.0562 ^a (0.0137)	-0.0484 ^b (0.0209)	-0.0486 ^b (0.0227)	-0.0286 ^a (0.0073)	-0.0286 ^a (0.0089)
Ability	-0.3677 (0.5268)	-0.4809 (0.6930)	0.8552 ^b (0.3767)	1.1270 ^c (0.6322)	0.1020 (0.4700)	0.8689 ^c (0.4712)
Last offer rejected	0.4023 ^c (0.2219)	0.3384 (0.3193)	0.0898 (0.1935)	0.0660 (0.1934)	0.0936 (0.1841)	0.0935 (0.2309)
Last offer rejected x Ability	-0.2037 (0.3272)	-0.0770 (0.4209)	-0.7198 (0.5135)	-0.5905 (0.7992)	-0.7358 ^a (0.2793)	-0.7096 ^b (0.3311)
Male		-0.0669 (0.5978)		-1.4289 ^b (0.5731)		0.4949 (0.5406)
Graduate student		1.0452 (0.9194)		0.7009 (1.1050)		0.0239 (0.4745)
Econ. or related field student		-0.6167 (0.7724)		0.5356 (0.6163)		0.4671 (0.4739)
Previous participant		0.7361 (0.7726)		0.8089 (0.6247)		-0.0334 (0.5569)
Risk lover		0.7481 (0.6495)		2.0600 ^a (0.7448)		-0.5330 (0.7039)
Constant	2.5425 ^a (0.4551)	2.4670 ^b (1.1222)	2.5775 ^a (0.4815)	1.0425 (0.9960)	2.1583 ^a (0.3576)	1.5274 (0.9924)
ρ	0.5944 ^a (0.0894)	0.6801 ^a (0.1162)	0.7192 ^a (0.0735)	0.6630 ^a (0.1243)	0.5866 ^a (0.0875)	0.5301 ^a (0.1348)
Log Likelihood:						
Constraint value	-375.19	-375.19	-408.71	-408.71	-382.17	-382.17
Binary Probit value	-347.12	-322.97	-365.78	-317.76	-365.31	-354.48
Random effects Probit value	-258.66	-253.48	-245.94	-239.73	-302.60	-301.64
Number of observations	900	900	900	900	900	900

Note: Number of observations: 900 for all specifications. a: statistically significant at 1%; b: statistically significant at 5%; c: statistically significant at 10%.

4.3. Reputation issue and how workers react to training offers

The light column of figure 2 indicates that with the introduction of information with a fixed number of periods, more training is offered to high ability workers relative to low ability workers, which contradicts our theoretical predictions. It appears in that employers are particularly concerned with their reputation with high ability workers. In every information treatment, the worker knows about the reputation of the employer to which he is currently matched. Specifically, the worker knows if his current employer has honored his last promise or not. In the affirmative case, the employer is developing a good reputation, $P_{obs} > 0$, and otherwise a bad reputation, $P_{obs} = 0$. There are cases where the employer has no reputation, $P_{obs} = none$, because he never offered

training or the offers were never accepted by the worker. This is also the situation that prevails for the first period of the game.¹² On the one hand, it may be less risky for employers with a good reputation ($P_{obs} > 0$) to have their costly training offer be rejected. Thus, compared to employers with a bad reputation ($P_{obs} = 0$), a higher proportion of employers with a good reputation should offer training to workers regardless of their ability level. This behavior is observed in figures 3a and 3b, which reports the proportion of training offers conditioned on the reputation of employers.

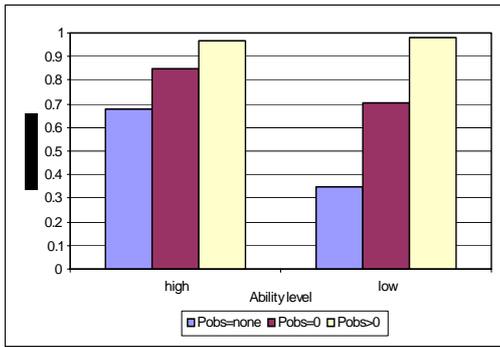


Figure 3a: 25 periods

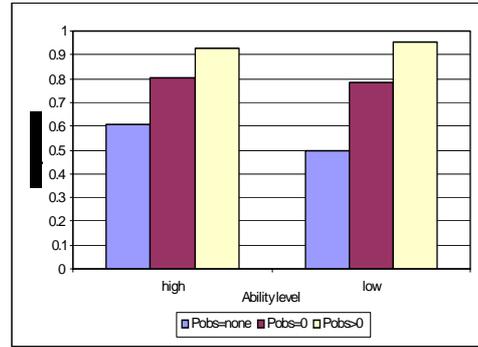


Figure 3b: Expected 25 periods

Training offers by ability level and reputation

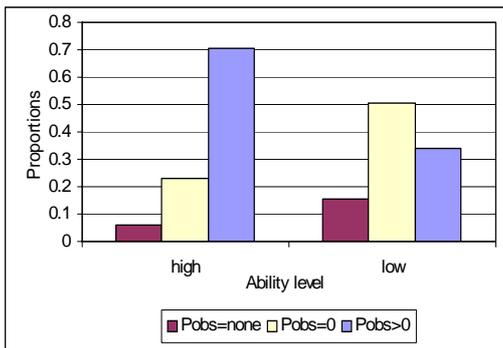


Figure 4a: 25 periods

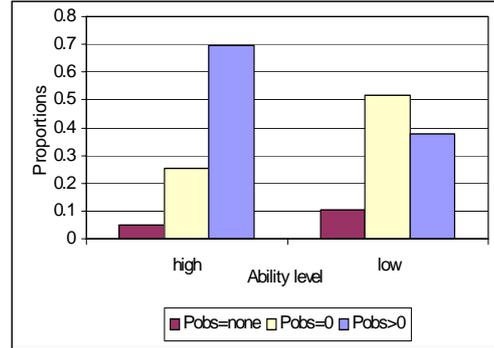


Figure 4b: Expected 25 periods

Distribution of employers' reputation status by ability level of workers

On the other hand, the rent produced with the training of a high ability worker is higher than the rent obtained with a low ability worker. Therefore, the employers confronted to high ability workers have a strong incentive to make a training offer and to build a good reputation. In other words, they are more likely to make an offer in the subsequent games.

This virtuous dynamics is observed in figures 4a and 4b, which report the distribution of the employees' reputation status by the ability level of workers. In the information treatment with a fixed number of periods, we observe a larger proportion of employers with a good reputation in the high ability workers category relative to low ability workers

¹²In all figures dealing with employers' reputation, we excluded the first period decisions.

(U-test statistically significant). A substantial difference is also observed in a reversed way for the employers with a bad reputation status. A similar pattern is found in the information treatment with expected 25 periods: high ability workers attract employers with a good reputation and low ability workers have a larger share of bad reputation employers (U-test statistically significant).

As seen in Figure 2, the proportion of workers accepting the training offer vary by treatments. Low ability workers knowing that the rent generated by their training is relatively low might anticipate that employers will not honor their promise irrespective of the information situation and therefore are more likely to refuse the training offer. On the opposite, high ability workers are more confident to receive what was promised to them for training and are more likely to accept it. However, the information condition appears to matter when the employer has a good reputation. This is illustrated with figures 5a and 5b that show the proportion of low and high ability workers accepting the training offer controlled by the level of reputation of the employer. We can see that a good reputation by the employer contributes to narrow the gap between low and high ability level of the worker in accepting the training offer (U-test statistically insignificant in the "fixed" 25 periods treatment). A bad reputation substantially lowers the acceptance level in general, but particularly for the low ability workers (U-test statistically significant in the 25 periods).

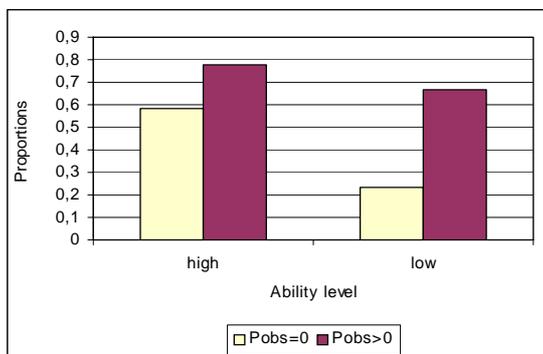


Figure 5a: 25 periods

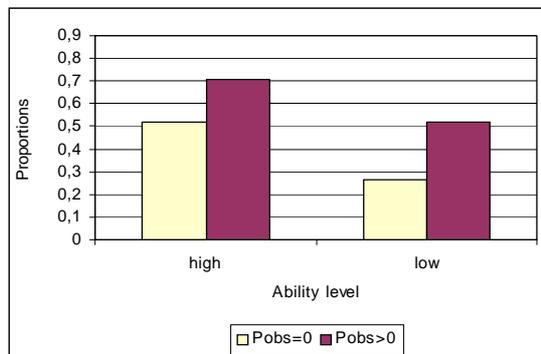


Figure 5b: Expected 25 periods

Proportion of workers by ability level accepting the training offer
by employer of different levels of reputation

Other variables are likely to affect the worker's behavior. If the last promise was not honored by the employer, this costly situation for the worker might affect his decision when the next offer will appear. The value of the promise might also play a role in the worker's decision. In particular, we have noted that 3% of the employers' offers were not credible: these are offers where the employers would be better off offering nothing if the workers were to accept that kind of offers. These offers are clearly non credible and we expect workers to reject them.

In table 5, we analyze the determinants of the decision by a worker i at period t to accept or reject an offer by the employer. Since the worker's decision is conditioned by the employer offering a training, we use a random effects probit model with unbalanced data for the estimations. In the no information treatments (NI), assuming workers marginally trust the employers' promise of in the first round, the probability of accepting the offers declines strongly over periods. Following a refusal by an employer to transfer the amount promised, the probability to accept a new offer is reduced. Thus, workers are discouraged to cooperate over time by employers who refuse to pay their promises. The erosion of trust can be explained by negative reciprocity: workers misled by their current employer are less likely to accept new offers from future employers. The absence of reward from one particular employer discredits all employers.

In both information treatments (I) and (IE), the high ability worker is more likely to accept the training than a low ability worker, which contradicts our theoretical predictions for the (I) treatment. An increase in the value of the amount promised increases the probability to accept the offer, but within certain limits as the probability to accept an offer is decreasing with a non credible promise. Thus, the size of the rent associated with training influences positively the probability of accepting training. In the information treatments, the reputation of the current employer comes into play: a good reputation does increase the probability that the worker will accept the offer while a bad reputation decreases this probability. In both treatments, the bad reputation status exerts a stronger effect. Thus, there is evidence of a reciprocity strategy played by the workers. This reciprocity is relatively more important in the information treatment with a fixed number of periods. For the information treatment with a random number of periods, the reciprocity associated with the variable 'last acceptance not honored' appears to matter as much as the reciprocity with the employer's reputation status contrary to the previous information treatment. This difference might be explained by the risk factor associated with the random number of periods the game is played. Some indication leading in that direction is that the probability of accepting the training offer decreases with the number of periods of play in that information treatment.

Table 5: Determinants of workers accepting the training
(Random effects probit model with unbalanced data)

Variables and incidental param.	Non Inform		Inform		Inform	
			25 periods known		Expected 25 periods	
	(1)	(2)	(1)	(2)	(1)	(2)
1st period	0.5524 ^c (0.3132)	0.5527 (0.3531)	0.3472 (0.5039)	0.3306 (0.5462)	0.2150 (0.3107)	0.2078 (0.3557)
Last 5 periods	0.2354 (0.2239)	0.2356 (0.2991)	0.1954 (0.2735)	0.2033 (0.3269)		
Period	-0.0535 ^a (0.0126)	-0.0535 ^a (0.0169)	-0.0054 (0.0145)	-0.0061 (0.0161)	-0.0208 ^a (0.0076)	-0.0207 ^a (0.0075)
Ability	0.4853 (0.3320)	0.5658 (0.4221)	0.7700 ^a (0.2475)	0.8454 ^a (0.2833)	0.7416 ^a (0.2672)	0.8327 ^b (0.3296)
Last acceptance not honored	-0.3702 ^b (0.1807)	-0.3703 ^c (0.1922)	-0.1341 (0.2520)	-0.1262 (0.2754)	-0.5446 ^b (0.2524)	-0.5378 ^c (0.2772)
Amount promised	0.2011 (0.2516)	0.2192 (0.2746)	2.7366 ^a (0.4194)	2.7657 ^a (0.5080)	1.5826 ^a (0.2932)	1.5932 ^a (0.3253)
Non-credible promise	-0.7882 (0.4992)	-0.8075 (0.5776)	-1.9633 ^a (0.4339)	-1.9619 ^a (0.4749)	-1.0346 ^a (0.2625)	-1.0338 ^a (0.3206)
Good reputation of A			0.8593 ^b (0.4057)	0.8134 ^c (0.4599)	0.6510 ^a (0.2104)	0.6466 ^a (0.2208)
Bad reputation of A			-0.9972 ^a (0.3856)	-1.0156 ^b (0.4330)	-0.5672 ^b (0.2295)	-0.5719 ^b (0.2446)
Male		-0.2447 (0.5455)		-0.0781 (0.3322)		-0.0021 (0.4589)
Graduate student		0.1083 (0.5385)		0.4108 (0.3502)		-0.2931 (0.3525)
Econ. or related field		-0.4868 (0.3724)		0.1323 (0.2876)		0.2606 (0.3989)
Previous participant		0.0932 (0.5549)		0.2691 (0.2391)		0.3480 (0.2731)
Risk lover		0.3285 (0.4110)		0.2779 (0.2968)		-0.1224 (0.4599)
Constant	-0.1302 (0.3200)	-0.0700 (0.5902)	-1.5348 ^a (0.3902)	-1.9917 ^a (0.5813)	-0.9282 ^a (0.2992)	-1.0354 ^b (0.4615)
ρ	0.3770 ^a (0.0788)	0.3677 ^a (0.1002)	0.2159 ^a (0.0764)	0.1813 ^b (0.0903)	0.2898 ^a (0.0730)	0.2610 ^a (0.0743)
Log Likelihood:						
Constraint value	-503.82	-503.82	-507.81	-507.81	-529.35	-529.35
Binary Probit value	-467.63	-458.49	-343.17	-336.26	-437.50	-429.97
Random effects probit value	-411.67	-409.87	-328.97	-325.05	-402.35	-400.54
Number of observations	768	768	748	748	764	764

Note: statistically significant at 1%; b: statistically significant at 5%; c: statistically significant at 10%.

Thus, our theoretical predictions concerning the workers' behavior are relatively accurate as the game evolved for the no information treatments. Without information about reputation, there is little reason to suppose that cooperation can be sustained. Our predictions are also in line with the results for the information treatments with a random number of periods of play. The employers' reputation matters and more able workers are more willing to accept the training offers. However, they are refuted for the information treatments with fixed number of periods where the ability level of the workers and the reputation of the employers influence significantly the decision by workers to accept the training offer. These results can be explained by the fact that some participants assess a positive probability that their partners are 'cooperative' if the others cooperate, then sequential equilibria exist where perfectly rational players cooperate in finitely repeated game until the last few periods (Kreps, Roberts and Wilson, 1982). Unfortunately, we do not observe any period effects to validate this explanation.¹³

Interestingly, the random effects probit models leave no room for the observed characteristics by the participants to play a role in the decision to accept a training offer. Incentives and information variables associated with the experimental variables are the key factors to explain the workers' decision to accept the employer's offer. Note that with matched employers-workers survey data, up to 30% of workers refuse training offers (See Turcotte, Leonard and Montmarquette, 2003).

4.4. Employers' monetary incentives and reward of workers' training.

Can the bilateral deviation from the equilibrium be explained (rationalized) by the employers' monetary incentives (in ECU) and reward behavior? From the worker's points of view, does it pay to cooperate?

An employer can influence the worker's behavior in two ways. First, by attaching the promise of a bonus to the worker's acceptance of the training. In doing so, the employer promises to reciprocate to the worker's cooperative behavior (see Ferh and Gächter, 1999, Falk and Gächter, 2002). If the worker accepts the training, he trusts the employer's reciprocity. Second, an employer may or may not honor his promise at the end of the game. The reward behavior contributes, in the *No Information* treatments, to reinforce trust in reciprocity and, in both *Information* treatments, to build the employer's reputation.

¹³Cooperation with a finite horizon model was also noted by Bolton et al (2005). They believe that a theoretical model can support this result.

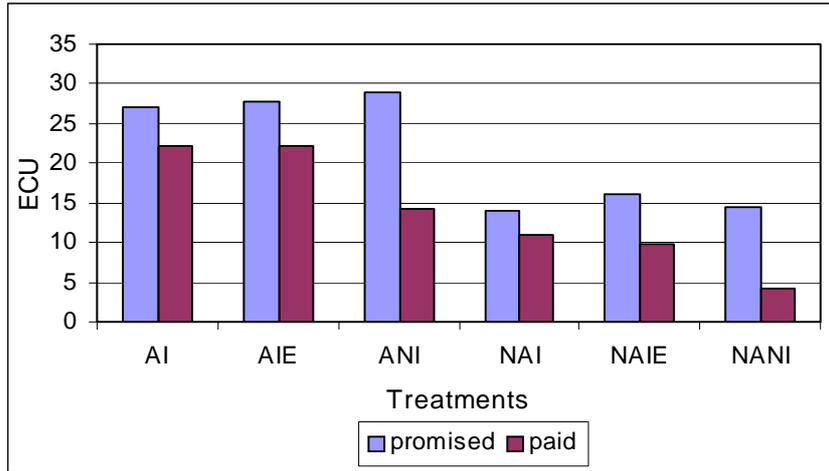


Figure 6: Bonuses promised and paid to workers

In figure 6, we show that the value of the employers' promises are higher than the reward payments. The amounts promised and paid to depend on the ability level of the worker: the higher the ability level, the higher the bonuses promised and paid (most U-tests are statistically significant). These results were predicted only for the random periods treatment. As expected, however, the differences between the values of the bonuses promised and paid are lower with the information treatments than with the no information treatments (t-tests statistically significant).

4.4.1. Employers' reward and reputation building

At the end of a round, the employer offering training chooses whether to honor his promise. This decision does not have the same impact and interpretation in our treatments. In the *No Information* treatments, the employer's individual decision has no direct influence on future games. But, if all of them refuse to pay, they discourage workers over the next rounds to accept training through negative reciprocity. In the information treatments, the employer developing a good or a bad reputation does not have a neutral effect on the worker's acceptance decision for training as was shown in table 4.

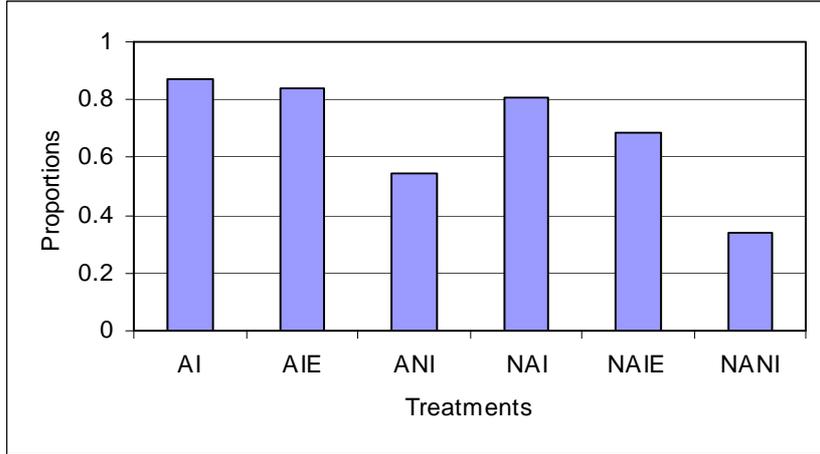


Figure 7: Proportions of bonuses paid to workers by treatments.

Figure 7 shows that the proportion of bonuses paid to trained workers are high for informed workers, reaching 87% for high ability workers in the information treatment with a fixed number of periods. The proportion drops dramatically in the no information treatment with less than one third of low ability trained workers rewarded and 55% for the high ability workers (U-tests statistically significant for both *AI* and *AIE* with respect to *ANI* and *NANI*). As seen before, both information treatments reduce the gap between low and high ability trained workers in terms of employers honoring their promises.

In table 6, we use a two-step procedure with unbalanced panel data, explaining first the decision by the employers to respect or not to respect their promise with a random probit model. In the second step, we use Feasible Generalized Least Squares to analyze the determinants of the actual amount transferred to the trained workers corrected for a selection bias with the Mill's inverse ratio variable obtained from the first step.¹⁴

To compare the promises in the different ability treatments, we have standardized them: $P^{nh} = \frac{P}{(101-46.2)}$ for the high ability treatment and $P^{nl} = \frac{P}{(35.5-2.5)}$ for the low ability treatment. Normalized offers above one are not credible - accounting for 3.1% of the total offers - and were ignored in the regressions.¹⁵

The regression results confirmed the importance of information and therefore of the development of a good reputation in the probability of an employer respecting his promises as suggested with figures 5a and 5b. We would have expect, however, this reputation seeking to be more important in the information with expected 25 periods treatments

¹⁴The two-step procedure is an alternative to a generalized tobit model, which is not obvious to estimate in a panel setting. For the amount transferred, we use a two error components random effects model. New cross-variables are introduced to distinguish between the information with fixed 25 periods and the non information treatments for 'Last 5 periods', 'Last offer' and 'Ability' variables. This two-step procedure is less restrictive than the traditional Tobit model. Unfortunately, none of these techniques are nested.

¹⁵Few observations are clustered at one. We have ignored this upper limit.

than with the fixed 25 period treatments. When an employer has his last training offer rejected, he has a tendency not to respect his promise in an effort somehow to recoup his losses. However, this strategy is less important for the high ability workers in line with the importance for the employers to maintain a good reputation with this category of workers. We note that as the experiment evolves, the probability of an employer honoring his promises declines with endgames effect in the *No Information* and fixed *Information* treatments. Finally, as for the case of the probability of a worker accepting the training, we found that the observed covariate variables are insignificant when we control for a random individual effect.

Information significantly increases the amount transferred to the trained workers. The worker's ability strongly influences the amount transferred, in all treatments, but even more so in the no information treatment and in the information treatment with a fixed 25 periods. In a sense the level of ability narrows the gap between the information and the no information treatments in the value of the amounts transferred to the workers when the employer has decided to honor his promise. Finally, the amounts transferred increase with graduate students and with male participants.

Table 6: Determinants of employers respecting his promise and amounts transferred to workers
(Random effects probits and FGLS in panel with unbalanced data)

Variables and incidental param.	Random effects probit	FGLS	Random effects probit	FGLS
Period	-0.0279 ^b (0.0129)		-0.0306 ^b (0.0133)	
Period x inform 25	0.0192 (0.0175)		0.0212 (0.0176)	
Inform (fixed)	1.6752 ^a (0.5847)	0.1450 (0.0942)	2.0278 ^a (0.7180)	0.2021 ^b (0.0965)
Inform 25	1.2274 ^c (0.6401)	0.2251 ^b (0.0895)	0.9685 (0.8617)	0.1688 ^b (0.0817)
Non Inform x last 5 periods	-0.5153 ^c (0.3046)	0.0091 (0.0625)	-0.5325 ^c (0.2981)	0.0483 (0.0543)
Inform x last 5 periods	-0.4875 (0.3381)	-0.0599 ^b (0.0247)	-0.4322 (0.3511)	-0.0396 ^c (0.0212)
Ability	0.3995 (0.5721)	0.1494 ^b (0.0635)	0.9766 (0.6629)	0.1827 ^b (0.0753)
Last offer rejected x Ability	0.5192 ^c (0.3143)	0.0264 (0.0397)	0.5256 (0.3226)	0.0043 (0.0357)
Ability x inform	0.6172 (0.7688)	0.0323 (0.0720)	0.1812 (0.9124)	-0.0470 (0.0780)
Ability x inform 25	0.6863 (0.8458)	-0.0732 (0.0701)	-0.0619 (0.9570)	-0.1448 ^c (0.0770)
Last offer rejected	-0.6399 ^b (0.2724)	-0.0303 (0.0510)	-0.6397 ^b (0.2776)	0.0010 (0.0450)
Last offer rejected x Inform	-0.5037 (0.3718)	-0.0285 (0.0319)	-0.4841 (0.3805)	-0.0187 (0.0319)
Last offer rejected x inform 25	-0.0690 (0.3529)	0.0170 (0.0324)	-0.0547 (0.3752)	0.0088 (0.0318)
Male			-0.4700 (0.3764)	0.0497 ^c (0.0283)
Graduate student			0.7138 (0.4498)	0.1377 ^a (0.0339)
Econ. or related field student			-0.2530 (0.4033)	-0.0430 (0.0281)
Previous participant			-0.0769 (0.3857)	0.0195 (0.0309)
Risk lover			0.2354 (0.4040)	-0.0425 (0.0375)
Constant	-0.3768 (0.4273)	0.1540 (0.1076)	-0.5375 (0.6704)	0.1340 (0.1073)
ρ	0.6685 ^a (0.0562)		0.7153 ^a (0.0545)	
Mill's Inverse Ratio		0.1619 ^b (0.0766)		0.0999 (0.0626)
R-squared		0.0209		0.0919
Log Likelihood:				
Constraint value	-643.08		-643.08	
Binary Probit value	-537.78		-523.38	
Random effects probit value	-412.08		-409.36	
Number of observations	1108	812	1108	812

Note: 1108 observations for the probits and 812 for the FGLS regressions. a: statistically significant at 1%; b: statistically significant at 5%; c: statistically significant at 10%.

5. Conclusion

Do people succeed in cooperating and generating a training rent? As pointed out by game theory, this strongly relies on the credibility at the end of the game of the profit sharing rule. In the absence of external institutions, coordination on the optimal outcome is difficult to achieve. However, reputation building can be an effective means of enforcing cooperation if an institution tracks and disseminates information about players' past actions.

In the no information treatments, the decisions by the employers and the workers converge over time with the theoretical predictions of no offer and no acceptance of training. As predicted, the ability level (i.e. the size of the rent), does not play a role. The employer and the worker enter into a negative reciprocity dynamics. Unrewarded trainings reduce the worker's probability to accept the training over time. As a consequence, the employer decreases the amount promised. In that context there are major barriers to training in firms.

In both information treatments, the probability of offering a training decreases over time. In the information treatments with a fixed number of periods, a higher ability increases the probability of offering a training, contradicting the theoretical predictions. An offer by an employer rejected in the previous period decreases the probability that the employer will offer a training to a high ability worker in the information treatment with a random number of periods.

In both information treatments, the ability and the amount promised by the employers increase the probability of workers accepting the training. Information allows reputation building. An employer with a good reputation coupled with a credible offer greatly increases the probability that the worker will accept the training while a bad reputation reduces that probability.

The development of a good reputation plays a strong role in the probability of an employer respecting his promises. However, this reputation seeking is not as important in the information treatment with a random number of periods. An employer whose last training offer was rejected tries to recoup his losses by not respecting his current promise. This strategy is less important for the high ability workers in line with the importance for the employers to maintain a good reputation with this category of workers. We note that as the experiment proceeds, the probability of honoring his promise declines with endgames effect in the no information and in the fixed information treatments. Finally, the ability narrows the gap between the information and non information treatments in the amounts transferred to the workers.

The introduction of an information system on the reward of the last trained worker positively and significantly influences the behavior of the players. However, this mechanism presents some drawbacks. Not all the employers were able to establish a good

reputation, which suggests that information does not provide enough incentives to discipline reward behaviors. Overall, while information and reputation matter for training in firms, however, this is likely to be a long and costly process and might not be a good substitute for a certification alternative.

References

- [1] Acemoglu D., and J-S. Pischke. 1999a. Beyond Becker: Training in Imperfect Labour Markets, *The Economic Journal*, 109 (453), 112-142.
- [2] Acemoglu D., and J-S. Pischke. 1999b. The structure of wages and investment in general training, *Journal of Political Economy*, 70 (3), 539-572.
- [3] Acemoglu D., and J-S. Pischke. 2000. Certification of Training and Training Outcomes, *European Economic Review*, 44, 917-927.
- [4] Autor D., 2001. Why do temporary helps firms provide free general skills training?, *Quarterly Journal of Economics*, 116 (4), 1409-1448.
- [5] Axelrod R. (1984). *The Evolution of Cooperation*, New York: Basic Book.
- [6] Barron, J.-M., M.C. Berger, and D.A. Black.. 1999. Do Workers Pay for On-the-Job Training ?, *Journal of Human Resources* , 34 (2), 236-252.
- [7] Becker G.S. 1962. Investment in human capital: a theoretical analysis, *Journal of Political Economy*, 107 (3), pp 917-927.
- [8] Bolton G.E., E.Katok and A.Ockenfels. 2004. How effective are Electronic Reputation Mechanisms? An Experimental Investigation, *Management Science*, 50(11), 1587-1602.
- [9] Bolton G.E., E. Katok and A.Ockenfelsé 2005. Cooperation among strangers with limited information about reputation, *Journal of Public Economics*, 89, 1457-1468.
- [10] Booth A.and M.L., Bryan..2005. Testing some Predictions of Human Capital Theory: New Training Evidence from Britain, *Review of Economics and Statistics*, 87(2), 391-394.
- [11] Booth A.and M.L, Bryan. 2007. Who Pays for General Training in Private Sector Britain? *Research in Labor Economics*, 26, 85-123.
- [12] Booth A.and G. Zoega. 2000. Why do Firms Invest in General Training? 'Good Firms' and 'Bad Firms' as a Source of Monopsony Power, Discussion paper ISER, University of Essex.
- [13] Brandts J.and N. Figueras. 2003, An Exploration of Reputation Formation in Experimental Games, *Journal of Economic Behavior and Organization*, 50, 89-115.
- [14] Falk F., and S. Gächter. 2002. Reputation and Reciprocity: Consequences for the Labour Relation, *Scandinavian Journal of Economics*, 104 (1), 1-27.
- [15] Fehr E., and S. Gächter. 1999. Collective Action as a Social Exchange, *Journal of Economic Behavior and Organization*, 39, 341-369

- [16] Fischbacher U. 2007. Z-tree: Zurich Toolbox for Ready-made Economics Experiments, *Experimental Economics* 10(2), 171-178.
- [17] Garcia F., J. Arkes and R. Trost. 2002. Does employer-financed general training pay? Evidence from the US Navy, *Economics of Education Review*, 21, 19-27.
- [18] Kessler A.S., and C. Lülfesmann. 2006. The Theory of Human Capital Revisited: On the Interaction of General and Specific Investments, *The Economic Journal*, 116(October), 903-923.
- [19] Kreps D., P. Milgrom J. Roberts and R. Wilson. 1982. Rational Cooperation in the Finitely Repeated Prisoner's Dilemma, *Journal of Economic Theory*, 27, 245-252.
- [20] Leuven E., H. Oosterbeek H, R. Sloof and C. van Klaveren. 2005. Worker reciprocity and employer investment in training, *Economica*, 72, 137-149.
- [21] Lowenstein M.A., J.R. Spletzer. 1999. General and Specific Training: Evidence and Implications, *Journal of Human Resources*, 39(4), 710-733.
- [22] Oosterbeek H., R. Sloof and J. Sonnemans. 2007. Who should invest in firm specific training?, *Journal of Population Economics*, 20 , 329-357.
- [23] Osborne M.J. and A. Rubinstein. 1994. *A Course in Game Theory*. Cambridge: MIT Press.
- [24] Peraita C. 2001. Testing the Acemoglu-Pischke model in Spain, *Economics Letters*, 72, 107-115.
- [25] Turcotte J., A, Léonard and C. Montmarquette 2003. New Evidence on the Determinants of Training in Canadian Business Locations, working paper W-02-9E, Human Resources Development Canada.
- [26] Selten R. 1978. Chain Store Paradox, *Theory and Decision*, 9, 127-159.
- [27] Sloof R., H. Oosterbeek and J. Sonnemans Specific investments, holdup, and the outside option principle, *European Economic Review*, 48, 1399-1410.
- [28] Spence A.M. 1973. Job Market Signaling, *Quarterly Journal of Economics*, 87, 355-74.

6. Appendix

6.1. Numerical application

Table A1: The distribution of the workers' type.

Types	Ability level	% of workers	$h = 100 \times \eta_i$
p_0	very low	20%	$\eta_0 = 46$
p_1	low	30%	$\eta_1 = 80$
p_2	high	30%	$\eta_2 = 126$
p_3	very high	20%	$\eta_3 = 216$

Table A2: The output $y_i = \alpha^{e\tau} \eta_i$ with $i=0, \dots, 3$

employer	worker	output	Types			
Training	effort		p_0	p_1	p_2	p_3
$\tau = 1$	$e = 1$	y_1	69	120	189	324
$\tau = 1$	$e = 0$	y_2	46	80	126	216
$\tau = 0$		y_3	46	80	126	216

6.2. Definition of variables used in the regressions

Table A3: Definition of variables

Endogenous Variables	
Decision by A to offer a training:	1 = yes; 0 = no
Amount promised by A :	P or 0
Decision by B to accept the offer	1 = yes; 0 = no
Decision by A to honor his promise	1 = yes; 0 = no
Amount transferred by A	P or 0
Exogenous or Predetermined Variable	
Variable associated with the experiment	
Dummy by treatment: Non-Informed	= 1; 0 otherwise
Informed with 25 periods	= 1; 0 otherwise
Inform with expected 25 periods	= 1; 0 otherwise
Low ability	= 1; 0 otherwise
High ability	= 1; 0 otherwise
1st period dummy	= 1 if the first period; 0 otherwise
Last 5 periods dummies	= 1 if the last five periods; 0 otherwise
Period 1 to 25	
Last offer by A was rejected:	1 = yes; 0 = no
Last offer by A rejected*High ability	= 1 if the last offer by A was rejected by high ability workers; 0 otherwise
Last acceptance by B was not honored by A :	1 = yes; 0 = no
Non credible offer by A :	crossed variable with P and a dummy set to 1 if the offer by A means A losing money; 0 otherwise
Reputation of A :	
Bad reputation corresponds to the fact that the last bonus promised by A equals 0:	1 = yes; 0 = no
Good reputation corresponds to the fact that the last bonus promised by A is positive:	1 = yes; 0 = no
No reputation means that participant A has never had the opportunity to honor or not his promise:	1 = yes; 0 = no
Characteristics of the participants	
Sex:	1 = male; 0 = female
Graduate student:	1 = yes; 0 = otherwise
Economics or related field:	1 = yes; 0 = otherwise
Previous participant:	1 = the participant has participated to other experiments; 0 = otherwise
Risk seeking attitude:	= 1 if the participant selected the lottery instead of the fixed show-up fee.

A:employer; B: worker.

6.3. Instructions for the high ability and information with fixed 25 periods treatment (AI)

You are taking part in an experiment where you are asked to make decisions. Over the course of this experiment, you can win money. The amount of money depends on your decisions, and in some cases, on another person's decisions.

Each one of you takes his/her decisions individually in front of his/her computer. You are asked not to communicate with other participants.

In the experiment, anonymous pairs will be formed from a participant A and a participant B . The experiment will be comprised of 25 independent periods. Each each new period, the pairs will be randomly formed with a participant A and a participant B . You are designated as a participant A or a participant B at the beginning of the experiment. You will keep this role for the entire duration of the experimental session. Unfolding of a period:

Each period consists of three steps.

During the first step, participant A decides whether or not to offer a premium P to participant B . P must take the form of an integer and a decimal. The allowed values of P are, for example: (0.1; 0.2; ...; 13.7; 13.8; ...).

⇒ If A does not offer a premium, the period ends and the participants' earnings are 46.2 experimental units (EU) for A and 23.5 EU for B .

In the second step, if A has offered a premium P , B is informed of the amount of the promised premium and must then decide to accept or to decline the proposition from A .

⇒ If B refuses, B will earn 23.5 EU and A will gain 41.2 EU. The period is now over.

⇒ If B accepts, B will earn 13.5 EU plus the premium P , that is $(13.5 + P)$. A will earn the amount corresponding to 101.0 minus the premium P , that is $(101.0 - P)$.

In the third step, A decides to pay or not to pay the promised premium. If the decision is positive, the value of the promised premium is P . If A does not pay the premium, the value of P is 0.

Observation of the last premium paid by participant A :

At the beginning of each period except for the first period, the participant B takes note of the last premium paid by the participant A . The participant B receives the following message on his computer screen:

→ "The last premium paid by this participant A was of" followed by the amount of the last premium paid by A .

If this participant A has not paid the last promised premium, the following message is shown on the screen:

→ "The last premium paid by this participant was 0"

Note that if A has never offered a premium to a participant B , this information is not available. B is informed that this participant A has never offered a premium to a participant B up to now. Participant B sees the following message on the computer screen:

→ “This participant A has not paid a premium to a participant B so far. Note that either A has never promised a premium, or no participant B has accepted his or her proposition.”

Information available at the end of each period:

At the end of each period, depending on the decisions taken, you are informed of:

- A 's decision (offer a premium or not);
- The amount of the promised premium P ;
- B 's decision (accept or decline the premium);
- The payment or the non-payment of the promised premium;
- Your earnings for this period;
- Your cumulative earnings.

Calculating your earnings:

Your total earnings from the experimental session are determined by the sum of the earnings for each period. The value of your account will be converted in Canadian dollars with a conversion rate of 2 cents per 1 EU.

Before we begin the experiment, we will ask you a few questions regarding the understanding of these instructions. To carry on, everybody must have correctly answered all questions.

You will then be asked to please provide us with some information regarding your age, gender, level and field of study, attended school or university and whether you have already taken part in an experiment.

We encourage you to take a few minutes to go over the instructions. You will then be asked to take place in front of your computer. If you have any questions, raise your hand and we will come and see you.

During the experiment, please do not ask questions or raise your voice. Thank you for respecting these rules.