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Ambiguous incentives and the persistence of effort: Experimental evidence



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ABSTRACT

When the assignment of incentives is uncertain, we study how the regularity and frequency of rewards and risk attitudes influence participation and effort. We contrast three incentive schemes in a real-effort experiment in which individuals decide when to quit: a continuous incentive scheme and two intermittent ones, fixed and random. In all treatments, we introduce a regime shift by withdrawing monetary rewards after the same unknown number of periods. In such an ambiguous environment, we show that less able and more risk averse players are less persistent in effort. Intermittent incentives lead to a greater persistence of effort, while continuous incentives entail exit as soon as payment stops. Randomness increases both earlier and later exiting. This selection effect in terms of ability and risk attitudes combined with the impact of intermittent rewards on persistence lead to an increase in mean performance after the regime shift when incentives are intermittent.

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1. Introduction

Ambiguity is pervasive. In many economic activities agents learn the states of underlying processes by observing outcomes across time. For example, an investor in the stock market may observe fluctuations in the value of his shares. What is signaled by a drop in the value of the shares: a change in the fundamental value of the assets or just an insignificant random event? Should the investor sell his shares or keep them? Similarly, if an employee no longer receives a bonus in addition to her salary, should she consider that this is due to temporary circumstances or to a permanent change? Should she change her reference point?

In this paper we explore ambiguous situations where economic agents reap the benefits of engaging in an activity across time until – unknown to them – there is a shift in the underlying process and pursuing the activity is no longer profitable.

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Knowing that agents dislike income variability, we seek to illuminate when and why they persist or desist from participating in the activity when they bear all the cost of uncertainty. How long, for example, will the investor continue to place new orders and does this depend on the regularity of his previous outcomes? How long will an employee keep working in the same firm if she no longer receives a bonus? How is the decision affected by preferences regarding risk and ambiguity and/or the regularity with which bonuses have been paid in the past? Knowing when, if, or how the parameters governing an underlying process have changed is, however, not a trivial intellectual task. When agents engage in repeated activities across time, one typically assumes that learning results from feedback and beliefs are updated in a Bayesian manner. However, the structure of incentives might influence this process when the environment is ambiguous. For example, [Bereby-Meyer and Roth \(2006\)](#) have shown that the speed of learning in repeated games is affected by whether incentives involve probabilistic or continuous reinforcement.

Our goal is to draw attention to the likelihood that organisms will persist or desist in effort before and after regime shifts when the payment of rewards is ambiguous, conditional on individuals' ability and risk attitudes, and how the structure of incentives affects persistence and effort over time. Our hypothesis is that such an ambiguous environment will impact whether individuals are willing to persist or not in the activity and how long, according to their individual cost of effort, *i.e.*, ability level, risk/ambiguity aversion, and expected income. Another hypothesis is that the frequency and the regularity of incentives, or equivalently their concentration or spreading over time, influence persistence in the task because they condition the speed at which individuals update their beliefs. They therefore affect the identification of regime shifts in ambiguous environments.

For example, contrast two ambiguous situations where the same total amounts of non-contractual bonuses have been distributed to workers in addition to their salary prior to a regime shift but where afterwards no more bonuses are paid. In one group, the firm has distributed bonuses both regularly and frequently (*e.g.*, on a monthly basis). This corresponds to a *continuous* incentive scheme. In the second group, workers have been used to receiving less frequent or more concentrated but bigger bonuses in the same interval of time (*e.g.*, every six months on average). This corresponds to an *intermittent* incentive scheme. We conjecture that regardless of the scheme, both more risk or ambiguity averse workers and less able workers will exit this situation earlier than others in order to avoid ambiguity. Indeed, the less able workers, who have a higher marginal cost of effort, have a lower expected payoff and therefore a higher risk aversion than abler workers with a higher expected payoff. Thus, it is likely that these workers require higher risk premia and are more likely to drop out as soon as possible, before the regime shift, because their expected payoffs do not allow them to bear the full cost of uncertainty. Moreover, we conjecture that workers exposed to regular and frequent incentives will perceive a regime shift more rapidly than those exposed to irregular and less frequent incentives. They will exit more rapidly after the regime shift than those exposed to intermittent incentives, because even with the same degree of loss aversion and the same reference payoff, they are able to update their beliefs more rapidly due to a different structure of incentives.

In this paper we investigate experimentally the persistence in effort in an ambiguous environment according to the individuals' ability level and degree of risk and ambiguity aversion, and the differential effects of continuous and intermittent (random and fixed) incentive schemes before and after the introduction of a regime shift. Participants in our experiment were required to perform a tedious task repeatedly and to decide when to stop performing the task definitively. As such, goal setting was endogenous. The task itself involved counting specific letters in written paragraphs where words had been combined randomly to form meaningless sentences. We compare three treatments in a between-subjects design. In the Baseline treatment, participants were paid a piece-rate and each period gave rise to actual payment. This corresponds to a continuous incentive scheme. In the Random Intermittent Incentive treatment, for each participant there was a one out of three chance that any particular period would be paid and we determined individually randomized sequences of payment for all these participants. In the Fixed Intermittent Incentive treatment, one period out of three was paid according to a fixed schedule. In all three treatments, payment was stopped after the 20th period. To introduce ambiguity, the participants were informed of the amount of the piece-rate but they received no *ex ante* information about the sequences of payments. They were only informed at the beginning of the session of their show-up fee and that some periods would be paid whereas others would not, and at the end of each period, whether it was paid or not. We also elicited participants' attitudes toward risk and ambiguity.

Our findings show that under ambiguity, more risk averse and less able participants are more likely to quit the task as soon as possible, *i.e.*, before the regime shift, regardless of the treatment probably because they dislike having to bear all the risk. As well-known in contract theory, maintaining them longer would require insuring them, at least partly, against income variability. Moreover, in the Baseline treatment where it takes less time to identify the regime shift individuals exit soon after payment stops. This may be due to the large immediate gap between their income expectations and their updated beliefs about receiving a payment, which is likely perceived as a loss (see [Koszegi and Rabin, 2006](#), for a model of reference-dependent preferences based on expectations, and see [Crawford and Meng, 2011](#), [Abeler et al., 2011](#), for tests of this theory). On the other hand, participants in the Random Intermittent Incentive treatment exit either before or long after the regime shift, with the Fixed Intermittent Incentive treatment in an intermediate position. Therefore, under ambiguity, both the frequency and randomness of incentives matter in the decision to exit a situation, with randomness having more extreme effects in both directions. The gap between the individuals' income expectations and their updated beliefs about the likelihood of payment is smaller than in the Baseline. Moreover, intermittent incentives lead to more persistent and higher effort levels. Indeed, when incentives are continuous, once payment stops individuals who do not exit immediately exert less effort than those under the other schemes.

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