How Do Expectations Influence Labour Supply?

Evidence from Framed Field Experiments

by

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Abstract

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Models of reference dependence have improved the connection between economic theory and documented labour supply behaviour. In particular, the Kőszegi and Rabin (2006, 2007, 2009) [hereafter "KR"] theory of expectation based reference dependent preferences appears to be a disciplined way to unify the conflicting wage elasticity estimates, and recent laboratory and natural experiments suggest this theory may work in practice as well. I take this theory to the field in a pair of laboratory-like experiments designed to test if expectations determine the effort of a group of impoverished individuals involved in piece-rate work in Northeast Brazil. I use Abeler, Falk, Goette, and Huffman's (2011) experimental mechanism, which is a clear test of KR preferences in effort provision, in two experiments: first to test if *rational* expectations act as a reference point that influences effort, and second to test if *adaptive* expectations act as a reference point that influences effort. In both experiments, I find that although people do not behave in accordance with KR preferences, they do not behave as though they make their decisions following canonical lines either. I then outline a speculative rationale for the observed behaviour in these experiments – the adaptive heuristic of regret matching – where workers are able to evaluate their ex post feelings of regret, even if they do not know the source of those feelings, to optimize behaviour going forward.

To Matty.

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All remaining errors and omissions are my own.

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Introduction

Labour income is a critical resource for the world's poor, yet remarkably little is conclusive about how labour supply is determined. The canonical model of lifecycle labour supply fails to reconcile the large literature which presents conflicting evidence about the way individuals respond to wage changes. In particular, variations of this standard model of inter-temporal labour supply suggest that workers respond positively to transitory wage shocks: they work more when wages are high and substitute to leisure when its price – the foregone wage – is low. However, estimated transitory wage elasticities are often negative or insignificant.[1]

One leading explanation for this behaviour is that workers exhibit reference-dependent preferences. That is: (i) they make labour supply decisions over very narrow time horizons,[2] and (ii) they have some target level of income after which the marginal return to labour drops discontinuously. Kőszegi and Rabin's (2006, 2007, 2009) [henceforth KR] model of *rational expectation based reference-dependence* has become a workhorse for models that exhibit these characteristics. When applied to labour supply, their model suggests that in addition to valuing the level of income, workers evaluate income as gains or losses with respect to their recently held probabilisitic beliefs (i.e., expectations) about that income. Since loss averse workers are more motivated to avoid feelings of loss than to acquire gains, the marginal return to effort drops discontinuously once accumulated income exceeds expected income. As a result, effort increases in expectations of income.

Although many have tested the KR model, I am the first to test it with respect to labour supply in a real effort framed field experiment.[3] Specifically, I conduct a pair of

[1]For instance, consider Mankiw, Rotemberg, and Summers (1985), Browning, Deaton, and Irish (1985), Altonji (1986), Laisney, Pohlmeier, and Staat (1992); Pencavel (1986); and Mulligan (1995).

[2]Read et al. (2000) defines isolating decisions as if they are not embedded in a stream of decisions as "narrow bracketing." This is closely linked to Thaler's (1985) notion of "mental accounting" – the way in which gamblers evaluate the outcomes of a particular day of gambling as independent of the outcomes on other days spent gambling

[3]A framed field experiment is defined by Harrison and List (2004) as an experiment using a non-standard subject pool (i.e., not university students or any other low cost but low relevance population) in a field context where the subjects are familiar with the incentive scheme, commodity, or task parameters.

experiments to test the KR model's predictions among a sample of impoverished individuals involved in piece-rate work in Northeast Brazil. In the first experiment, I replicate Abeler et al.'s (2011) design and manipulate workers' rational expectations of income with a lottery-based payment contract for an open-ended shift of work. Once participants quit working, their payment is determined by a coin-flip: half the time, they receive their piece-rate earnings; otherwise, they receive a fixed payment. Under a canonical lifecycle lens, participants' behaviour would not respond to the size of fixed payment as it does not contribute to the marginal return to effort. In contrast, if participants have KR preferences, their effort increases in their probabilisitic beliefs about income, and as such, will increase in the fixed payment.

In the second experiment, conducted three weeks after the first, I manipulate participants' adaptive expectations about income. Specifically, I return to a subsample of participants and offer them the opportunity to work an additional open-ended shift for a payment lottery. Among those who agree, some are offered the same lottery as during their first shift, while others are offered unexpectedly higher or lower piece-rate wages than the wages offered in the first round. If participants optimize over their lifecycle, their current behaviour would be independent of their past piece-rate wage since it does not contribute to the marginal return to current effort or lifetime wealth. In contrast, if participants have KR preferences, their effort increases in the past wage, since adaptive beliefs about income are determined by the payment lottery faced in the first experiment.

In both experiments I find that although participants do not behave as though they have KR preferences, they do not behave as though they are optimizing over their lifecycle either. In contrast to a lifecycle model, labour supply is consistent with participants narrowly bracketing their decisions. Parameters that increase participants' expected income – the piece-rate wage and the fixed payment – all (at least weakly) result in lower effort. Although this narrow bracketing lies at the core of reference dependence, this is not the pattern of behaviour we would expect if participants had KR preferences. Instead, I observe a remarkable amount of inertia in behaviour – participants act the same in the first and second experiments, even if the conditions have changed. When participants do update their behaviour, it appears to be a function of their *regret* of the first experiment's outcome.

My results contribute to a growing literature that finds KR preferences are insufficient for explaining the labour supply behaviour of populations from the developing world. In the field, I find statistically different results than Abeler et al. (2011) find in the lab. These differences highlight that the influence of expectations on effort may be context specific, and emphasize a need for caution when extrapolating from WEIRD behaviours to

forecast the behaviour of workers in developing countries.[4] Further, workers' propensity to keep labour supply constant, especially when faced with wage changes, suggests that the heuristics that determine effort evolve with experience and the precise, but foreign, mechanisms that allow us to link theory to behaviour in experiments may also alter the nature of optimization.

The thesis is organized as follows. In the first chapter, I introduce a simple model of lifecycle labour supply that has been at the core of the discipline since the 1970s and reflect upon this model's inability to reconcile much of the observed wage elasticity evidence since its inception. Alternatively, models of reference dependence have gained traction thanks to their ability to rationalize much of the observed behaviours, and in particular, the KR model of reference dependence has been very influential. I outline this model, and then situate this thesis within this broad set of literature seeking to understand what determines labour supply.

In the second chapter, I replicate an experiment testing KR preferences originally conducted by Abeler et al. (2011) in a laboratory. Beyond my experiment's essential value in our peer-reviewed discipline as a replication, my experiment is also the first test of KR preferences in a real-effort framed field experiment. I manipulate workers' rational expectations of income with a lottery-based payment contract for an open-ended shift of work. This engineers workers' probabilistic beliefs about income and allows me to test if these expectations determine labour supply. I find that workers narrowly bracket their labour supply choices in this context, consistent with reference dependence but not with canonical lifecycle labour supply. Still, this narrow bracket created income effects in the experiment that dominated results, masking any potential evidence of KR preferences.

The experiment discussed in Chapter 2 tests how *rational* expectations of income influence behaviour. In Chapter 3, I present an experiment that tests how *adaptive* expectations of income influence effort provision. I revisit a subsample of participants from the first experiment and offer them a second shift of employment with a similar lottery payment contract, but I randomly assign unanticipated piece-rate wage shocks. Since the income earned in the first experiment defines participants' adaptive expectations of income for this second experiment, I test if their past incomes determine their current behaviour. Again, I find only weak support for KR preferences, but strong evidence of inertia in effort provision.

The final chapter of this dissertation explores two unanticipated but interesting findings from the previously discussed pair of experiments: (1) there is inertia in behaviour,

[4] "WEIRD" is an acronym for Western Educated Industrialized Rich Democratic (Henrich, Heine and Norenzayan, 2010).

even when the conditions changed, and (2) losers of the payment lottery update behaviours they regretted given the outcome of the lottery. I propose that Hart and Mas-Colell's (2000) *regret matching* combined with the misattribution of that regret may rationalize these stylized facts. This is a purely speculative adaptive heuristic that approximates rational behaviour with a simple and unsophisticated rule of thumb that helps agents iterate towards "better" decisions.

Chapter 1

The Context: A History of Labour Supply

1.1 Introduction

Although the experiments in this thesis are tightly linked to the KR model of reference dependence and the Abeler, Falk, Goette, and Huffman (2011) experiment which tests that model, these experiments sit on a broad foundation of research seeking to understand how workers respond to compensation. Remarkably little is conclusive about how labour supply is determined. In this chapter, I will explore what has been modelled and what has been documented regarding labour supply in recent years, illuminating the gap in our knowledge which these experiments are designed to fill.

I begin by illustrating a simple canonical model of lifecycle labour supply which serves as the workhorse for many labour economists, and as a benchmark to which many reference dependent behaviours are compared. I then document many empirical inconsistencies with variations of this lifecycle model. These inconsistencies led economists to explore behavioural reasons for these observed deviations from theory. Starting with the seminal work studying New York City taxi cab drivers, I explore recent empirical work identifying that reference dependence may be relevant for effort provision. Finally, I outline a stylized version of the KR model of reference dependence as a formalization of the many behavioural explanations for the observed labour supply elasticities, serving as the foundation for my experiments and unifying much of the literature.

1.2 Lifecycle Model of Labour Supply

Several foundational questions regarding labour supply were at the forefront of economic thought in the 1970s: "what determines the shape of the lifecycle hours profile? how does labor [sic] supply respond to aggregate wage changes? what is the source of idiosyncratic changes in year–to–year labor [sic] supply?"[1] Lucas and Rapping (1969) appear to be the first to model cyclical hours variation as a response to transitory wage changes in an attempt to answer these questions. This lifecycle framework, in principle, reconciled backward-bending, inelastic, long-run labour supply curves with elastic short-run labor supply curves.[2] As such, these authors suggested that the lifecycle model could explain year over year movements in labour supply.[3] Later Ghez and Becker (1975) suggested the model could also explain systematic age effects on hours worked. Eventually, MaCurdy (1981) and Altonji (1986) suggested this model could also link person-year specific hours variation to unanticipated wage changes.

To understand any model of labour supply, including the aforementioned lifecycle model, it is useful to build on a static model that measures within-period hours worked. I will follow the notation of Blundell and MaCurdy (1999) to illustrate this simple model. To start, assume each worker has a quasi-concave utility function defined over within period consumption, C_t, leisure hours, L_t, and individual characteristics, X_t:

$$U(C_t, L_t, X_t). \tag{1.1}$$

This utility is maximized subject to a budget constraint determined by the hourly wage rate, W_t, non-labour income, Y_t, and total time available, T:

$$C_t = W_t(T - L_t) + Y_t, \tag{1.2}$$

where a single consumption good is taken as the numeraire.[4] The first order conditions take the usual form containing the marginal utility of income, λ_t:

$$U_C(C_t, L_t, X_t) = \lambda_t, \text{and} \tag{1.3}$$

$$U_L(C_t, L_t, X_t) \geq \lambda_t W_t. \tag{1.4}$$

[1] Card, 1991, p.1.
[2] Card, 1991, p. 2.; Lucas and Rapping, 1969, p.722.
[3] Card (1991)
[4] Total hours worked $= T - L_t$.

The reservation wage, the wage below which a person will supply zero hours of work, is defined where the inequality in Equation (1.4) strictly holds. This foundation allows us to see the average relationship between worker preferences and labour choices, often characterized with the marginal rate of substitution ("MRS") between consumption and leisure:

$$MRS_L(C_t, L_t, X_T) \equiv \frac{U_L}{U_C} \geq W_t. \tag{1.5}$$

Solving the first order conditions in Equations (1.3) and (1.4) can yield the Marshallian labour supply functions with the uncompensated wage elasticity and the Hicksian (compensated) wage elasticity using the Slutsky equation.[5]

A simple lifecycle model can be characterized as a multi-period version of this static model with full separability across time. As such, the lifecycle utility starting at time t and ending at time τ is the analog of Equation (1.1):

$$U_t = U(C_t, L_t, X_t, C_{t+1}, L_{t+1}, X_{t+1}, ..., C_\tau, L_\tau, X_\tau), \tag{1.6}$$

maximized subject to the time path of assets, A, which is the intertemporal analog of Equation (1.2):

$$A_{t+1} = (1 + r_{t+1})(A_t + Y_t + W_t(T - L_t) - C_t). \tag{1.7}$$

The variable A_{t+1} is the value of assets in period $t + 1$, defined as a function of the real interest rate earned between period t and $t + 1$, r_{t+1}, and the wealth available at the end of period t. The separability assumption means that the within period marginal rate of substitution continues to characterize each period's relative amounts of leisure and consumption.

To solve for the optimal labour supply, there are two common approaches. The first is two-stage budgeting, where we simply need the allocation of lifetime full income to each period to solve for optimal behaviour.[6] Hence, the worker first decides how much income to allocate to each period t, then solves the static problem. Models that use this approach tend to take the across period allocation of wealth as fixed, and as such, miss the important reallocation of income at this first stage in their elasticity estimates. A

[5]The Slutsky equation breaks down the change in demand between the substitution and income effects:

$$\frac{dh}{dw} = \frac{dh}{dw}\bigg|_{U=U^*} + h\frac{dh}{dY}.$$

[6]Full income in any period, t, is defined as $Y_t + W_t T$.

second approach is to assume the marginal utility of wealth is constant, and thus the parameter λ_t is a sufficient statistic for solving any within period maximization problem. These Frisch labour supply functions are often characterized by a dynamic programming formulation:

$$V(A_t, t) = \max[U(C_t, L_t, X_t) + \kappa V(A_{t+1}, t+1)], \tag{1.8}$$

that yields three first order conditions:

$$U_C(C_t, L_t, X_t) = \lambda_t, \tag{1.9}$$

$$U_L(C_t, L_t, X_t) \geq \lambda_t W_t, \tag{1.10}$$

$$\lambda_t \equiv \partial V / \partial A_t = \kappa(1 + r_{t+1})\lambda_{t+1}, \tag{1.11}$$

which are the first order conditions of the static problem, plus the Euler equation for λ. With this formula, the consumer choses to allocate wealth across periods so that her marginal utility of wealth in period t is equal to the discounted marginal utility of wealth in period $t+1$.

These simple models of lifecycle labour supply become slightly more complicated with the introductionsof uncertainty, and substantially more complicated if we relax the separability assumption allowing, for instance, a person's wages to be a function of their time-varying human capital.[7] I will not outline either of these extensions here, but encourage interested readers to review Blundell and MaCurdy (1999) for lifecycle models that address these extensions. But with all of these additions, one feature holds true: workers respond positively to small transitory wage shocks: they work more when wages are high and substitute to leisure when its price – the foregone wage – is low.

It should now be apparent that the term "wage elasticity" is quite ambiguous in a lifecycle framework. Researchers can, and have, used this term to discuss responses to very different types of wage changes. Regressions of hours worked on wages yield coefficients that confuse responses from movement along a lifetime wage profile (i.e., expected wage rate changes), arising from shifts in the profile (i.e., shocks to lifetime wealth), and those from changes in slope of the profile (i.e., unanticipated wage rate changes).[8] Furthermore, identifying any of the potential elasticities of a lifecycle model

[7] Blundell and MaCurdy, 1999, p.1598.
[8] MaCurdy, 1981, p.1060.

using cross-sectional data will be inherently limited.[9] Ultimately, in 1991 Card concluded that the empirics using variations of the life-cycle model sheds very little light on the core questions that motivated it in the first place.[10]

Card's conclusion was built on a large early literature that presents conflicting evidence about the way individuals respond to wage changes within each of its definitions.[11] Despite the predictions of the above described standard model of intertemporal labour supply, estimated transitory wage elasticities are often negative or insignificant. For instance, Mankiw, Rotemberg and Summers (1985) recovered the parameters for the three lifecycle optimization conditions – the trade of between current and future consumption, the trade off between current and future leisure, and the trade off between current consumption and current leisure – using aggregate data and an instrumental variables technique. They find that the aggregate data is not well characterized by a model of stochastic dynamic optimization, and in particular, "no clear relation between the quantity of leisure and the relative price of present versus future leisure."[12] Their results "cast serious doubt on the premise of most classical macro-economic models that observed labor [sic] supply represents unconstrained choices given perceived opportunities."[13]

Browning, Deaton and Irish (1985) use panel-like data of British male cohorts in the 1970s to estimate a lifecycle model that integrates consumption and family labour supply with uncertainty. Despite their data exhibiting standard lifecycle patterns of hours and wages, the theory is found "incapable of offering a satisfactory common explanation of the behaviour of hours and wages per both the business cycle and life cycle."[14] They estimate the elasticity of weekly hours worked with respect to anticipated wage changes to be about 0.15, but "sensible" positive elasticities are not robust to specification changes.[15]

Laisney, Pohlmeier and Staat (1992) provide a summary of the results, assumptions, and characteristics of a number of studies estimating intertemporal labour supply elasticities in their Table 1 (pp. 32–39). The list of intertemporal elasticity estimates across

[9] Blundell and MaCurdy, 1999, p.1598.

[10] Card, 1991, p. 1.

[11] By the early 1990s, extensive reviews of the literature, and this conflicting evidence, surrounding male labour supply had been compiled by Pencavel (1986), and female labour supply compiled by Killingsworth and Heckman (1986), both published in the 1986 Handbook of Labor of Economics. Laisney, Pohlmeier and Staat (1992) provides an extension of these earlier two reviews focusing on the movement away from panel data towards dynamic models with endogenous wages within the community. For a more recent brief synopsis of wage elasticites, see Chetty et al. (2011*b*). For a meta-analysis of quasi-experimental extensive margin elasticities, see Chetty et al. (2011*a*). For a meta-analysis of intensive margin elasticities from micro data see Chetty (2012).

[12] Mankiw, Rotemberg and Summers, 1985, p.32.

[13] Mankiw, Rotemberg and Summers, 1985, p.34.

[14] Brownling, Deaton, and Irish, 1985, p.503.

[15] Brownling, Deaton, and Irish, 1985, p.503.

articles, subsamples, and specifications are reported as: -0.11 – 0.475 (Altonji, 1986), 0.8 (Bover, 1991), 0.40 (Browning, Deaton and Irish, 1985), -0.17 – 0.17 (Ham, 1986), -0.406 (Heckman and MaCurdy, 1982), 1.14 and 1.72 (Jakubson, 1988), a lower bound of 0.149 (Johnson and Pencavel, 1984), -0.84 – 1.14 (Lilja, 1986), -0.307 – - 1.38 (Lillard, 1977), -0.67 – 0.114 (Lundberg, 1988), a lower bound of 0.71 – 1.43 (MaCurdy, 1983), and 0.1 – 0.23 (MaCurdy, 1981).

The last in that list, the MaCurdy (1981) paper, uses a first differenced labour supply equation to estimate small positive male intertemporal elasticities using US data, in what was arguably the "seminal paper as far as empirically implementable models are concerned."[16] Altonji (1986) revisits this analysis with a different sample and a different control for wages and finds results consistent with MaCurdy.[17] But these results come with the strong caveat that these calculations are based upon "the assumptions that workers freely choose hours and face exogenous wages" and "that the unobserved components of wages and labor [sic] supply preference are independent."[18] To relax these assumptions, economists began exploring labour markets where workers arguably are free to choose their hours and face exogenous wages, starting with the Camerer, Babcock, Loewenstein and Thaler's (1997) analysis of New York City taxi cab drivers.

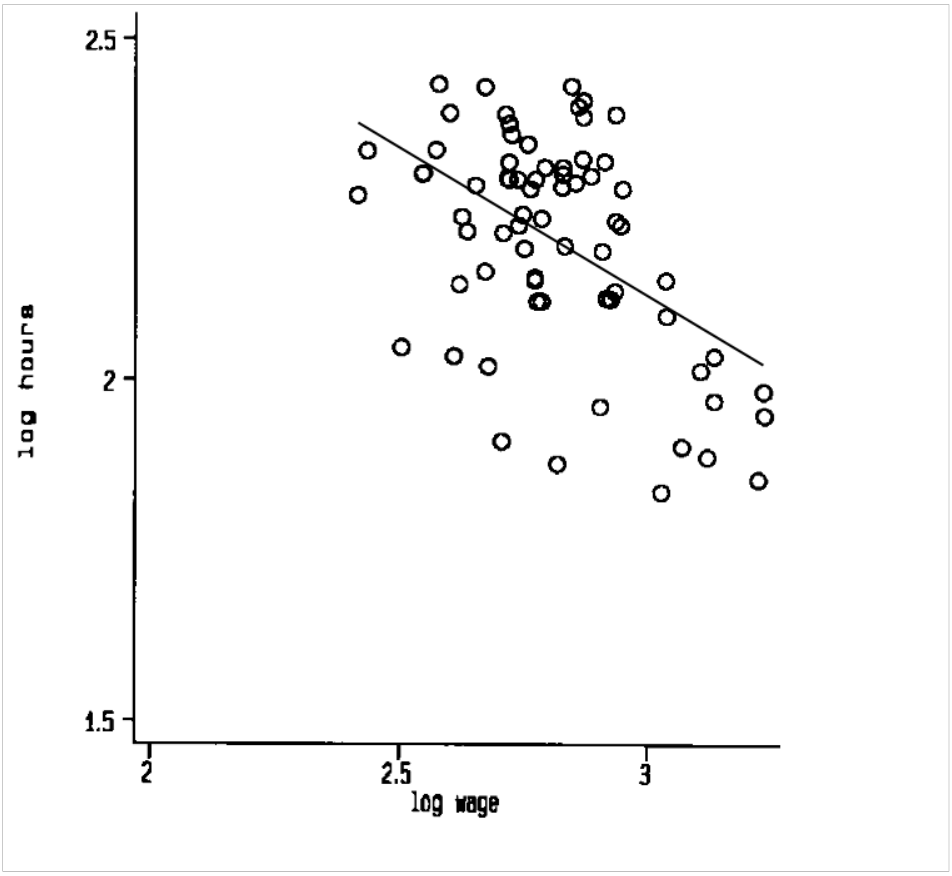
1.3 One Day at a Time Model of Labour Supply

In a seminal paper, Camerer et al. (1997) test labour supply responses to transitory wage changes under close to ideal conditions. They study New York City taxi cab driver behaviour. Drivers face a exogenous volatility in their wages across days, but within a day, these wages are relatively constant. Drivers are also relatively free to choose their hours within and across days conditional on the observed wage. Finally, the amount of income earned in any given day, even of the highest wages, will be small enough that it has a negligible impact on lifetime wealth. This provided an opportune environment for estimating transitory wage elasticity amongst the conflicting evidence calculated with micro and macro data in the previous decade.

In contrast to standard models of lifecycle labour supply, where people respond positively to small transitory wage shocks (they work more when wages are high and substitute to leisure when its price – the foregone wage – is low), Camerer et al. (1997) estimated negative wage elasticities. They observed that drivers quit early on the high

[16] Laisney, Pohlmeier, and Staat, 1992, p.2.
[17] Antonji, 1986, p.205.
[18] Antonji, 1986, p.209.

Figure 1.1: Labour Supply Curve of New York City Taxi Cab Drivers



Note: Original graph of observed relationship between log hours and log wages from Camerer et al. (1997) with line of best fit, the labour supply curve, superimposed from Camerer (1997).

wage days, and drove more on the low wage days. These results are illustrated in Figure 1.1.

These authors identify two significant implications from these results: first, it is difficult to rationalize a negative elasticity if workers made their labour supply decision with more than a *one day at a time* horizon. Secondly, once we accept this narrow horizon for decisions, the strong negative relationship observed implies a sharp decrease in the marginal utility of income after some threshold. Qualitative evidence suggests that this threshold is an *income target*. At the start of the day (or earlier) a driver sets an income target for himself, and the probability of him quitting for the day jumps sharply once he has achieved this goal.

At the heart of the *one day at a time* decision making observed in naturally occurring environment is something akin to an income effect. If subjects think about income in the narrow bracket of days, changing their piece-rate wage changes their relevant measure

of wealth, and it is entirely possible that a standard *income effect* may dominate the *substitution effect* even when transitory wage shocks have no impact on lifetime income. The usual reference for understanding choice bracketing key to the notion that these drivers care about daily and not lifetime wealth comes from Read et al. (2000):

> A set of choices are bracketed together when they are made by taking into account the effect of each choice on all other choices in the set, but not on choices outside of the set. When the sets are small, containing one or very few choices, we say that bracketing is *narrow*, while when the sets are large, we say that it is *broad*. Broad bracketing allows people to consider all the hedonic consequences of their actions, and hence promotes utility maximization. Narrow bracketing, on the other hand, is like fighting a war one battle at a time with no overall guiding strategy, and it can have similar consequences.[19]

This choice bracketing is one of the primitives of any sort of reference dependence. As Barberis, Huang and Thaler (2006) highlight, if agents took into account their lifetime wealth and expected wage profile at any given moment, most reference dependence would be irrelevant because the deviations from reference points have negligible impacts on the big picture.[20] As such, the models of reference dependence used to explain cab driver and others' behaviour are characterizing the importance of reference points conditional on *narrowly bracketed* decisions.

Camerer et al.'s (1997) results and their implications have been hotly contested since publication. Farber (2005) uses the same data as Camerer et al. (1997) but different econometric techniques to come to the opposite conclusion: that these drivers do behave in a canonical manner. Although in a later paper he develops a model of labour supply that incorporates a reference dependent component for these drivers,[21] Farber (2015) more recently concludes that reference dependence is not an appropriate characterization of driver behaviour.[22] Crawford and Meng (2011) found that drivers exhibit reference dependent behaviour, although they widen the set of reference points to hours targets.

Analyses of these drivers is still ongoing thanks to the rich publicly available data and conflicting results. Zha, Yin and Du (2017) continue to support income targeting. Leah-Martin (2017) suggests that drivers are reference dependent, but in the classic vein

[19] Read et al., 2000, p.172.

[20] Barberis, Huang and Thaler (2006) actually discussed risks, and not income, although the rationality is the same.

[21] Farber (2008)

[22] Although Luo (2016) contests these findings.

of Kahneman and Tversky (1979)'s prospect theory. Thakral and Tô (2017) suggest that adaptive expectations explain the patterns of behaviour, not income targets or canonical models.

For cab drivers in other countries, Chou (2002) found income targeting behaviour amongst taxi drivers in Singapore, and Agarwal et al. (2014) fine tuned this analysis to find that across days, workers behaved as though they have an income target, although within-days, they supplied more hours during the (sometimes unanticipated) high wage periods. In a similar pattern of behaviour, Kenyan bicycle Taxi drivers responded positively to both anticipated and unanticipated wage shocks, but had a discontinuous jump in their probability of quitting once they earned enough to cover their daily needs.[23] Jonason and Wållgren (2013) found that Stockholm drivers have positive wage elasticities and do not behave consistently with the one-day income target at all.

Other effort providers have been studied as well. Eggert and Kahui (2013) find that effort targeting may explain the behaviour of paua (abalone) divers in New Zealand. Marathon runners finish at round numbers.[24] Most notably, Fehr and Goette (2007) found that bicycle messengers appeared reference dependent. Although messengers worked more hours in total and more shifts in total in response to a wage increase, they worked fewer hours per shift.

Although most of these examples have been studies of the natural work environments, Fehr and Goette (2007) was an experiment. Reference points are inherently hard to observe, and thus their effects (or lack thereof) are inherently hard to test. The use of experiments, in the lab or in the field, allows researchers to observe and manipulate potential reference points, and contribute to this conversation about reference dependent labour supply. Fehr and Goette (2007) had exogenous variation in their regressor of interest because they randomly assigned it.

1.4 Experimental Labour Supply

Charness and Kuhn (2011) point out in the 2011 *Handbook of Labor Economics*, there was an explosion of laboratory experiments in economics starting in the 1990s in general, with the relationship between compensation and effort the focus of many, if not most, of the labour experiments. One of the greatest advantages of the lab is that economists can (i) identify a theoretical model with a particular equilibrium, then (ii) assign people to play that exact game with monetary consequences, and (iii) check the outcomes against

[23] Dupas and Robinson (2014)
[24] Allen et al. (2014).

the theoretical predictions. Although lab experiments, like most statistical hypothesis testing, cannot prove that theory works in practice, they are very useful for identifying when mechanisms that work in theory do not work in practice, "*even under conditions designed to be ideal*" for the mechanism.[25] As such, they are a great way to pre-test hypotheses and mechanisms before conducting more expensive (or risky) research or implementing policies based on these theoretical mechanisms.[26]

The earliest laboratory tests of an effort response to piece-rate wages found backward bending labour supply curves.[27] Later Gneezy and Rustichini (2000) found in a pair of real effort experiments that the relationship between effort and piece-rate wages was U-shaped.[28] Ariely et al. (2009), who exposed subjects in the U.S. and India to incentives ranging from small to very large relative to their typical levels of pay, found very high incentives had a detrimental effect on effort. These results suggest the response to incentives is highly non-monotonic.

Abeler, Falk, Goette, and Huffman (2011) are the first to explicitly test if reference points, defined as workers' rational expectations of income, influence labour supply in a laboratory experiment. Building on the assumption that workers' income targets are based on rational expectations, they pay their subjects with a lottery and examine if the rational expectations generated by the lottery influence behaviour. Consistent with the model of reference dependence defined by Kőszegi and Rabin (2006), and outlined in detail below, they find that workers do behave as though they are loss averse with respect to their expected income.

One of the strongest objections to lab experiments is that they are not externally valid. Participants tend to be inexperienced undergraduate students, the stakes are low, and the participants know they are being observed. Although most economic theories are built independent of representativeness, and so there is no reason to believe that convenient samples should behave differently than more representative samples, this is a valid objection. There are a number of less convenient samples who have been tested in laboratory labour experiments, and the results are remarkably similar to student performance.[29] And many of the labour markets studied in field and natural experiments also

[25] Charness and Kuhn, 2011, p.3, emphasis original.

[26] Charness and Kuhn, 2011, p.3.

[27] Charness and Kuhn, 2011, p.17, citing Swenson (1988). The next two experiments were also related to tax policy effects on labour.

[28] Not to be confused with an inverted U-shaped repsonse. These authors found that experimenters need to pay enough, or pay nothing at all. Offering small amounts of finacial compensation reduces effort when compared to the zero compensation case, although eventually the relationship between effort and compenstaion becomes positive once the compensation is "enough."

[29] Charness and Kuhn, 2011, p.3.

seem just as narrow as the population of students.[30] Ultimately, Charness and Kuhn (2011) conclude "many of the objections raised against laboratory experiments are either red herrings or can be met by taking the laboratory to the field, using 'real' people..., real-effort tasks, and varying the stakes."[31] As some have suggested that "Field experiments provide a meeting ground between" the lab and naturally occurring environments.[32]

1.5 Reference Dependent Labour Supply

KR proposes a model of *rational expectation based reference-dependence* which can be applied to labour supply. Their theory suggests that in addition to valuing the level of income, workers evaluate income as gains or losses with respect to their recently held probabilisitic beliefs (i.e., expectations) about that income. Since loss averse workers are more motivated to avoid feelings of loss than to acquire gains, the marginal return to effort drops discontinuously once accumulated income exceeds expected income. As a result, effort increases in expectations of income.

The KR model of reference dependent choice can be applied to labour supply decisions. Consider the period t labour supply decision of a worker who experiences some uncertainty about her return to effort, Y_t, that period. This model supposes that this worker has some expectation of her return to effort, $\tilde{Y}_t$, that will have an impact on her labour supply choice. In that sense, her hours of labour supplied will be determined by both her known wage rate and her expectations of income, $h_t(w_t, \tilde{Y}_t)$. Additionally her reference dependence creates a kink in her utility function where her realized return to effort is equal to her expectations, $Y_t = \tilde{Y}_t$. Failing to reach her expected income hurts, and so the marginal return to effort drops once she reaches her expected earnings. In this sense, her reference dependence only matters because she is loss averse – falling short of her expectations hurts more than exceeding her expectationsl makes her happy.

Following the notation of Farber (2015), consider the following utility function that captures the above described characteristics,

[30] Charness and Kuhn (2011) reference field experiments such as windshield repairers (Lazear, 2000), tree planters (Shearer, 2004), fruit pickers (Bandiera, Barankay and Rasul, 2005), and bicycle messengers (Fehr and Goette, 2007). For natural experiments, they reference stadium vendors (Oettinger, 1999), Continental Airlines employees (Knez and Simester, 2001), textile workers (Hamilton, Nickerson and Owan, 2003), steel minimill workers (Boning, Ichniowski and Shaw, 2007), and taxi drivers (Crawford and Meng, 2011).

[31] Charness and Kuhn, 2011, p.6.

[32] Harrison and List, 2004, p.1009.

$$U(Y_t, h_t) = \begin{cases} (1+\alpha)(Y_t - \tilde{Y}_t) - \frac{\theta}{1+\nu} h_t^{1+\nu} & \text{for } Y_t < \tilde{Y}_t \\ (1-\alpha)(Y_t - \tilde{Y}_t) - \frac{\theta}{1+\nu} h_t^{1+\nu} & \text{for } Y_t \geq \tilde{Y}_t, \end{cases} \tag{1.12}$$

where a worker receives wage rate w_t to earn positive utility from income $Y_t = w_t \times h_t$, and disutility θ from hours worked h_t. She has an expected level of income $\tilde{Y}_t$ where her utility function is kinked. The parameter ν is a parameter related to the elasticity of labour supply. The parameter $\alpha \in [0, 1]$ captures the change in marginal utility at the kink, and so the $\pm\alpha(Y_t - \tilde{Y}_t)$ captures the "gain-loss" utility component at the core of the KR model.[33] The remaining terms $(Y_t - \tilde{Y}_t) - \frac{\theta}{1+\nu} h_t^{1+\nu}$ are the canonical additive "consumption utility."

The purely canonical utility in nested in this functional form. The canonical worker is not loss averse, has no kink in her utility function, and no "gain-loss" utility. This special case is captured when parameter $\alpha = 0$. She has a smooth labour supply function, $h_t = \frac{w_t}{\theta}^{\frac{1}{\nu}}$, with a labour supply elasticity of $\frac{1}{\nu}$ for all hours worked. For the reference dependent worker with unrealistically high or low expectations of income, her labour supply takes a similar shape. Given the current wage rate, if the expectations are so high that it would never be optimal to work enough hours to meet or exceed that target, or the expectations so low that it would never be optimal to meet or fall short of the target, the elasticity of labour supply is still $\frac{1}{\nu}$ and the "gain-loss" utility is irrelevant to her decision.

In the range of wage rates where the target is relevant, in the intermediate range where the target is neither too small nor too large, the worker will always find it optimal to work until she has earned her expected target. Her labour supply will have an elasticity of -1 and the functional form $h_t = \frac{\tilde{Y}_t}{w_t}$.[34]

[33] Any function $\mu(.)$ can transform the difference between her realized income Y_t and her expectations $\tilde{Y}_t$ into gains and losses of utility. This function needs to have two features: (i) $\mu(0) = 0$ and (ii) for any $K > L > 0$, $\left|\mu(K - L)\right| < \left|\mu(L - K)\right|$. The first ensures that if expectations are exactly met, they do not contribute to total utility. This means that when expectations perfectly match reality and there is no uncertainty, people will behave as if they are not reference-dependent. The second ensures that agents are more motivated to avoid losses than they are to acquire gains. This notion of loss aversion, introduced by Kahneman and Tversky (1979), is often captured by a loss aversion parameter $\lambda > 1$ used to weight the magnitude of losses over gains in total utility. In this utility specification, I have characterized $\mu(.)$ with linear loss aversion, using a parameter $\alpha \in [0, 1]$:

$$\mu(s) = \begin{cases} (1-\alpha)s & \text{if } s \geq 0 \\ (1+\alpha)s & \text{if } s < 0 \end{cases}$$

[34] The above functional form is practical in this environment, but this model quite generalizable.

The implications of this model are twofold: having higher expected earnings weakly increases effort if workers are reference dependent. Either these expectations are so high that they are irrelevant, or they prolong the pain of failure to motivate workers to choose more effort than they would have without expectations at all. Secondly, this can explain why transitory wage increases can result in a decrease in effort. Higher wage rates allow workers to meet their target earnings with fewer hours worked.

Underlying the notion that a target income could generate labour supply elasticities of -1 is that this worker is not optimizing her lifetime wealth, but rather considering a much smaller frame of reference. The urge to quit working when expected income is attained is driven by standard income effect felt only because the worker is making her decision in a very narrow bracket.[35] If she had reference dependent preferences, but did not consider an event in relative isolation, then that reference dependence would often have a negligible impact on her decisions.[36] Furthermore, this reference dependence only maps to behaviour if workers are loss averse as well. If losses with respect to expectations do not have a greater utility weight than gains – if losses do not hurt more than equal sized gains increase happiness – then reference dependence would, yet again, have no impact on behaviour. It is only the intersection between reference dependence, narrow bracketing, and loss aversion that could lead a reference set, like expectations, to influence labour supply.

The most substantial advantage of this framework is that it can rationalize, and unify, much of the disparate evidence regarding labour supply behaviour. Estimates of intertemporal labour supply can be either positive or negative under this framework. Furthermore, the practical interpretations of the modelled rational expectations can encompass many other tested and interpretations of reference points, such as adaptive expectations, endowments, and the status quo. Furthermore, this one model can be adapted for a number of different types of reference dependent choices beyond labour supply, such as consumption and investment decisions.

For any stochastic income, G, it is not evaluated against the average expected income, but rather its expected utility. This expected utility is calculated as the average of how each realization of G feels relative to every realization of the reference point H. If H is the recently held probabilistic belief about the outcome, then this utility could be characterized as:

$$U(G|H) = \int \int u(y_t|\tilde{y}_t) dH(\tilde{y}_t) dG(y_t).$$

[35] Read et al. (2000)

[36] Barberis, Huang and Thaler (2006)

1.6 This Thesis

I am the first to test the KR model of labour supply in a real effort framed field experiment. A framed field experiment is defined by Harrison and List (2004) as an experiment using a non-standard subject pool (i.e., not university students or any other low cost but low relevance population) in a field context where the subjects are familiar with the incentive scheme, commodity, or task parameters. I use a population for whom the decisions in the experiment are particularly relevant for their livelihoods, and offer high enough stakes that behaviour in this experiment can have a short run economic impact on participant's lives. These features put this experiment firmly in the "meeting ground" between the lab and naturally occurring environments.[37]

Specifically, I conduct a pair of experiments to test the KR model's predictions among a sample of impoverished individuals involved in piece-rate work in Northeast Brazil. In the first experiment, I follow and Abeler et al.'s (2011) design and manipulate workers' *rational* expectations of income with a lottery-based payment contract for an open-ended shift of work. In the second experiment, I use the randomly assigned parameters of the first experiment to pin down workers' *adaptive* expectations of income. In both experiments I find, like many predecessors before me, that the relationship between effort and compensation is complicated. I observe labour supply behaviour inconsistent with the canonical lifecycle model in so far as workers are, at minimum, narrow bracketing their decisions. Still, they are not overtly behaving according to the KR model either.

All of the data used in this thesis were collected in a pair of experiments conducted on the same population requiring them to conduct the same task. For efficiency, I describe this population and task below.

1.6.1 The Population

I carry out the experiments in the relatively isolated interior of Northeast Brazil. The impoverished participants of this experiment live within a longstanding garment producing economy where there are very few economic alternatives to participating in the home-based production of textiles for the domestic market.[38] In 2013, approximately 500,000 people lived in the cities that encompass this regional economy, with most directly or indirectly surviving on incomes from apparel production.[39] The high degree of informality in labour relations, the precariousness of the labour market, and the lack of alternative

[37]The terminology "meeting ground" is from Harrison and List (2004, p. 1009).
[38]Tendler (2002); Tilly et al. (2013).
[39]Tilly et al. (2013).

employment options have generated some of the lowest labour costs in the country.[40] In July 2014, the time of this experiment, the state mandated minimum salary for those with formal employment was 724BRL per month (approximately $325USD). For most households in this population, this represented an upper bound on an individual's income. Only one third of the multigenerational households participating in these experiments reported having even a single member earning an income this high, as most working-aged individuals worked informally in the apparel sector or in seasonal agriculture.

The population of garment labourers normally work from their homes unsupervised. They are free to choose when to work, and once working, they are free to choose when to quit producing. They have the flexibility to intertemporarily substitute away from work whenever the opportunity cost of their time is high. Their labour is unskilled, repetitive, and manual in nature and their incomes are directly linked to their output. Each of these features is mimicked in the experiment design so that the decisions made in these experiment parallel the decisions participants make in their daily lives.

These participants were identified from the sample of household included in the Bobonis, Gertler, Gonzalez-Navarro, and Nichter (2017) field experiment on which I was a research assistant. Their study population consisted of rural households without reliable access to drinking water in the semi-arid region in the Northeast of Brazil. The authors conducted an in-depth baseline survey of 1,189 household heads in October–December of 2011 collecting a rich set of household characteristics.[41] From this baseline survey, I identified all households living in the longstanding garment production economy – those within the municipalities of Bezerros, Caruaru, and São Caitano, of the state Pernambuco. From all the adults living in these households, I used Stata to randomly select a subsample of my ideal population size, plus at least 15% to account for attrition, and then randomly assigned my treatments at the neighbourhood level. Once that assignment was complete, I confirmed that treatment assignment was balanced on a number of characteristics.[42] The resulting average sample participant was a unemployed woman in her early 40s with a grade school education.

[40] Almeida (2008).

[41] Bobonis et. al, 2017, p.8.

[42] The characteristics used in the balance calculations were: age, sex, education (last grade completed), health (a scale from 1 to 4), unemployment, number of household children, number of household members, and if the house's water supply tested positive for E. coli during the baseline survey. A follow-up survey conducted in November–December 2012 had household members participate in a battery of hypothetical behaviour economic games. From this survey, I also ensured the panel was balanced with respect the the author's measures of myopia, risk aversion, altruism and reciprocity.

1.6.2 The Task

The Abeler et al. (2011) experiment that I replicate and extend in this thesis was designed to have an easily observed and measured labour supply combined with opportunity to manipulate rational expectations of income. The original research subjects were students, and the authors chose an appropriate task for that sample: counting zeros in a matrix of numbers in a computer lab. For this replication, rather than using computers to do a mental task, my subjects produced a simple manual output: they placed stickers over randomly distributed markers on small pieces of paper. The output required two inputs other than their labour: a deck of 4.25" x 5.5" cards, each of which had 10 randomly placed black markers (see Figure 1.6b), and a roll of labelling stickers (see Figure 1.6a).[43] Participants used the stickers to completely cover all the dots on each card. Once all dots were covered, the card was considered a produced unit of output.[44]

[43]The cards were numbered and there were 100 unique designs that we ordered into identical decks for each participant. The decks of cards were sorted by hand in Brazil, and it was discovered ex post that the ordering was not always identical across decks – although the composition of cards was the same.

[44]Participants were given reminders and unlimited opportunities to fully correct for low quality work, resulting in very rare differences between the amount of output attempted and the amount of output completed

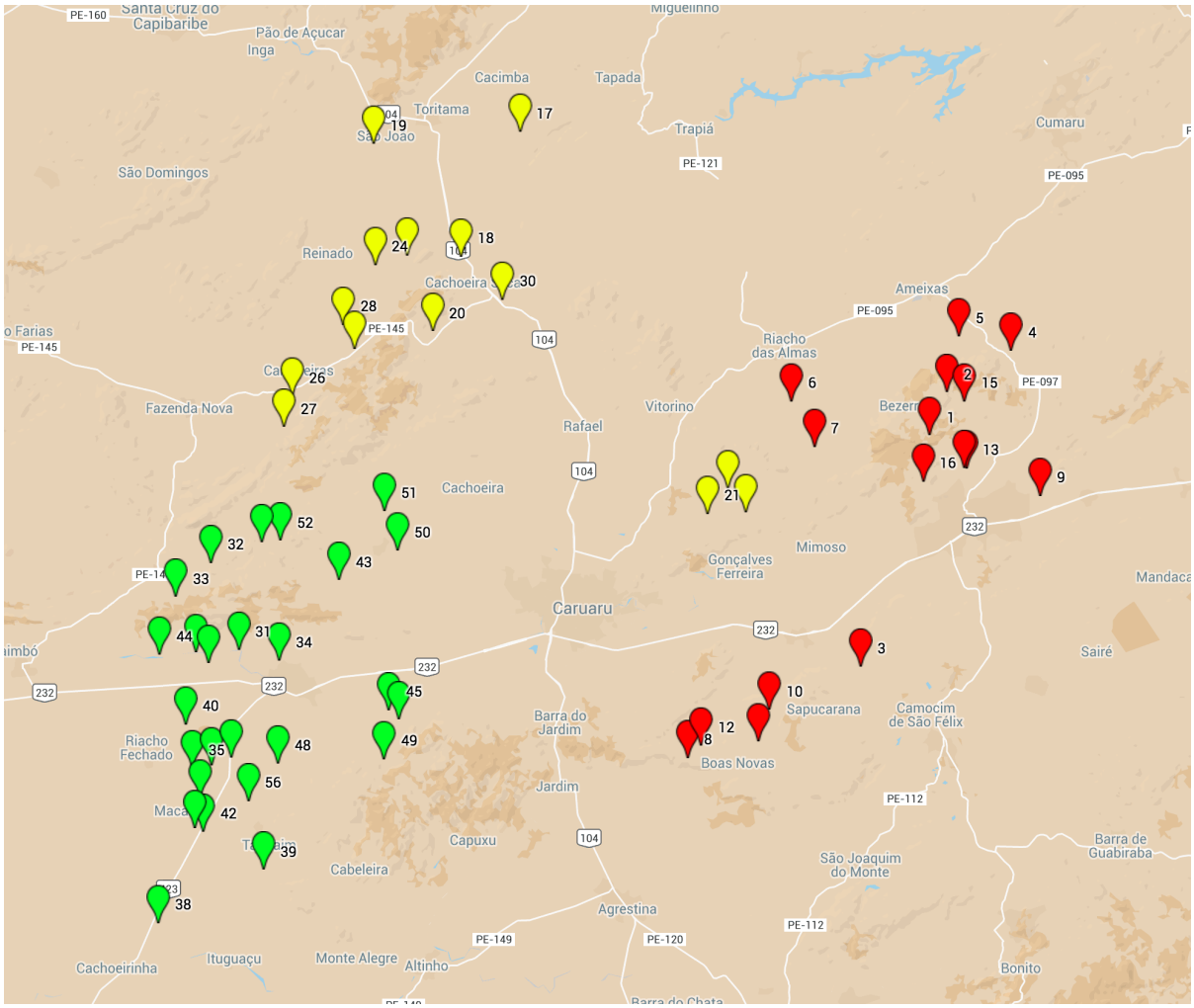
Figure 1.2: Map of South America

Map markers correspond to the neighbourhood clusters selected for in the experiment. The clusters marked in green are in the municipality of São Caitano, the red are in Bezerros, and the yellow are in Caruaru.

Figure 1.3: Map of Northeast Brazil

Map markers correspond to the neighbourhood clusters selected for in the experiment. The clusters marked in green are in the municipality of São Caitano, the red are in Bezerros, and the yellow are in Caruaru.

Figure 1.4: Map of Subject Neighbourhood Clusters

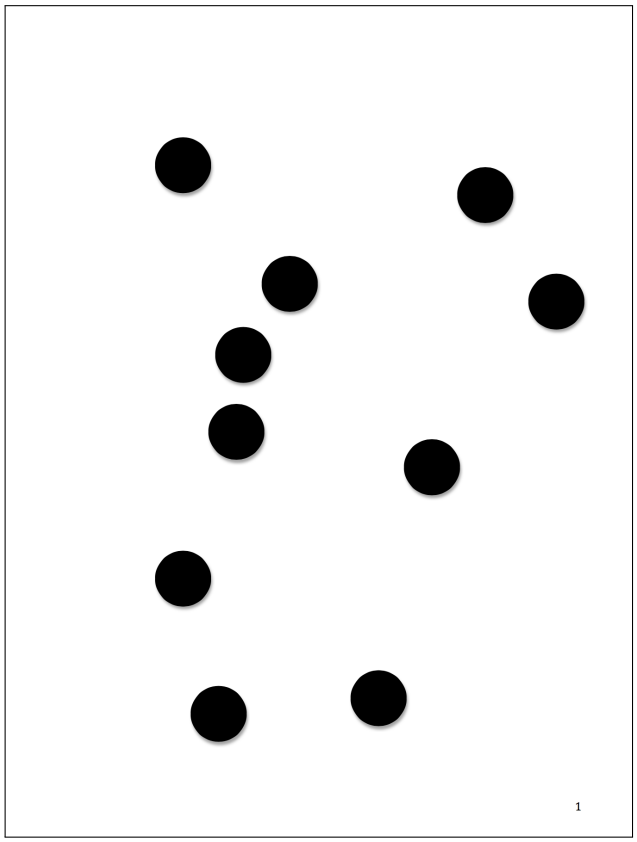


Map markers correspond to the neighbourhood clusters selected for in the experiment. The clusters marked in green are in the municipality of São Caitano, the red are in Bezerros, and the yellow are in Caruaru.

Figure 1.5: Neighbourhood Citizen and the Author Trimming Thread from Khaki Shorts for a Piece-rate during the Experiment Pilot

Figure 1.6: The Task – Cover the Black Markers with the Red Stickers

(a) Removable Labelling Stickers



(b) Sample Card with 10 Markers

Figure 1.7: Photo of a Live Experiment during the Pilot

Chapter 2

Replication Experiment: Reference Points and Effort Provision in the Field

2.1 Introduction

Johannes Abeler, Armin Falk, Lorenz Goette, and David Huffman motivate their 2011 paper *Reference Points and Effort Provision* with the need to understand the feelings of a worker who receives a 5% pay increase, but is disappointed simply because she was expecting a 10% raise. This realized raise makes her better off – she can continue to expend the same effort but earn more money – yet she is disappointed. A positive relationship between wages and effort is at the heart of canonical economics of labour supply: increasing someone's wage rate should make them want to work more, so long as it only negligibly affects lifetime wealth. But what if she does not compare this 5% pay increase to her old wage, but rather, to her expected wage? In that case, she would see this 5% raise as a loss, and rationally, may work less. Both the Abeler et al. (2011) experiment, and this replication, are designed to test the notion that a worker's expectations may serve as a her point of reference, and can explain why higher wages can lead to less work.

The standard model of intertemporal labour supply suggests that workers respond positively to transitory wage shocks: they work more when wages are high and substitute to leisure when its price – the foregone wage – is low.[1] However, estimated transitory wage elasticities are often negative or insignificant.[2] A number of models of behaviour

[1] I illustrate a simple lifecycle model of labour supply in Chapter 1, Section 1.2.

[2] For instance, consider Mankiw, Rotemberg, and Summers (1985), Browning, Deaton, and Irish

have sprung up to explain this phenomenon, many of which rely on the notion that workers have a (set of) reference point(s) that may influence their labour supply choices. But, as Abeler et al. (2011) put it,"despite their theoretical and intuitive appeal, models of expectation-based, reference-dependent preferences are inherently difficult to test, as expectations are hard to observe in the field." Their research design overcomes this hurdle, allowing both them and I to observe and manipulate workers' expectations in a real-effort experiment. Using this tool, we are able to test and quantify if expectations independently act as reference points and impact labour supply.

In this design, each worker is asked to perform a repetitive task for a piece-rate wage.[3] After each repetition of the task, the worker has the choice to quit or continue working. Once the worker has quit, she is compensated with a coin-flip: half of the time she is paid her accumulated earnings; otherwise, she is given a known fixed payment – regardless of how much, or little, work she completed. Although each worker knows she will be paid with this lottery while making her effort decisions, the payment is determined only *after* she has quit.

The primary treatment manipulation is the random assignment of the fixed payment to workers. This fixed payment plays a significant role to determine expectations of income, but is independent of canonical marginal returns to effort. Neither the marginal cost, nor marginal benefit, of working are dependent on the fixed payment, and as such, we should observe no difference across treatment arms if expectations of income are not a relevant reference point in the labour supply decision. Alternatively, if expectations do matter, we may observe a statistical difference in behaviour across treatment arms.

This experimental design is a literal interpretation of KR's *rational expectation based reference-dependence*. The KR model is particularly important in the discussion of labour supply because it reconciles disparate empirical estimates of labour supply elasticities.[4] Their theory suggests that in addition to valuing the level of income, workers evaluate income as gains or losses with respect to their recently held probabilisitic beliefs (i.e., expectations) about that income. Since loss averse workers are more motivated to avoid feelings of loss than to acquire gains, the marginal return to effort drops discontinu-

(1985), Altonji (1986), Laisney, Pohlmeier, and Staat (1992); Pencavel (1986); and Mulligan (1995).

[3]See Section 1.6.2 for a description of this task.

[4]By the early 1990s, extensive reviews of the literature and its conflicting evidence surrounding male labour supply had been compiled by Pencavel (1986), and female labour supply compiled by Killingsworth and Heckman (1986), both published in the 1986 Handbook of Labor of Economics. Laisney, Pohlmeier and Staat (1992) provide an extension of these earlier two reviews focusing on the movement away from panel data towards dynamic models with endogenous wages within the community. For a more recent brief synopsis of wage elasticities, see Chetty et al. (2011*b*). For a meta-analysis of quasi-experimental extensive margin elasticities, see Chetty et al. (2011*a*). For a meta-analysis of intensive margin elasticities from micro data see Chetty (2012).

ously once accumulated income exceeds expected income. As a result, effort increases in rational expectations of income.

The contributions of this research come from the difference between it and the Abeler et al. (2011) experiment. First, both experiments use very different populations. In the original research, subjects were undergraduate students from the University of Bonn working in a computer lab. In this replication, subjects were chosen from a population for whom their livelihood depends on piecework labour supply decisions. Alike taxi drivers and bicycle messengers, Brazilian garment workers of Pernambuco do low skilled repetitive work in a flexible labour environment where their compensation is tied to the amount of output they produce.[5] Furthermore, these Brazilian workers are not WEIRD, and their actions and motivations may be very different from previously tested WEIRD samples.[6]

Secondly, I find a very different set of results than Abeler et al. (2011). Abeler et al. (2011) find robust empirical evidence for KR labour supply behaviour: their subjects work more when their expectations are high, and the pattern of behaviour maps closely to the intricacies of the KR model. Instead I find higher (expectations of) income leads to less effort, a pattern consistent with the experience of wealth effects. The existence of these wealth effects suggest that subjects narrow bracket these labour supply decisions, making them independent of the broader environment in which they occur. These strong wealth effects, which are not plausible under a lifecycle model of labour supply, dominate the results and I do not observe evidence in favour of KR reference dependence.

The chapter is organized as follows. The following section outlines the experimental design, including a review of the context where this experiment was conducted. Section 2.3 walks through the theoretical framework, Section 2.4 describes the data, Section 2.5 outlines the empirical methodology, and Section 2.6 reports results. Section 2.7 reviews a number of extension exercises. Section 2.8 is a discussion, and Section 2.9 concludes.

2.2 Design

The Abeler et al. (2011) experiment was designed to have an easily observed and measured labour supply combined with opportunity to manipulate rational expectations of income. Unlike university students who will likely never make labour supply decisions based upon a piece wage contract, this experiment is conducted with a population whose livelihood

[5] For example, Camerer et al. (1997), Farber (2008), Crawford and Meng (2011), Farber (2015), or Fehr and Goette (2007).

[6] "WEIRD" is an acronym for Western Educated Industrialized Rich Democratic (Henrich, Heine and Norenzayan, 2010).

depends on these types of labour relations. The experiment is conducted in their place of work, and the experiment output is designed to mimic the type of output produced in their usual jobs. Finally, the amount of money offered in this experiment is large enough to have an economic impact on the short term livelihood of these workers.

The experiment involved two stages. The first stage was used to confirm, or collect, control information from subjects and allow them to become familiar with the task. In both the original and replicated experiments, subjects had four minutes to complete as many units of output as possible for a guaranteed piece-rate. In the Abeler et al. (2011) experiment, this was €0.10 per table of zeros successfully counted. In the Brazil replication, this was 0.05BRL per card of markers successfully covered.[7] In Brazil, these earnings were paid in cash to the subjects immediately to help legitimize the experimenters. This stage allowed subjects to become familiar with their own costs of effort and built a sense of how long it takes them to complete each unit of output. It also generated a measure that both papers used to control for relative productivity.

The second stage is where the treatment manipulation was introduced. Although the task was the same, there was a new payment contract. First, rather than working for four minutes, subjects were free to produce as many, or few, units of output as they pleased. Secondly, rather than being paid a guaranteed piece-rate wage for their output, subjects were told that they would be paid with a lottery. In the Abeler et al. (2011) experiment, subjects were asked to choose one of two sealed envelopes prior to starting work, knowing that one envelope had a card saying *acquired earnings* and the other said €3 (or the fixed payment amount to which they were randomly assigned). In Brazil, I told the participants that their payment of either their acquired earnings or the fixed payment would be determined by a coin flip. I allowed the participant to chose and examine the coin, as well as determine if the fixed payment would be *heads* or *tails*.[8]

We know the subjects rational expectations about the earnings at the time they are making their labour supply decisions: they would be paid their accumulated earnings with 50% probability, and the fixed payment with 50% probability. To be sure that the these amounts were always salient to the subjects, the Abeler et al. (2011) experiment displayed the running values on the computer screen. In the Brazil experiment, the facilitators wrote the running totals on the back of the completed cards displayed for the participants, and confirmed orally at least once per 10 completed cards.

There were two main treatments: people were assigned to either a high, or low, fixed

[7] 1 BRL ≈ 0.45USD ≈ €0.33 at the time of the experiment in Summer 2014. A description of the experiment tasks is contained in the previous chapter.

[8] The equivalent of *heads* or *tails* in Brazil is *cara* or *coroa*.

payment. In the Abeler et al. (2011) experiment, the "LO" fixed payment was three euros, and the "HI" fixed payment was seven euros. In Brazil, the LO fixed payment was three Brazilian Reals and the HI was six Brazilian Reals. I deviated from the relative value of these treatment amounts was to allow for an additional test of the reference dependent model discussed in Section 2.7. In the main specifications, the Brazilian piece-rate was 0.20BRL per unit of output, comparable to the Abeler et al. (2011) piece-rate of €0.20 per unit of output.

Abeler et al. (2011) were concerned with peer effects on labour supply, and as such, had their subjects perform their tasks in isolation from other participants and the facilitators. This was not possible in Brazil. Although it may have minimized some confounding noise in the outcomes, it would have minimized the external validity as well. The Brazilian population from which subjects were drawn work from their homes in the presence of friends and family. As this is the natural employment environment for these piece-rate workers, it is also the environment in which the experiment was conducted.

Abeler et al. (2011) conducted additional robustness tests to see if salience or reciprocity are the drivers of their results. In this replication I address reciprocity, although I do so using an alternative methodology. I do not address salience, but instead test if an additional implication of the labour supply model holds. This additional test and results are discussed in Section 2.8.

2.3 Theoretical Framework

Recall how the KR model of reference dependent choice can be applied to labour supply decisions.[9] Consider the period t labour supply decision of a worker who experiences some uncertainty about her return to effort, Y_t, that period. This model supposes that this worker has some expectation of her return to effort, $\tilde{Y}_t$, that will have an impact on her labour supply choice. In that sense, her hours of labour supplied will be determined by both her known wage rate and her expectations of income, $h_t(w_t, \tilde{Y}_t)$. Her reference dependence creates a kink in her utility function where her realized return to effort is equal to her expectations, $Y_t = \tilde{Y}_t$. Failing to reach her expected income hurts, and so the marginal return to effort drops once she reaches her expected earnings. In this sense, her reference dependence only matters because she is loss averse – falling short of her goal hurts more than exceeding her goal makes her happy. As with neoclassical models of intertemporal labour supply, her labour supply is increasing in her transitory wage, $\frac{\partial h_t}{\partial w_t} > 0$, over the domain of wages where meeting her expectations are irrelevant. It is

[9] Please refer to Chapter 1, Section 1.5.

only near the kink in her utility function that her response to transitory wage shocks becomes ambiguous. A general version of this model is discussed in the previous chapter, and adapted for the experiment below.

The experiment design manipulates the worker's expectations of income. Suppose this worker will be paid with a lottery. At the time she makes her effort choice, she knows that with probability p she will be paid some function of her effort, $w_t h_t$, and with probability $(1-p)$ she will receive a fixed payment, f_t, regardless of her effort, h_t. Thus, her expected income can be written as $\tilde{Y}_t = p(w_t h_t) + (1-p)f$. If her realized income is f_t, then we can write her utility function as:

$$u(f_t, h_t) = \begin{cases} (1+\alpha)p(w_t h_t - f_t) - \frac{\theta}{1+\nu} h_t^{1+\nu} & \text{for } f_t < w_t h_t \\ (1-\alpha)p(w_t h_t - f_t) - \frac{\theta}{1+\nu} h_t^{1+\nu} & \text{for } f_t \geq w_t h_t. \end{cases}$$

If her realized income is $w_t h_t$ then we can write her utility function as:

$$u(w_t h_t, h_t) = \begin{cases} (1-\alpha)(1-p)(f_t - w_t h_t) - \frac{\theta}{1+\nu} h_t^{1+\nu} & \text{for } f_t < w_t h_t \\ (1+\alpha)(1-p)(f_t - w_t h_t) - \frac{\theta}{1+\nu} h_t^{1+\nu} & \text{for } f_t \geq w_t h_t. \end{cases}$$

Thus, choosing her effort h_t to maximize her expected utility:

$$\max_{\{h_t\}} \mathbb{E}\big[U(Y_t, \tilde{Y}_t)\big] = p\big[u(w_t h_t, h_t)\big] + (1-p)\big[u(f_t, h_t)\big],$$

will generate a discontinuous marginal return to effort function, which will equal her cost of effort at the optimal amount of work. The result is a discontinuous labour supply curve divided at the point where here accumulated earning $w_t h_t$ equal the fixed payment f_t,

$$h_t = \begin{cases} \left(\frac{pw_t - p(1-p)\big(1-\alpha\big)}{\theta} \right)^{\frac{1}{\nu}} & \text{if } f_t < w_t h_t \\ \left(\frac{pw_t + p(1-p)\big(1+\alpha\big)}{\theta} \right)^{\frac{1}{\nu}} & \text{if } f_t \geq w_t h_t. \end{cases}$$

The curve has an elasticity of $\frac{1}{\nu}$ with respect to the linear transformations of the wage rate found in the numerators of the piecewise function on both sides of the discontinuity.[10] This expression shows that the loss-averse, reference-dependent worker is more motivated to work when earnings are less than the fixed payment compared to when earnings are more than the fixed payment. Avoiding the feelings of loss generate an extra motivation

[10] In the domain where $f_t < w_t h_t$, this linear transformation of the wage rate is $pw_t - p(1-p)\big(1-\alpha\big)$. In the domain where $f_t \geq w_t h_t$, the linear transformation is $pw_t + p(1-p)\big(1-\alpha\big)$.

for this worker when her earnings are below the fixed rate.

The shape of this discontinuous labour supply curve has three important implications regarding the relationship between expectations of income and hours worked. First, since workers are more motivated to work when accumulated earnings are less than the fixed payment, $w_t h_t < f_t$, than else wise, increasing this fixed payment will weakly increase the average amount of labour supplied.

Hypothesis 1. *Average effort in the HI treatment is higher than in the LO treatment.*

Second, the discreet drop in the marginal return to effort at the point where $w_t h_t = f_t$ means she is more likely to quit once she has produced enough output to cross this threshold. We should observe a significant increase in the probability that a worker quits exactly when she has earned the fixed payment, $\bar{h_t} \equiv \frac{f_t}{w_t}$.

Hypothesis 2. *The probability to stop at $w_t h_t = f_t^{L0}$ is higher in the LO treatment than in the HI treatment; the probability to stop at $w_t h_t = f_t^{HI}$ is higher in HI than in LO.*

Finally, the mechanism that drives a negative wage elasticity is through the decline in $\bar{h_t}$ as wages increase. Thus, conditional on the amount of effort needed to achieve her expectations, $\bar{h}$, the labour supply elasticity should be positive: $\frac{\partial h_t}{\partial w_t} > 0|_{\bar{h_t}}$

Hypothesis 3. *Average effort increases in wage conditional on $\bar{h_t} \equiv \frac{f_t}{w_t}$.*

2.4 Data

In this project, I randomized payment contracts to 366 adults in 43 neighbourhood clusters for a shift of manual labour to take place in their homes.[11] Subjects were recruited from a baseline survey and offered the chance to participate.[12] Of the subjects selected from the baseline survey for participation, only 207 were found, although amongst those found, I had 100% acceptance of our offer to participate in this experiment.[13] In order to

[11] A cluster was defined as households that were walking distance from each other and at least 2km from the next neighbourhood cluster.

[12] Baseline household demographic information and localization information courtesy of Gustavo J. Bobonis, Paul Gertler, Marco Gonzalez-Navarro, and Simeon Nichter's research regarding clean water access in the semi-arid regions of Brazil (Bobonis et al., 2017).

[13] Only 207 members of this preselected sample were found by the research team. Reported reasons by neighbours and other household members included moving, death, illness, and being at work. Upon discovering that a preselected individual could not be located, the research team attempted to replace this person with another from the same household. If no additional adult members of the household were available, the team would seek to replace within the same neighbourhood cluster. If that was not possible, the observation was dropped. In all, 159 individuals were replaced, created a total sample of 366 individuals

maintain optimal treatment arm sample sizes, individuals we were unable to locate were replaced with an adult from the same household. If that was not possible, they were replaced with an adult from the same neighbourhood cluster. If that was not possible, the observation was foregone.

The experiment took place in July and August of 2014.[14] A team of up to four locally hired professional surveyors travelled to the preselected individual's homes and invited them to participate in a shift of work. Upon their first meeting, surveyors described this experiment as participation in two immediate income generating activities: a mandatory four minutes of work in the first stage, and an open-ended amount of work in the second stage that could end at the participant's discretion. Less than one percent of shifts lasted more than an hour. The survey team was in the field six days a week from sun up to sun down.[15] This experiment was completed in 24 days in the field.

To minimize the chance that participants would learn about the various payment contracts offered to others, these contracts were randomized at the neighbourhood level. Since the payment contract randomization takes place at the neighbourhood level, the individual observations are not independent, and so the unit of analysis is the neighbourhood level behaviour. The 366 individuals in the survey came from 131 households, with no more than four adults coming from the same household. Table 2.1 presents self-reported characteristics of these participants at the time of the first experiment. The typical participant was a woman in her early 40s.

The four minute practice stage identified the relative productivity of participants. The median participant completed 1.5 cards per minute during this stage, with the slowest producing 0.5 cards per minute and the fastest at 3.25 cards per minute.

During the second (main) stage, the average amount of output produced was 20.0 cards and the average amount of time worked was 12.5 minutes. Table 2.2 reports the unconditional mean and standard deviation of output produced by payment contract treatment cell. In contrast to the results in Abeler et al. (2011), despite random assignment, it is immediately apparent that there are no statistical differences in the unconditional average behaviour due to treatment.

[14]The first experiment took place after the completion of the locally hosted World Cup.

[15]The team did not work on Saturdays because this is the day that locals (including the surveyors) go to the market to do the weekly shopping and/or vending home produced goods like vegetables. They also only worked during daylight due to safety concerns. Many of these clusters were accessed only on unlit dirt roads.

2.5 Empirical Methodology

The empirical methodology of this replication follows that of Abeler et al. (2011) for comparability, although an argument can be made that different econometric approaches may be better suited for this assessment. For instance, we use OLS in levels to identify the impact of a expectations on labour supply, which is known to have drawbacks with count data. The main specification for both papers addresses Hypothesis 1:

$$h_{ic} = \alpha + \beta f_{ic}^{HI} + \boldsymbol{X_{ic}}\boldsymbol{\gamma} + \epsilon_c. \tag{2.1}$$

The dependent variable h_{ic} is the measure of labour supply for individual i from neighbourhood cluster c. Two measures are reported: the count of units of output produced, and the amount of time spent working. The only notable difference between this specification and that in the original research is that I have chosen to use "completed tasks" rather than "accumulated earnings" as one of my dependent variables. This is a linear transformation of the outcome Abeler et al. (2011) used, but is preferable in the context of this paper for comparing across the two potential replications of the original research possible in Brazil.[16]

Included in this specification is a vector of individual characteristics in $\boldsymbol{X_{ic}}$, to control for a subject's age, sex, and other characteristics outlined in the regression tables. The coefficient of interest is β: the estimated relationship between the randomly assigned expectations of income and effort. The variable f_{ic}^{HI} is an indicator that individual i from cluster c was randomly assigned the high fixed payment for her lottery. If rational expectations of income influence these workers' behaviour, we'd expect β to be positive and significant. Two additional variations of Equation 2.1 are estimated in the extensions in Section 2.7.

To examine Hypothesis 2, I follow Abeler et al. (2011) to test if workers are disproportionately likely to stop working when their accumulated earnings equal their randomly

[16]The two potential replications differ in the piece rate wage - thus the accumulated earnings would be proportionally higher in the high wage case causing unnecessary incomparability. The results are only reported for the high piece-rate treatment arm because this replication most closely matched that in the Abeler et al. (2011) design. In the Abeler et al. (2011) experiment, students had to produce 15 units of output to make $wh = f$ in the low fixed payment lottery and 35 units of output to make $y(e) = f$ in the high fixed payment lottery. In my experiment, in the high wage treatment arm, participants had to produce 15 units of output to make $wh = f$ in the low fixed payment lottery and 30 units of output to make $wh = f$ in the high fixed payment lottery. The approximate amount of time to produce one unit of output was the same in both experiments.

assigned expectations. To examine this point, I use a multinomial logit framework:

$$\text{StopCategory}_{ic} = \alpha + \beta f_{ic}^{HI} + \boldsymbol{X_{ic}\gamma} + \epsilon_c. \tag{2.2}$$

The dependent variable is a categorical variable with three outcomes *stop when* $wh = f^{LO}$, *stop when* $wh = f^{HI}$, and *stop elsewhere* . The category of *stop elsewhere* is omitted, and the coefficients are jointly estimated for the other regressors. This estimation allows me to identify if an individual is disproportionally likely to quit working precisely when her accumulated income equals the fixed payment. To complement this specification I also do a survival analysis, inspired by the methodology of Farber (2008) and Crawford and Meng (2011), to predict the likelihood that a person quits working after any given unit of output produced. Where the multinomial logic specification predicts if a person quits working at *exactly* the point where her accumulated income is equal to the fixed payment, the survival analysis estimates if there is a structural break in the probability of quitting *after* their accumulated income exceeds the fixed payment. This specification is:

$$\text{StopAfterTask}_{ich} = \alpha + \beta(Income \geq f_{ich}) + \phi Cum\_Income_{ich} + \psi Cum\_Min_{ich} + \boldsymbol{X_{ic}\gamma} + \epsilon_c. \tag{2.3}$$

The dependent variable in Equation (2.3) is an indicator that is equal to 0 if an individual continues to work after producing output h, and a 1 if she decides to quit working immediately after producing that output. As such, the mean of this variable tells us the average probability that a participant will quit working after producing an additional unit of output. The variable Cum_Income_{ich} is a continuous variable that is equal to the total amount of income accumulated after the completion of task h, wh. Similarly, Cum_Min_{ich} is an estimate of how much time had been spent working when task h was completed.[17] The coefficient of interest is β, which estimates the marginal change in the probability of quitting of when person i has completed enough tasks such that her accumulated income is greater than the fixed payment.

2.6 Results

Abeler et al. (2011) test Hypothesis 1 with Equation (2.1) and a sample size of 120 students. They find that the high fixed payment increased average effort by about 25%

[17]The average time it took to produce each unit of output was calcualted using the total amount of time spent working divided by the total units of output produced. This average was then scaled up to estimate the cumulative time required to produce h units of output.

(significant at 5%) – just under 2 extra completed units of output and a little more than 6 extra minutes of work. In this replication, the average participant completed 20 units of output in 12.5 minutes, so a comparable effect to that found in Abeler et al. (2011) would be a 5 card or 3 minute increase in effort. The results reported in Table 2.3 show that the effects of expectations on effort in the Brazil replication are much smaller in magnitude and the opposite sign of that identified by Abeler et al. (2011), albeit statistically insignificant.

As these outcomes are count data with a lower bound at zero, it might be best to use the natural log of the dependent variables rather than estimate in levels. These results are reported in Table 2.4. These estimates suggest that those in the HI Treatment arm produce 19%–30% fewer output, and work 36%–48% fewer minutes, than their LO Treatment counterparts.

The top panel of Table 2.5 indicates precisely what Hypothesis 2 predicted, although the bottom panel does not offer the complementary result. Although agents assigned a fixed payment of 3BRL are more likely to stop when accumulated earnings are equal to 3BRL, they are also more likely to stop when accumulated earnings are equal to 6BRL, albeit this is imprecisely estimated. The average effect is illustrated in Figure 3.1: a histogram of accumulated earnings less the fixed payment. If subjects were more likely to quit at the threshold, we should observe bunching at zero. A McCrary test for bunching confirms what is visually obvious: there is no disproportionate jump in frequency to quit when $w_t h_t = f_t$.

To complement the above result, I plot the survival functions that display the fraction of participants who continued to work after accumulating each level of piece-rate income.[18] Even if participants are not disproportionately likely to quit exactly when $w_t h_t = f_t$, the expectations dependent model suggests that a worker is more likely to quit after she crosses that threshold than a worker who has not. In other words, the probability of survival will drop sharply at when $w_t h_t = f_t$ to capture the discontinuous drop in the marginal return to effort. As such, the probability of survival (i.e., continuing to work) to be higher for those in the HI treatment over the LO treatment in the range of earnings between the LO and HI fixed payments. Figure 3.2 shows some indication of this pattern, as the survival rate of those in the LO group is below that of the HI treatment group in the range of earnings between the fixed payments, although this difference is not statistically significant. There also appears to be a slight increase in the probability of quitting once those in the LO treatment accumulate 3 BRL, but there is

[18]Kaplan-Meier curves that display the fraction of participants who continued to work after accumulating each level of piece-rate income.

no comparable drop in the HI treatment behaviour at 6 BRL.

A formal survival analysis described in Equation (2.3) helps unpack these results further. The dependent variable of this analysis reported in Table 2.6 is an indicator that is equal to 0 if an individual continues to work after producing output h, and a 1 if she decides to quit working immediately after producing that output. As such, the mean of this variable, which tells us the average probability that a participant will quit working after producing an additional unit of output, is 4.7%. The reported coefficients are marginal effects: for the continuous variables, these are the instantaneous rates of change in the probability of quitting at output h; for the dummy variables, these are differences in the probability of quitting when these variables equal 1 over when they equal 0.

The first two columns of Table 2.6 report that the probability of quitting is increasing in the amount of time spent working – which is to be expected for both canonical and reference dependent workers. We expect that for any sort of income targeting behaviour, conditional on the time spent working, the probability of quitting would increase in the income earned. In other words, for a given amount of labour supply, the higher amount of income accumulated should put income targeters closer to their goals, and thus make them more likely to quit working. The results reported here suggest otherwise: the more income earned for a given amount of time spent working, the more likely a participant is to keep working. This is consistent with a canonical pattern of behaviour.

In addition to cumulative income and effort, I additionally control for whether or not a participant has accumulated more income than her fixed payment at unit of output h. If the optimal stopping decision is affected by expectations of income as outlined in the expectation dependent model, then we would expect there to be a positive and significant increase in the probability of quitting once accumulated income is greater than the fixed payment. The result in Column (1) – (3) suggests this may be true on average, although it is not statistically significant. To unpack the (lack of) average effect, I break the sample into the HI and LO treatment groups. Those in the HI treatment group should only see an increased probability of quitting when their accumulated income crosses f^{HI} and the LO treatment should only see an increase in their probability of quitting when their accumulated income crosses f^{LO}. Despite statistical insignificance, this is the opposite pattern of that observed in Columns (5) – (8).

2.7 Extensions

2.7.1 Wage Elasticity

The purpose of the model underlying this experiment, like many other behavioural models of labour supply, is to explain why individuals work less when the experience transitory wage increases. The seminal example is New York City taxi cabs: cab drivers have a tendency to quit early on days where they earn relatively more money per hour.[19] The explanation at the heart of this experiment is that the increase in transitory wages allows workers to hit their expected earnings earlier, and the resulting satisfaction from meeting that goal leads them to quit early and go home. Rather than maximizing their lifetime utility, they narrow bracket the decision, and quit when they are happy within the day.[20] The ability to reach a short term goal more easily counteracts the effect of increased wages on effort, and can even dominate.

The extension of this rationale is that a transitory wage increase should increase effort as long as the effort required to meet their expectations remains constant. I am able to test this prediction in this experiment. In addition to the HI and LO treatment arms conducted with the piece-rate wage of 0.20BRL designed to map to the Abeler et al. (2011) experiment, an additional 188 participants were assigned to the HI and LO treatment arms with a piece-rate wage of 0.10BRL. Not only does this low wage experiment serve as an additional replication of the Abeler et al. (2011) experiment, but comparing individuals in the LO treatment arm with the low wage, and the HI treatment arm with the high wage, allows me to isolate the wage elasticity holding the amount of effort required to meet expected income constant.[21] In both of these categories, a subject has to produce 30 units of output to meet expectations, so the only difference between the behaviour of the two groups will be driven by the piece-rate wage. Since there is no reason for there to be a negative wage elasticity when the threshold level of effort is held constant, I estimate:

$$ln(h_{ic}) = \alpha + \phi w_{ic}^{HI} + \boldsymbol{X_{ic}}\boldsymbol{\gamma} + \epsilon_c \Big|_{w\times 30 \text{ units of output}=f}. \tag{2.4}$$

I anticipate that $\phi > 0$. This test, amongst all the specifications in this paper, is built on the assumption that the changes in the wage rate and the fixed payments cannot induce an income effect because they are transitory and negligible for lifetime wealth. If the

[19] For example, Camerer et al. (1997), Farber (2008), Crawford and Meng (2011), or Farber (2015).

[20] See Read et al. (2000).

[21] The results of this experiment are comparable to the high wage experiment, in that all of the coefficients of interest from the Abeler et al. (2011) experiment are statistically insignificant.

increases in the fixed payment resulted in an income effect, then the coefficient ϕ will be estimating the wage elasticity absent the reference dependent effect, but it will still be downward biased by the income effect.

The results are reported in Table 2.7. In general, we see that effort is decreasing in the randomly assigned piece-rate wage when I do not fix the amount of effort required to accumulate the fixed payment amount. Depending on the specification, output decreases by 24.5–28.3% when I double the randomly assigned wage rate, although it is only marginally significant. When I fix the effort requirement to hit this goal, this elasticity does not change, although it becomes less precisely estimated. The elasticity is still negative, estimated as a noisy 22.3% decline in effort in response to doubling the wage rate, although it is statistically no different than 0. But this lack of statistical effect is not because of the slight decrease in magnitude that may have indicated a downward bias in the estimate due to reference dependence, but rather, an increase in the standard error. If anything, the continued negative result, which is robust to holding the effort required to meet the target constant, is further evidence of narrow bracketing. This appears to be another wealth effect. Increasing the wage in the experiment leads people to work less, which in this narrow context, means the income effect is dominating.

2.7.2 Reciprocity

The baseline survey used to identify subjects contained measures of hypothetical reciprocity. At least one adult per household was asked a battery of questions to determine their relative reciprocity that was applied to the whole house. This battery is a variation on a standard dictator game with one additional step. The subject is told that she is a recipient of an envelope of money. This money was sent by a stranger, like herself, who received 10BRL from our research team and was given the opportunity to share this gift with an anonymous member of his community. The research team told him that we would more than match his generosity: we would triple the amount he put in the envelope before it was given to the receiver. The receiver was told that she would have the chance to thank the sender by returning none, some, or all of the money to the sender, but her anonymity was protected. Then, we measured what share of the money the receiver claimed she would return for a sequence of received amounts. A subject who does not return a higher share when she receives an envelope containing 30BRL (i.e., the sender sent the maximum) than when she receives an envelope with 6BRL (the sender sent the lowest amount) was deemed a low reciprocity type.

Of the 178 subjects involved in the main sample of this experiment, I have this measure

for 100 individuals. I include this binary measure for being a low reciprocity type, as well as an interaction between HI treatment and being low reciprocity to equation 1 in the following sense:

$$h_{ic} = \alpha + \beta f_{ic}^{HI} + \lambda LowReciprocity_{ic} + \psi(LowReciprocity_{ic} \times f_{ic}^{HI}) + \boldsymbol{X_{ic}\gamma} + \epsilon_c \quad (2.5)$$

and report these results in Table 2.8. I find the results are not statistically different across reciprocity types, suggesting that the absence of the average response to the high fixed payment treatment is not driven by heterogeneity with respect to reciprocity.

2.8 Discussion

The predictions from this experiment are dependent on the assumption that the increase in the fixed payment from 3BRL to 6BRL changes expectations but has no wealth effect on subjects. Although this is clearly true that an additional 3BRL (1.5CAD) has a negligible impact on an adult's lifetime wealth, it may not be the case that it has a negligible impact on the wealth measured over a smaller timeframe. If we use the formal minimum wage, known to only be earned by the highest income earners in these communities, this extra expected 3BRL is about half a percent of monthly income, about a 1.8% increase in weekly income, or 12.6% increase in that day's income. If subjects think about income in the narrow bracket of days, changing the fixed payment is not just changing a subject's rational expectations of income – it is changing their expected wealth.

This choice bracketing is one of the primitives of reference dependence. As Barberis, Huang and Thaler (2006) highlight, if agents took into account their lifetime wealth and expected wage profile at any given moment, most reference dependence would be irrelevant because most stakes have negligible impacts on the big picture.[22] As such, the models of reference dependence used to explain cab drivers, students, and now Brazilian piece-rate worker behaviour are characterizing the importance of reference points conditional on *narrowly bracketed* decisions.

As any worker decides how much labour to supply for a given wage rate, there are both income and substitution effects that play into her decision. The canonical relationship of intertemporal substitution discussed in this paper assumes that for the range of wages in question, the substitution effect dominates and a worker optimizes by choosing to work

[22]Barberis, Huang and Thaler (2006) actually discussed risks, and not income, although the rationality is the same.

more hours when the wage rate is high, and consume more leisure when its cost – the foregone wage – is low. But it is well documented that labour supply curves are *backwards bending*. After some threshold wage, the income effect dominates the substitution effect and a worker's preferences for leisure change. This threshold level of wealth that drives wage elasticities to become negative, is in some sense, the same as the reference dependent model of labour supply, but with a *broad* bracket. The results of this experiment suggest a similar pattern, a wealth effect within a *narrow bracket*.

The existence of an expected wealth effect would put a downward bias on the coefficients related to both the HI fixed payment and the HI wage. This could explain why unlike the result reported in Abeler et al. (2011), I find coefficients that are small, often negative, and statistically insignificant. I simply offered participants too much money when benchmarked to their current wages. Yet, the existence of a wealth effect from such a transitory income generating opportunity is strong evidence that a standard model of intertemporal labour supply to maximize lifetime wealth does not apply to these Brazilian garment workers either.

Canonical households treat income as fungible: a dollar is a dollar within the budget, no matter where is comes from.[23] But violations of this fungibility, especially in experimental contexts, is well noted. If experimental participants evaluate the income earned during an experiment in isolation from income generated by more traditional methods, it may explain why so few participants maximized the income generating potential of these shifts of the experiment. The financial marginal return to effort within the experiment was substantially higher than the financial marginal return to effort in alternative income generating activities. The average participant could have guaranteed to be paid at least the state mandated hourly wage with ≈22 minutes of effort in the low wage treatment arm, yet only 13 of 605 observations of labour supply were top censored.[24] This suggests that the piece-rate workers may consider the money earned in this experiment as different from that earned elsewhere, and narrow bracket their decision to earn income within this experiment from alternative sources of income.

A competing explanation of the negative wage elasticity is an alternative form of reference dependence: external income targeting. External income targeting behaviour consists of participants having an income goal that is independent of treatment – for instance, to earn enough money to buy bread for dinner or medicine for a parent. In a supplementary analysis of heterogeneous treatment effects, it is apparent that the

[23] Adapted from Hastings and Shapiro (2013).

[24] This per hour earnings value is not salient because the state mandated minimum wage is paid as a monthly salary.

negative wage elasticity found on average is driven by individuals who, ex post, report that they do not know how they will spend the money earned in this experiment.[25] If external income targeting was the reason for this behaviour, it should have been the opposite – people with a particular use for the money should have had the negative wage elasticity.

An additional, and more appealing, competing explanation for the negative wage elasticity is that the experiment participants were less naive than me when it comes to the behaviour of the enumerators. Despite the coin flip in the payment lottery itself being fair, the enumerator response to the coin flip was not. Even if heads and tails were being awarded with equal probability, paying f and wh were not. The correlation between receiving the f in the payment lottery and the total earnings accumulated is -0.30 and significant at the 1% level.[26] The marginal effects from a probit model estimation show that the probability of receiving the fixed payment in the lottery is about 72% when accumulated earnings are equal to zero, and decreasing by about 5% for every extra accumulated BRL. The odds of the lottery were statistically different from fair when accumulated earnings were less than 3.5BRL and greater than 4.9BRL – otherwise the outcome statistically favoured the higher of the two payments. Whatever the mechanism that generated this relationship, receiving the fixed payment in the lottery is correlated with choosing to work and earn less.[27] If workers expected that the enumerators would always favour the higher payment, there is no reason for effort to respond as predicted to the experiment parameters.

2.9 Conclusion

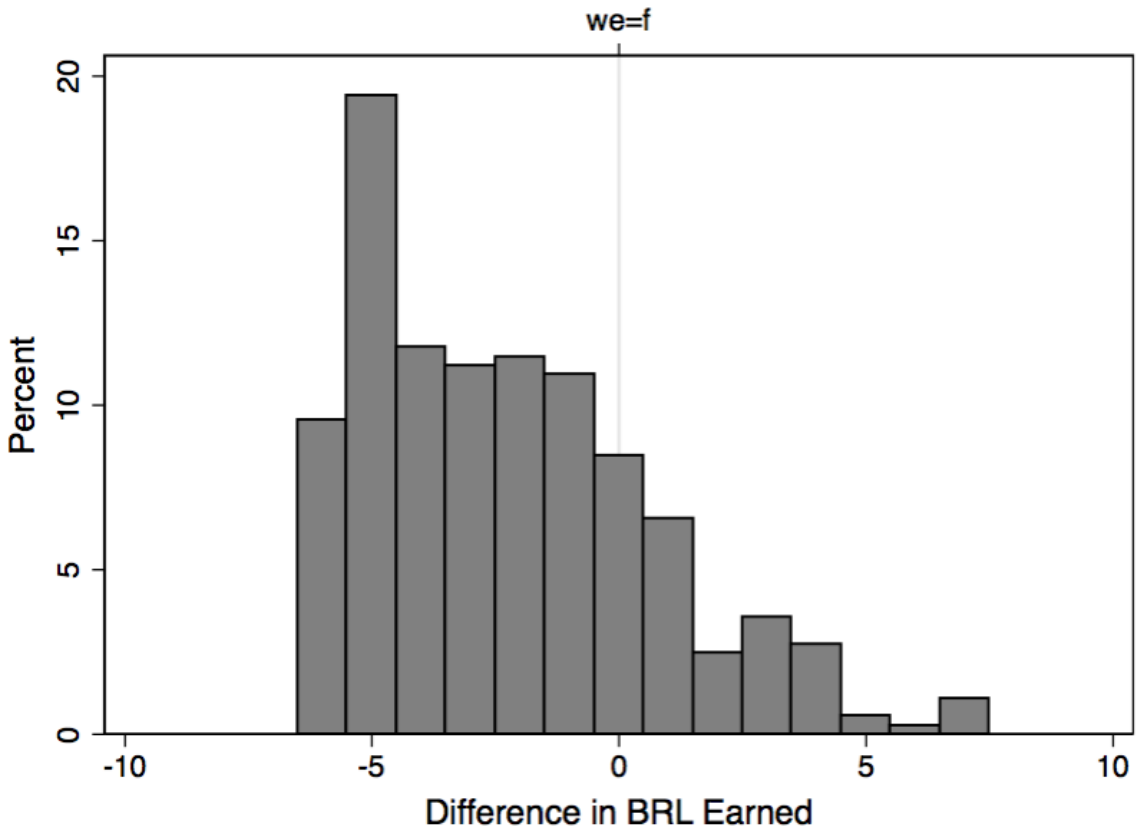
Abeler et al.'s (2011) laboratory design presented a clear test of KR preferences in an effort provision context. I followed and extended this methodology in the first test of the KR model in a real-effort framed field experiment. I manipulated Brazilian piece-rate workers' rational expectations of income with a lottery-based payment contract for an open-ended shift of work. I engineered workers' probabilistic beliefs about income and

[25] It is an identical analysis to that which is reported in Table 2.3 but with additional controls for individuals reporting that they do know how they will spend their earnings and an interaction with the high wage treatment. For those who do know how they will spend their earnings, their wage elasticity is precisely 0 (i.e., the general wage elasticity and interacted elasticity are of equal magnitudes and opposite signs with at least marginal significance of p = 0.101).

[26] Significance level determined from a regression with clustered robust standard errors.

[27] For instance, the enumerators may have been stealing the difference by awarding the low amounts and recording the high amounts, enumerators may have wanted subjects to "win", enumerators may have wanted to avoid conflict, etc.

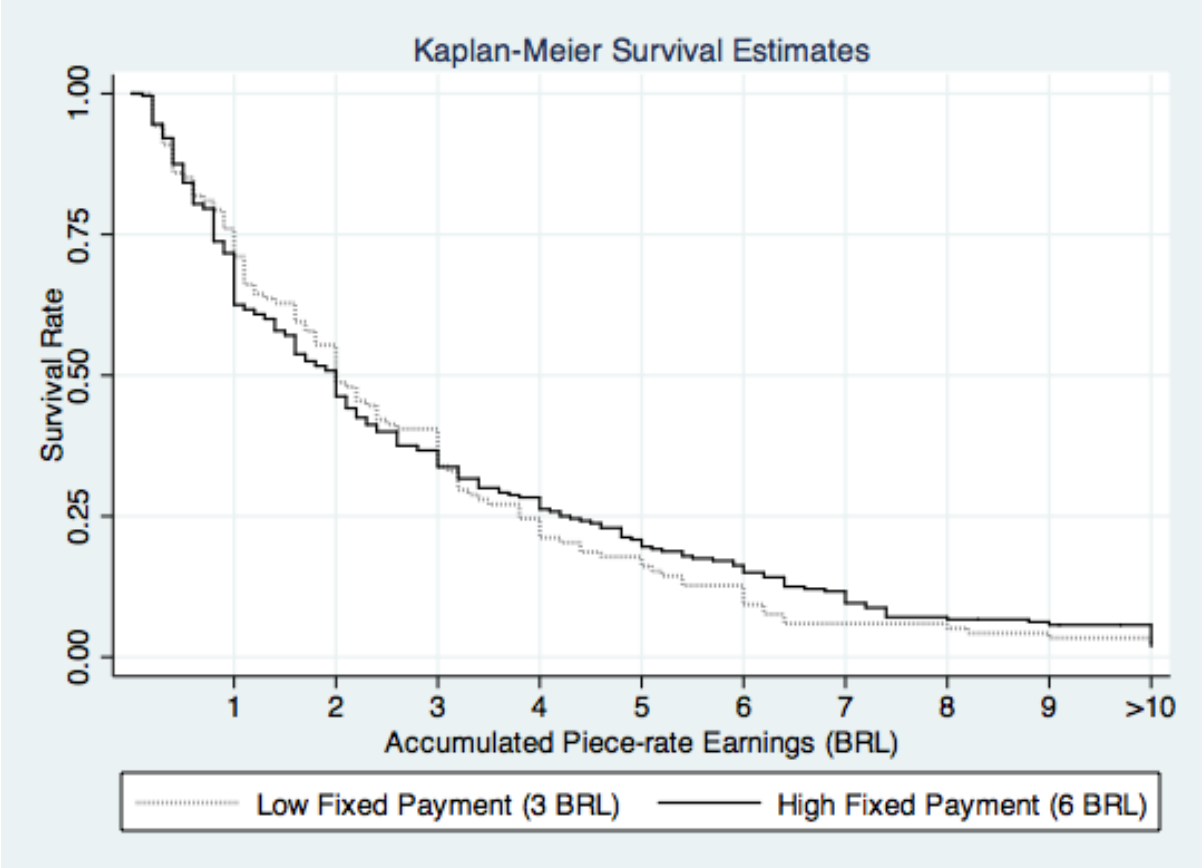
Figure 2.1: Histogram of First Shift Piece-rate Accumulated Earnings Minus Fixed Payment, $wh - f$



Note: This is a histogram of piece-rate earnings from the first shift minus the fixed payment ($wh - f$). The bin width is 1 BRL. McCrary Test for Bunching at $wh = f$ p-value is 0.75 (bin size = 1BRL, cut = -0.5BRL, bandwidth is default at = 2.69 BRL).

tested if these expectations determine labour supply. Unlike the strong results in the original experiment, I found only weak evidence that rational expectations do influence effort: if expectations are high participants work less than if expectations are low. This behaviour is not only statistically different from that observed by Abeler et al. (2011), but is also not easily rationalized by either KR preferences or a canonical lifecycle model of labour supply. Rather, despite the small stakes and transitory nature of this experiment, these agents behave as though they experience a wealth effect.

Figure 2.2: Survival Estimates



Note: On the vertical axis is the fraction of participants still working after earning the piece-rate income plotted along the horizontal axis. The log rank test for equality of survival functions has a p-val = 0.681 (i.e., these lines are not different). If workers have KR preferences, there should be a sharp decrease in the survival rate where piece-rate earnings equal 3 for those assigned the low fixed payment, and similarly where piece-rate earnings equal 6 for those assigned the low fixed payment.

Table 2.1: Sample Characteristics of Participants

	Low Wage		High Wage	
	(1)	(2)	(3)	(4)
	Low Fixed	High Fixed	Low Fixed	High Fixed
Age	41.34	45.10	43.76	44.26
	(15.83)	(18.80)	(15.86)	(15.04)
Male	0.47	0.39	0.39	0.44
	(0.50)	(0.49)	(0.49)	(0.50)
Employed	**0.50**	**0.34**	0.38	0.41
	(0.50)	(0.48)	(0.49)	(0.49)
– works from home	0.26	0.38	0.29	0.47
	(0.44)	(0.49)	(0.46)	(0.50)
– works for a piece-rate	0.52	0.41	0.35	0.38
	(0.51)	(0.50)	(0.49)	(0.49)
Survives on a Subsistence Agriculture	0.13	0.18	**0.32**	**0.21**
	(0.34)	(0.39)	(0.47)	(0.41)
Survives on a Minimum Salary	0.39	0.33	0.29	0.29
	(0.49)	(0.47)	(0.46)	(0.46)
Survives on a Retirement Pension	0.26	0.29	0.19	0.22
	(0.44)	(0.45)	(0.39)	(0.41)
Household Receives Bolsa Familia	0.15	0.13	**0.31**	**0.16**
	(0.36)	(0.33)	(0.46)	(0.37)
Observations	62	126	59	119

Reported values are the mean (sd) of each variable across the 4 treatment arms of the first shift. All measures are self reported. "Survives on" and income does not necessarily mean that the participant is the one earning that income (i.e., another household member's income). The standard retirement pension is equal to the state mandated minimum salary. Bolsa Familia is a conditional cash transfer program. Bolded values are statistically different from each other at 10%.

Table 2.2: Average Output by Payment Contract Treatment Cells

		Piece-rate Wage w_t	
		0.10/unit	**0.20/unit**
Fixed Payment f_t	**3BRL**	19.1(19.7)	19.2(15.5)
	6BRL	21.8 (22.3)	18.8 (18.8)

Notes:

[1] Reported values are the unconditional mean (standard deviation) of units of output produced in each treatment cell in the replication experiment.

[2] Reported piece-rates are the number of BRL per units of output used to calculate accumulated income.

[3] Reported fixed payments are the number of BRL offered as the anchor in the payment lottery.

[4] At the time of the experiment, 1BRL $\approx$ 0.45USD and local minimum wage for formal employment was 724BRL per month.

Table 2.3: Effort as a Function High Expectations of Income - Levels

	Comp. Tasks				Min. Worked			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HI Treatment	-0.405	-1.305	-3.268	-3.310	-0.316	-0.472	-1.465	-2.361
	(3.512)	(3.158)	(2.577)	(3.498)	(1.841)	(1.803)	(1.643)	(1.862)
Productivity	–	10.55***	10.36***	8.726***	–	1.833*	1.915*	1.427
	–	(2.129)	(2.776)	(2.426)	–	(1.031)	(1.104)	(1.328)
Constant	19.20***	2.402	19.26***	20.22	12.11***	9.186***	16.37***	19.03*
	(2.452)	(3.605)	(5.777)	(14.70)	(1.265)	(2.023)	(2.821)	(9.261)
Sex	No	No	Yes	Yes	No	No	Yes	Yes
Time of Day FE	No	No	Yes	Yes	No	No	Yes	Yes
Age	No	No	No	Yes	No	No	No	Yes
Interviewer FE	No	No	No	Yes	No	No	No	Yes
Weekday FE	No	No	No	Yes	No	No	No	Yes
Like Interviewer	No	No	No	Yes	No	No	No	Yes
Observations	178	178	178	169	178	178	178	169
Adjusted R-squared	0.000116	0.117	0.214	0.316	0.000243	0.0124	0.0755	0.207
Mean of Dep. Var.	18.93	18.93	18.93	18.80	11.90	11.90	11.90	11.86
SD of Dep. Var.	17.74	17.74	17.74	18.01	9.565	9.565	9.565	9.696

Notes:

[1] Robust neighbourhood clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] OLS regression – Interpretation of coefficients: a one unit change in X results in a β unit change in the mean count of the dependent variable.

[3] HI Treatment: An indicator that the randomly assigned fixed payment is 6BRL (vs 3BRL).

[4] Productivity: The number of tasks per minute completed during Stage 1.

[5] Controls: Sex is an indicator if the subject is male; Time of the Day is a categorical variable for morning, lunch time, early afternoon, and late afternoon (omitted); Age is a subject's age and age squared reported in years; Interviewer fixed effects for the 6 unique interviewers; Weekday fixed effects for the 6 days of the week that interviews were conducted; Like Interviewer is a set of characteristics that compare the subject to their interviewer, including an indicator if they are the same sex, an indicator if they are the same age defined as less than 5 years absolute age difference, and the absolute age difference between the interviewer and the subject.

Table 2.4: Effort as a Function High Expectations of Income - Logs

	ln(Comp. Tasks)				ln(Min. Worked)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HI Treatment	-0.208	-0.298*	-0.333**	-0.357**	-0.453	-0.532*	-0.511	-0.736*
	(0.196)	(0.172)	(0.153)	(0.156)	(0.299)	(0.311)	(0.335)	(0.359)
Productivity	–	1.182***	1.020***	0.993***	–	1.044*	0.737	0.837
	–	(0.209)	(0.217)	(0.208)	–	(0.514)	(0.537)	(0.502)
Constant	2.603***	2.151***	2.932***	2.071***	2.058***	1.659***	2.387***	0.572
	(0.151)	(0.160)	(0.274)	(0.715)	(0.170)	(0.289)	(0.659)	(1.642)
Sex	No	No	Yes	Yes	No	No	Yes	Yes
Time of Day FE	No	No	Yes	Yes	No	No	Yes	Yes
Age	No	No	No	Yes	No	No	No	Yes
Interviewer FE	No	No	No	Yes	No	No	No	Yes
Weekday FE	No	No	No	Yes	No	No	No	Yes
Like Interviewer	No	No	No	Yes	No	No	No	Yes
Observations	178	178	178	169	178	178	178	169
Adjusted R-squared	0.00803	0.180	0.253	0.407	0.0107	0.0483	0.0912	0.241
Mean of Dep. Var.	2.464	2.464	2.464	2.448	1.756	1.756	1.756	1.729
SD of Dep. Var.	1.097	1.097	1.097	1.103	2.069	2.069	2.069	2.113

Notes:

[1] Robust neighbourhood clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] OLS regression – Interpretation of coefficients: a one percent change in X results in a β percent change in the mean count of the dependent variable.

[3] HI Treatment: An indicator that the randomly assigned fixed payment is 6BRL (vs 3BRL).

[4] Productivity: The number of tasks per minute completed during Stage 1.

[5] Controls: Sex is an indicator if the subject is male; Time of the Day is a categorical variable for morning, lunch time, early afternoon, and late afternoon (omitted); Age is a subject's age and age squared reported in years; Interviewer fixed effects for the 6 unique interviewers; Weekday fixed effects for the 6 days of the week that interviews were conducted; Like Interviewer is a set of characteristics that compare the subject to their interviewer, including an indicator if they are the same sex, an indicator if they are the same age defined as less than 5 years absolute age difference, and the absolute age difference between the interviewer and the subject.

Table 2.5: Multinomial Logit – The Probability of Stopping as a Function of Expected Income

	wh=f			wh ≈ f		
	(1)	(2)	(3)	(4)	(5)	(6)
Stopping when $wh = 3$BRL						
HI Treatment	-1.703***	-1.808***	-2.192***	-0.636**	-0.768**	-0.710**
	(0.561)	(0.605)	(0.773)	(0.322)	(0.341)	(0.354)
Productivity	–	0.956	1.187*	–	0.877***	0.900**
	–	(0.595)	(0.684)	–	(0.338)	(0.370)
Constant	-1.925***	-3.545***	-2.597*	-0.0426	-1.375***	-1.898**
	(0.291)	(1.127)	(1.422)	(0.241)	(0.463)	(0.815)
Stopping when $wh = 6$BRL						
HI Treatment	-1.144*	-1.268*	-1.428*	-0.621	-0.803**	-0.703*
	(0.689)	(0.698)	(0.766)	(0.387)	(0.359)	(0.416)
Productivity	–	1.323**	1.758**	–	1.403***	1.470***
	–	(0.657)	(0.797)	–	(0.366)	(0.390)
Constant	-2.485***	-4.821***	-5.223***	-0.693**	-2.958***	-3.471***
	(0.428)	(1.383)	(2.003)	(0.324)	(0.700)	(1.025)
Sex	No	No	Yes	No	No	Yes
Time of Day FE	No	No	Yes	No	No	Yes
Observations	178	178	178	178	178	178

Notes:

[1] Robust neighbourhood clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] Multinomial Logit Regression – categorical outcome of Stopping at wh = 3BRL (top), Stopping at wh = 6BRL (bottom), Stopping Else (base category).

[3] Interpretation of coefficient: Assignment of the high fixed payment (f = 6BRL) will result in a β change in the log odds of stopping when wh = Y. That is, odds of stopping at Y change by a factor of $\exp(\beta)$.

[4] Columns (1) – (4): Stopping exactly when wh=f

[5] Columns (5) – (8): Stopping when wh=f ± 1BRL

HI Treatment: An indicator that the randomly assigned fixed payment is 6BRL (vs 3BRL).

[6] Controls: Sex is an indicator if the subject is male; Time of day is a categorical variable for morning, lunch time early afternoon, and late afternoon (omitted).

Table 2.6: Survival Analysis – The Probability of Stopping as a Function of Expected Income

	Full Sample				HI treament		LO treatment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cumulative Income	-0.055***	-0.033*	-0.016	-0.017	-0.075*	0.003	-0.049**	-0.018
	(0.015)	(0.017)	(0.016)	(0.016)	(0.045)	(0.046)	(0.021)	(0.020)
Cumulative Time	0.019***	0.014***	0.018***	0.017***	0.022***	0.024**	0.019***	0.022***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)	(0.011)	(0.006)	(0.006)
Productivity	–	-0.206***	-0.214***	-0.220***	–	-0.319***	–	-0.204***
	–	(0.056)	(0.054)	(0.054)	–	(0.082)	–	(0.074)
Cumulative Income $\geq f$	0.142	0.143	0.101	–	–	–	–	–
	(0.087)	(0.089)	(0.104)	–	–	–	–	–
Cumulative Income $\geq f^{LO}$	–	–	–	0.089	0.301	0.294	-0.113	-0.072
	–	–	–	(0.103)	(0.193)	(0.191)	(0.099)	(0.100)
Cumulative Income $\geq f^{HI}$	–	–	–	0.038	-0.032	-0.301	0.187	0.170
	–	–	–	(0.121)	(0.333)	(0.317)	(0.125)	(0.127)
Sex	No	Yes	Yes	Yes	No	Yes	No	Yes
Time of Day FE	No	No	Yes	Yes	No	Yes	No	Yes
Age	No	No	Yes	Yes	No	Yes	No	Yes
Interviewer FE	No	No	Yes	Yes	No	Yes	No	Yes
Weekday FE	No	No	Yes	Yes	No	Yes	No	Yes
Like Interviewer	No	No	Yes	Yes	No	Yes	No	Yes
Observations	7670	7670	7230	7230	2440	2362	5230	4868
Mean of Dep. Var.	0.047	0.047	0.047	0.047	0.050	0.049	0.046	0.046
SD of Dep. Var.	0.212	0.212	0.212	0.212	0.217	0.216	0.209	0.210

Notes:

[1] Robust neighbourhood clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] Survival Analysis (probit) – Dependent Variable: An indicator that a person quit after producing output h.

[3] Cumulative Income: the estimated amount of income accumulated after producing output h.

[4] Cumulative Time: the estimated amount of time spent working after producing output h.

[5] Productivity: The number of tasks per minute completed during Stage 1.

[6] Controls: Sex is an indicator if the subject is male; Time of the Day is a categorical variable for morning, lunch time, early afternoon, and late afternoon (omitted); Age is a subject's age and age squared reported in years; Interviewer fixed effects for the 6 unique interviewers; Weekday fixed effects for the 6 days of the week that interviews were conducted; Like Interviewer is a set of characteristics that compare the subject to their interviewer, including an indicator if they are the same sex, an indicator if they are the same age defined as less than 5 years absolute age difference, and the absolute age difference between the interviewer and the subject.

Table 2.7: Effort as a Function High Expectations of Income and Wages – Logs

	Average Wage Elasticity		Effort to Goal Fixed	Effort to Goal Function of Wage
	(1)	(2)	(3)	(4)
HI Wage	-0.281*	-0.285*	-0.258	-0.332*
	(0.143)	(0.142)	(0.219)	(0.164)
HI Treatment	-0.0994	–	–	–
	(0.136)	–	–	–
Productivity	1.083***	1.069***	1.085***	1.045***
	(0.178)	(0.175)	(0.238)	(0.252)
Constant	2.329***	2.264***	1.867*	3.386***
	(0.545)	(0.520)	(0.958)	(0.671)
Sex	Yes	Yes	Yes	Yes
Time of Day FE	Yes	Yes	Yes	Yes
Age	Yes	Yes	Yes	Yes
Interviewer FE	Yes	Yes	Yes	Yes
Weekday FE	Yes	Yes	Yes	Yes
Like Interviewer	Yes	Yes	Yes	Yes
Observations	347	347	171	176
Adjusted R-squared	0.301	0.300	0.326	0.420
Mean of Dep. Var.	2.494	2.494	2.429	2.557
SD of Dep. Var.	1.085	1.085	1.115	1.054

Notes:

[1] Robust site-clustered standard errors in parentheses.

[2] * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[3] OLS regression – Interpretation of coefficients: a one unit change in X results in a e^{β} percent change in the mean count of the dependent variable.

[4] HI Wage: An indicator that the randomly assigned piece-rate is 0.20BRL/task.

[5] HI Treatment: An indicator that the randomly assigned fixed payment is 6BRL.

[6] Productivity: The number of tasks per minute completed during Stage 1.

[7] Controls: Sex is an indicator if the subject is male; Time of the Day is a categorical variable for morning, lunch time, early afternoon, and late afternoon (omitted); Age is a subject's age and age squared reported in years; Interviewer fixed effects for the 6 unique interviewers; Weekday fixed effects for the 6 days of the week that interviews were conducted; Like Interviewer is a set of characteristics that compare the subject to their interviewer, including an indicator if they are the same sex, an indicator if they are the same age defined as less than 5 years absolute age difference, and the absolute age difference between the interviewer and the subject.

Table 2.8: Effort as a Function High Expectations of Income and Reciprocity – Logs

	ln(Comp. Tasks)				ln(Min. Worked)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
HI Treatment	0.0635	-0.382	-0.525	-0.390	-0.485	-0.894	-1.143	-0.905
	(0.495)	(0.464)	(0.482)	(0.482)	(0.753)	(0.858)	(0.944)	(1.046)
Low Reciprocity	0.400	0.259	0.205	0.185	0.362	0.233	0.123	0.325
	(0.429)	(0.294)	(0.365)	(0.453)	(0.510)	(0.453)	(0.546)	(0.907)
Low Rec. × HI Treatment	-0.139	0.111	0.211	-0.0328	-0.139	0.0909	0.287	-0.105
	(0.511)	(0.414)	(0.459)	(0.573)	(0.813)	(0.810)	(0.919)	(1.044)
Productivity	–	1.229***	1.148***	1.327***	–	1.129	1.007	1.023
	–	(0.338)	(0.377)	(0.354)	–	(0.678)	(0.750)	(0.717)
Constant	2.220***	2.007***	3.280***	1.941*	1.917***	1.722***	3.547***	1.762
	(0.403)	(0.380)	(0.395)	(1.000)	(0.442)	(0.488)	(0.642)	(2.158)
Sex	No	No	Yes	Yes	No	No	Yes	Yes
Time of Day FE	No	No	Yes	Yes	No	No	Yes	Yes
Age	No	No	No	Yes	No	No	No	Yes
Interviewer FE	No	No	No	Yes	No	No	No	Yes
Weekday FE	No	No	No	Yes	No	No	No	Yes
Like Interviewer	No	No	No	Yes	No	No	No	Yes
Observations	100	100	100	94	100	100	100	94
Adjusted R-squared	0.0176	0.178	0.284	0.461	0.0174	0.0533	0.126	0.384
Mean of Dep. Var.	2.441	2.441	2.441	2.435	1.705	1.705	1.705	1.681
SD of Dep. Var.	1.126	1.126	1.126	1.131	2.187	2.187	2.187	2.244

Notes:

[1] Robust neighbourhood clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] OLS regression – Interpretation of coefficients: a one unit change in X results in a β unit change in the mean count of the dependent variable.

[3] HI Treatment: An indicator that the randomly assigned fixed payment is 6BRL (vs 3BRL).

[4] Low Reciprocity: An indicator that an individual is the low reciprocity type, as defined in section 2.7.2.

[5] Low Rec. × HI Treatment : An interaction of Low Reciprocity and HI treatment.

[6] Productivity: The number of tasks per minute completed during Stage 1.

[7] Controls: Sex is an indicator if the subject is male; Time of the Day is a categorical variable for morning, lunch time, early afternoon, and late afternoon (omitted); Age is a subject's age and age squared reported in years; Interviewer fixed effects for the 6 unique interviewers; Weekday fixed effects for the 6 days of the week that interviews were conducted; Like Interviewer is a set of characteristics that compare the subject to their interviewer, including an indicator if they are the same sex, an indicator if they are the same age defined as less than 5 years absolute age difference, and the absolute age difference between the interviewer and the subject.

Chapter 3

Extension Experiment: Adaptive Expectations and Effort Provision

3.1 Introduction

Despite the theoretical and intuitive appeal of models that use expectations as reference points, they are inherently difficult to test. The term "expectations" itself is vague enough to be used as an ad hoc umbrella to encompass many different motivations for behaviour. And even when expectations are explicit and observed, they are often the endogenous choices of actors.

The Abeler et al. (2011) design overcomes these hurdles allowing researchers to observe and manipulate workers' expectations in a real wage experiment. Using this lottery mechanism, we are able to test and quantify if expectations independently impact labour supply. In the last chapter experiment, I used this tool and found that the observable pattern of behaviour suggests that *rational* expectations of income do not influence effort in this population. Still, the experiment revealed patterns suggesting these workers do not optimize their labour provision on canonical lines either.

Building on the results from the last chapter and the literature, I extend my experiment to test an additional interpretation of the KR model. Rather than test if workers' *rational* expectations of income serve as a reference point, in this chapter I test if their *adaptive* expectations determine behaviour. This is a much more natural interpretation of the KR model of labour supply, since most natural labour contracts do not include a lottery. *Adaptive* expectations about the future are formed from past experiences.

Kőszegi and Rabin suggest that in some instances, where mathematical rationality may not be salient, the *status quo* may stand in for a person's expectations and reference points.[1] As such, I extend the original Abeler et al. (2011) experiment replicated in Chapter 2 to test for the importance of *adaptive* expectations in determining the labour supply behaviour of Brazilian piece-rate workers.

I return to a subsample of the replication experiment participants three weeks after the first experiment and offer them the opportunity to work for me again. Among those who agree, some are offered the same payment lottery as during their first experiment, while others are offered unexpectedly higher or lower piece-rate wages than the wages offered in the first experiment. Under a canonical lifecycle framework, participants' current behaviour should not respond to their past piece-rate wage as it does not contribute to the marginal return to current effort or lifetime wealth. In contrast, if participants have KR preferences, where their expectations are based on past experiences (adaptive expectations) rather than the payment lottery (rational expectations), their effort would respond to their previous piece-rate wage as it pins down their past experiences.

I find no statistically significant evidence that past wages directly influence current labour supply, and the imprecisely estimated relationship conflicts with the pattern predicted by the KR model. Yet there is substantial inertia in effort choices. The median workers, about one quarter of participants, did not change the amount of output they produced or the amount of time spent working across experiments. And in general, having exerted more effort or having been awarded a higher income in the first experiment led to more effort in the second experiment.

This result contributes to the growing literature that finds KR preferences are insufficient for explaining the labour supply behaviour of populations from the developing world. In the previous chapter, I found statistically different results than Abeler et al. (2011) found in a European lab. In this chapter, I eliminate the possibility that KR preferences describe the behaviour of my participants once I loosen the formality on the definition of expectations. Moving from testing *rational* expectations, to the more intuitive and natural *adaptive* expectations, did not result in this non-WEIRD sample behaviour to conform to the KR-like behaviours observed in WEIRD populations. These results emphasize a need for caution when extrapolating from WEIRD behaviours to forecast the behaviour of workers in developing countries.

The chapter is organized as follows. The following section outlines the experimental design, including an overview of the context where this experiment was conducted. Section 3.3 walks through the theoretical framework, Section 3.4 describes the data, Section

[1] Kőszegi and Rabin, 2006, pp.1141–1142.

3.5 outlines the empirical methodology and Section 3.6 reports results. Section 3.7 is a discussion, and Section 3.8 concludes.

3.2 Design

The Abeler et al. (2011) experimental mechanism used here has an easily observed and measured labour supply: subjects worked on tedious, repetitive task, chosen to have no benefits beyond the earned income. It was also patently boring and pointless, to be sure that it illicits a positive cost of effort in addition to the foregone time spent on subjects next best alternative. Since this population is known for doing repetitive manual tasks in the garment industry, such as sewing pockets into pairs of jeans, the task in this experiment is designed to also be low skilled, manual, and repetitive. My experiment is conducted in their place of work, and the experiment output is designed to mimic the type of output produced in their usual jobs. Further, the amount of money offered in this experiment is large enough to have an economic impact on the short term livelihood of these workers.

The experiment involved two stages. The first stage was used to confirm, or collect, control information from the subject and allowed the subject to become familiar with the task. In both the original and replication experiments, subjects had 4 minutes to complete as many units of output as possible for a guaranteed piece-rate.

After the first stage, the second stage is where the treatment manipulation was introduced. Although the task was the same, a new payment contract was introduced. First, rather than working for four minutes, subjects were free to produce as many, or few, units of output as they pleased. Secondly, rather than being paid a guaranteed piece-rate wage for their output, subjects were told that they would be paid with a lottery. The lottery served as the main treatment manipulation in the Abeler et al. (2011) experiment and the replication discussed in Chapter 2. We told the participants that their payment of either their acquired earnings or the fixed payment amount would be determined by a coin flip. The lottery defined *rational* expectation of income and we tested if it independently influenced behaviour.[2]

In this extension, the lottery serves as no more than a necessary complication for

[2]We know the subjects' rational expectations about the earnings at the time they are making their labour supply decisions: they would be paid their accumulated earnings with 50% probability, and the fixed payment with 50% probability. To be sure that the these amounts were always salient to the subjects, the Abeler et al. (2011) experiment displayed the running values on the computer screen and in the Brazil experiment, the facilitators wrote the running totals on the back of the completed cards displayed for the participants, and confirmed orally at least once per 10 completed cards.

the sake of continuity – not as the treatment manipulation. The Brazilian research team returned to a subset of participants from the replication experiment discussed in Chapter 2 and offered them the opportunity to participate yet again. There were three main treatments: the control group who faced the same payment contract again; those who were offered a piece-rate wage twice as large as their previous wage; and those offered a piece-rate half as large as their previous wage. We ensured that this (lack of) change in wage was salient to the participants and tested if the past wage influenced output. If adaptive expectations do not influence current labour supply, then there should be no relationship between past wages and current output.

On the other hand, this design allows us to compare effort amongst workers compensated with the same piece-rate, but who differ in their randomly assigned adaptive expectations of what that piece rate should be. For those paid the high piece-rate, half of subjects expected that wage, and the other half of subjects were surprised with a raise to that rate. For those paid the low piece-rate, half expected that wage, and the other half were surprised with a wage cut to that rate. Having higher (lower) than expected wages allows worker to reach their income expectations with more ease (difficulty), and as such, they are less (more) motivated to work than their equally paid counterparts.

3.3 Theoretical Framework

Recall how the KR model of reference dependent choice can be applied to labour supply decisions. Consider the period t labour supply decision of a worker who experiences some uncertainty about her return to effort, Y_t, that period. This model supposes that this worker has some expectation of her return to effort, $\tilde{Y}_t$, that will have an impact on her labour supply choice. In that sense, her hours of labour supplied will be determined by both her known wage rate and her expectations of income, $h_t(w_t, \tilde{Y}_t)$. Her reference dependence creates a kink in her utility function where her realized return to effort is equal to her expectations, $Y_t = \tilde{Y}_t$. Failing to reach her expected income hurts, and so the marginal return to effort drops once she reaches her expected earnings. In this sense, her reference dependence only matters because she is loss averse – falling short of her goal hurts more than exceeding her goal makes her happy. As with canoicall models of intertemporal labour supply, her labour supply is increasing in her transitory wage, $\frac{\partial h_t}{\partial w_t} > 0$, over the domain of wages where meeting her expectations are irrelevant. It is only near the kink in her utility function that her response to transitory wage shocks becomes ambiguous.

As with the replication, in this extension, suppose this worker will be paid with a

lottery. Her payment contract outlines that with probability p_t she will be paid some function of her effort $w_t h_t$, and with probability $(1-p_t)$ she will receive a fixed payment f_t regardless of h_t. If her expectations of income are not *rational*, but rather are *adaptive*, then her expected income can be written as $\tilde{Y}_t \equiv p_{t-1}(w_{t-1}h_t) + (1-p_{t-1})f_{t-1}$. Setting $p_t = p_{t-1} = p$ because both lotteries are determined with the same mechanism (the coin flip) and $f_t = f_{t-1} = f$ by design, results in two classifications of workers. Those whose current wage is weakly higher than their past wage, $w_t \geq w_{t-1}$, maximize:

$$U(Y_t, h_t\Big|_{w_t \geq w_{t-1}}) = \begin{cases} p^2(1-\alpha)h_t(w_t - w_{t-1}) - p(1-p)2\alpha(w_t h_t - f_t) - \frac{\theta}{1+\nu}h_t^{1+\nu} & \text{for } f_t < w_t h_t \\ p^2(1-\alpha)h_t(w_t - w_{t-1}) + p(1-p)2\alpha(w_t h_t - f_t) - \frac{\theta}{1+\nu}h_t^{1+\nu} & \text{for } f_t \geq w_t h_t, \end{cases}$$

and those whose current wage is lower than their past wage, $w_t < w_{t-1}$, maximize:

$$U(Y_t, h_t\Big|_{w_t < w_{t-1}}) = \begin{cases} p^2(1+\alpha)h_t(w_t - w_{t-1}) - p(1-p)2\alpha(w_t h_t - f_t) - \frac{\theta}{1+\nu}h_t^{1+\nu} & \text{for } f_t < w_t h_t \\ p^2(1+\alpha)h_t(w_t - w_{t-1}) + p(1-p)2\alpha(w_t h_t - f_t) - \frac{\theta}{1+\nu}h_t^{1+\nu} & \text{for } f_t \geq w_t h_t. \end{cases}$$

Choosing her effort, h_t, to maximize her expected utility results in the following piecewise labour supply curves. If the worker experienced a wage increase between the first experiment and the second, her optimal labour supply traces:

$$h_t^*\Big|_{w_t \geq w_{t-1}} = \begin{cases} \left(\frac{p^2(1-\alpha)(w_t - w_{t-1}) - p(1-p)2\alpha w_t}{\theta}\right)^{\frac{1}{\nu}} & \text{if } f_t < w_t h_t \\ \left(\frac{p^2(1-\alpha)(w_t - w_{t-1}) + p(1-p)2\alpha w_t}{\theta}\right)^{\frac{1}{\nu}} & \text{if } f_t \geq w_t h_t, \end{cases} \tag{3.1}$$

and if the worker experienced a wage cut between the first experiment and the second, her optimal labour supply traces:

$$h_t^*\Big|_{w_t < w_{t-1}} = \begin{cases} \left(\frac{p^2(1+\alpha)(w_t - w_{t-1}) - p(1-p)2\alpha w_t}{\theta}\right)^{\frac{1}{\nu}} & \text{if } f_t < w_t h_t \\ \left(\frac{p^2(1+\alpha)(w_t - w_{t-1}) + p(1-p)2\alpha w_t}{\theta}\right)^{\frac{1}{\nu}} & \text{if } f_t \geq w_t h_t. \end{cases} \tag{3.2}$$

For each piecewise section of supply functions (3.1) and (3.2), the marginal return to effort is higher for the worker who received the wage cut, $w_t < w_{t-1}$, than the one who got the raise, $w_t \geq w_{t-1}$. Each worker who received the wage cut is consistently disappointed because her accumulated income is always lower than her expectations, making her more motivated, all else equal, than her counterpart who is always satisfied for accumulating more than she expected at every unit of output. Notice that labour supply functions

(3.1) and (3.2) are the same if the past wage is equal to the current wage, $w_t = w_{t-1}$.

The discontinuous labour supply curves are divided at the point where here accumulated earning $w_t h_t$ equal the fixed payment f_t. The curve has an elasticity of $\frac{1}{\nu}$ with respect to the linear transformations of the wage rate found in the numerators of the piecewise function on both sides of the discontinuity. This expression shows that the loss-averse, reference-dependent worker is more motivated to work when earnings are less than the fixed payment compared to when earnings are more than the fixed payment. Avoiding the feelings of loss generate an extra motivation for this worker when her earnings are below the fixed rate.

The shape of these labour supply curves have two important implications regarding the relationship between *adaptive* expectations of income and hours worked. Consider two workers facing the same wage in the extension experiment. Those who see this wage as a cut, because it is lower than the wage they expected given their past experience, will be motivated to work harder than those workers who expected this same wage. Those who see this as a raise, because it is higher than the wage they expected given their past experience, will be less motivated to work than those who expected this same wage. These predictions can be formulated as a hypothesis:

Hypothesis 4. *All else equal, average effort increases in past wage, w_{t-1}.*

An extension of this trend is that other features of each worker's past experience with this experiment may form the adaptive expectations that influence their current behaviour. It is possible that the amount of time spent working or the amount of income paid in the first experiment comprise the expected outcomes of this extension experiment. Although each of these potential expectations are the result of the worker's choices, those choices were made based upon randomly assigned conditions. If these randomly assigned conditions have a strong relationship with these outcomes, they can be used as instruments to estimate if these past outcomes determine current behaviour.

Hypothesis 5. *All else equal, higher past effort and income payed lead to higher current effort.*

The most precise application of the KR model suggest not only that higher expectations lead to higer effort, but also that workers are disproportionaly likely to quit working precisely when the effort meets their expectations. As such, we expect:

Hypothesis 6. *All else equal, current effort is more likely to be equal to past effort ("inertia") than otherwise.*

3.4 Data

The sample of 245 individuals chosen to participate in this extension of Abeler et al. (2011) was chosen from the 366 adults in 43 neighbourhood clusters who participated in the replication experiment discussed in Chapter 2.[3] As previously discussed, participants were recruited from a baseline survey and offered the chance to participate. All of the subjects from the HI treatment category (individuals offered a fixed payment of 6BRL) in the replication experiment were chosen to participate in this extension experiment. We located 242 of 245 selected participants, and 3 individuals chose not to participate in the follow-up for reasons independent of this research.[4]

The experiment took place in August of 2014. A team of up to four locally hired professional surveyors travelled to the preselected individual's homes and invited them to participate in a shift of work. Upon their first meeting, for the replication experiment, surveyors described this shift as participation in two immediate income generating activities: a mandatory four minutes of work in the first activity, and an open-ended amount of work in the second activity that would end at the participant's discretion without penalty. Less than one percent of shifts lasted more than an hour. The survey team was in the field six days a week[5] from sun up to sun down. The extension completed in 15 days.

To minimize the chance that participants would learn about the various payment contracts offered to others, these contracts were randomized at the neighbourhood level. Since the payment contract randomization takes place at the neighbourhood level, the individual observations are not independent, and so the unit of analysis is the neighbourhood level behaviour. The 239 individuals in this extension came from 93 households, with no more than four adults coming from the same household. Table 3.1 presents self-reported characteristics of these participants at the time of the first experiment. The typical participant was a woman in her early 40s.

The four minute practice stage identified the relative productivity of participants. In the original replication experiment, the median participant completed 1.5 cards per minute during this task, with the slowest producing 0.5 cards per minute and the fastest

[3]Households that were walking distance from each other and at least 2km from the next neighbourhood cluster.

[4]The participants who chose not to participate in second second experiment after participating in the first mentioned the same reason for withdrawing: they were unhappy with the progress taking place in the Bobonis et al. (2017) project and would not participate in any more research until they receive access to clean water.

[5]Not Saturdays because this is the day that locals (including the surveyors) go to the market to do the weekly shopping and/or vending home produced goods like vegetables

at 3.25 cards per minute. In the follow-up extension experiment, the median participant completed 1.75 cards per minute, with the slowest producing 0.25 cards per minute and the fastest at 3.75 cards per minute. Participants worked statistically faster in the second experiment than in the first, suggesting that some learning-by-doing likely took place.[6]

During the second stage, the average amount of output produced was 16.6 cards and the average amount of time worked was 9.4 minutes. This is a two-by-two experiment based on having a high (or low) past wage, and a high (or low) current wage. There were 61 individuals who always faced the low wage, and 56 individuals who always faced the high, both of which serve as controls. There were 61 individuals who received a raise (i.e., high wage after low wage) and 60 who received a wage cut (i.e., low wage after high). Table 3.2 reports the unconditional mean and standard deviation of output produced by payment contract treatment cell. It is immediately apparent that there are no statistical differences in the unconditional average behaviour due to treatment.

3.5 Empirical Methodology

The initial specification tests if there is a direct relationship between past wages and current effort, examining Hypothesis 4:

$$ln(h_{i,c,t}) = \alpha + \lambda_t w^{HI}_{i,c,t} + \lambda_{t-1} w^{HI}_{i,c,t-1} + \psi(w^{HI}_{i,c,t} \times w^{HI}_{i,c,t-1}) + \boldsymbol{X_{ict}}\boldsymbol{\gamma} + \epsilon_c. \tag{3.3}$$

The dependent variable is the natural log of effort, $h_{i,c,t}$, the measure of labour supply for individual i from neighbourhood cluster c during the extension experiment at time t. Two measures are reported: the count of units of output produced, and the amount of time spent working. The current conditions are captured by the indicator $w^{HI}_{i,c,t}$ identifying that a worker has currently been assigned the high piece-rate wage, 0.20BRL per output, and a vector of individual characteristics in $\boldsymbol{X_{ict}}$. The coefficient of interest is λ_{t-1}, the estimated relationship between the past wage, from the earlier experiment, and the current behaviour. The variable $w^{HI}_{i,c,t-1}$ indicates if the worker's previous randomly assigned piece-rate was high, 0.20BRL per output. The two by two experimental design is thus captured by the potential combinations of indicators $w^{HI}_{i,c,t}$ and $w^{HI}_{i,c,t-1}$, and if the past wage determines current effort according to KR adaptive expectations, the coefficient λ_{t-1} would be negative. The interaction term $(w^{HI}_{i,c,t} \times w^{HI}_{i,c,t-1})$ is included in the most exhaustive specifications and indicates if both the past and present wage rates are

[6]For individuals who participated in both shifts, the t-test that the difference in the mean of the second shift (1.85 cards/min) and the first shift (1.64 cards/min) is 0 has a p-value = 0.00

high.

It would be quite surprising to find a statistical relationship between either of these randomly assigned piece-rate wages and effort in this experiment. During the first experiment, discussed in Chapter 2, I did not identify a strong relationship between the piece-rate wage and effort. As such, the same lack of relationship is to be expected again here. Furthermore, the expected relationship between the past wage and current effort is theoretically indirect: past wages change past income, past income becomes a worker's expectations of current income, and expectations determine behaviour.

I test Hypothesis 5 with the main specification:

$$ln(h_{i,c,t}) = \alpha + \lambda_t w^{HI}_{i,c,t} + \phi_y \text{Income}_{t-1} + \phi_h \text{Effort}_{t-1} + \boldsymbol{X_{ict}\gamma} + \epsilon_c, \tag{3.4}$$

which explores the direct relationship between past wages and current output. Like before, the dependent variable is the natural log of effort, $h_{i,c,t}$, the measure of labour supply for individual i from neighbourhood cluster c during the extension experiment at time t. Two measures are reported: the count of units of output produced, and the amount of time spent working. Expected income is defined by adaptive expectations as the amount of money paid at the end of the first experiment, Income_{t-1}.[7] Expected effort is also defined by adaptive expectations as the number of minutes that the individual worked in the first experiment, Effort_{t-1}. I expect there is a positive relationship between both of these expectations and the labour supply not only because of behavioural issues, but because these measures are endogenous.

Researchers often use an instrumental variable ("IV") strategy to estimate unbiased treatment effects when there is endogenous selection into treatment. Since the first shift income and effort are endogenous, an IV strategy will allow me to identify the causal effects of a recent past experiences target on effort.

A valid instrument is one that (i) determines an agent's effort/income in the first shift, while it (ii) does not determine other factors that affect the effort choice in the second shift. Valid instruments are hard to come by in naturally occurring data, but experimental variation is ideal for this sort of analysis. The randomly assigned constraints for the first experiment may satisfy these conditions. The first experiment wage rate theoretically influences current effort only through the way it changes expectations. Since it was randomly assigned, it is a natural instrument. Because all participants in the second experiment were assigned the same fixed payment (f = 6BRL), this was not a possible instrument.[8] By design, I had planned to use to outcome of the payment lottery

[7] Either the accumulated earnings or the fixed payment depending on the outcome of the coin flip.

[8] The baseline population from whom the sample was chosen was too small to draw an additional 120

as the other instrument, since it is correlated with income but randomly assigned. For reasons discussed in Section 2.8, this was not possible. In order to remain overidentified, I used the time of day that the first experiment took place as an instrument for current behaviour.[9] The time of the day that the previous experiment was conducted is correlated with the opportunity costs of time and thus optimal effort in the first experiment, but independent of the effort in the second experiment. It also was as good as randomly assigned, since enumerators set their routes based on personal goals, rather than subject characteristics.[10]

To examine Hypothesis 6, I graphically explore if workers are more likely to stop working when their current accumulated earnings were equal to their past income or their current time spent working equalled their time spent working. I then test this formally with the following survival analysis:

$$\begin{aligned}\text{StopAfterTask}_{icht} = \alpha + \beta_y(\text{Income}_{ht} \geq \text{Income}_{t-1}) + \beta_e(\text{Effort}_{ht} \geq \text{Effort}_{t-1}) \\ + \phi Cum\_Income_{icht} + \psi Cum\_Min_{icht} + \boldsymbol{X_{ict}\gamma} + \epsilon_c\end{aligned} \tag{3.5}$$

The dependent variable in Equation 3.5 is an indicator that is equal to 0 if an individual continues to work after producing output h, and a 1 if she decides to quit working immediately after producing that output. As such, the mean of this variable tells us the average probability that a participant will quit working after producing an additional unit of output. The variable Cum_Income_{ich} is a continuous variable that is equal to the total amount of income accumulated after the completion of task h, wh. Similarly, Cum_Min_{ich} is an estimate of how much time had been spent working when task h was completed. The first coefficient of interest is β_y, which estimates the marginal change in the probability of quitting when person i has completed enough tasks such that her accumulated income is greater than the amount she was paid in the previous experiment. The second coefficient of interest is β_e, which estimates the marginal change in the probability of quitting of when person i has worked for as many minutes as she did previous experiment.

adults and costs were prohibitive.

[9]Time of Day is a set of indicators identifying if they experiment took place in the morning, lunch hour, early afternoon, or late afternoon

[10]For example, on some days, enumerators planned a loop that began and ended at headquarters. On other days, they started as far from headquarters as possible and worked their way back. On others, they began near headquarters and worked towards some particular destination for the end of the day, and often, the goal was to find themselves near a restaurant at lunch time if one of the workers forgot to pack a meal.

3.6 Results

To understand the relationship between current effort and past wages, elasticities are calculated from specification (3.3) and reported in Table 3.3 and Table 3.4 for the amount of output produced and time spent working respectively. Although the signs on the coefficients are the opposite of that predicted by the KR theory underlying this experiment – higher past wages lead to lower effort – and the magnitude of the coefficients are reasonable – doubling the past wage reduces effort by 6.1–7.4% – and the results are imprecisely estimated. People who got raises worked (weakly) harder than their equally well paid counterparts, and people who got wage cuts worked (weakly) less than people who were equally poorly paid.

I examine if past behaviour is correlated with present behaviour using specification (3.4) with results reported in Table 3.5 and Table 3.6 for the amount of output produced and time spent working respectively. The OLS results report the unsurprising relationship that those who were paid more in the first experiment, and those who worked for a longer duration, continued to do so. Columns (6) from Table 3.5 and Table 3.6 suggest doubling the income paid in the first experiment (i.e., a 100% increase) is correlated with no statistical difference in time spent working conditional on time spent working during the first experiment, but an 83% increase in the output produced. Doubling the amount of time someone worked during the first experiment is correlated with 39% more output produced and 22% more time worked in the second experiment. The IV results are not reported because they are comparable to the OLS estimates and I failed to reject that the instruments were weak.[11] As such, very little of a causal nature can be gleaned from these correlations.

Examining the distributions of outcomes confirms that there is a strong relationship between the behaviour of subjects between the first and second experiments. Figure 3.1 plots the difference in the number of tasks completed (i.e., output produced) in the second experiment and the first. As such, the bar at zero represents the individuals whose output did not change. The bin width is equal to 5 units of output, and as such the spike at zero represents the 55 individuals (26.8% of subjects) who produced the same output plus or minus two cards. Fourteen individuals (5.9%) produced exactly the same number of output. A similar pattern exists for time spent working, as is illustrated in Figure 3.2. About 19% of subjects quit working within 1 minute of the time the quit in the first experiment. The relationship between these propensities to provide the

[11] When instruments are weak, the IV bias which is in the same direction as the OLS bias, converges to the magnitude of the OLS bias as the first stage r-squared converges to zero (Bound, Jaeger and Baker, 1995)

same effort as a function of the new randomly assigned piece-rate wage are discussed extensively in Chapter 4. In a callback to Chapter 2, Figure 3.3 confirms that, yet again, the fixed payment from the lottery had no impact on individuals quitting behaviour. Although there is no treatment variation in this experiment, all subjects were offered a fixed payment of 6BRL in the lottery, and there is no evidence that subjects were more apt to quit when their accumulated earnings equalled the fixed payment of 6 BRL.

To explore Hypothesis 6, I estimate the survival analysis outlined in Equation (3.5) using a linear probability model and report the results in Table 3.7. The average quitting hazard in the sample is 6%, meaning that the average probability that a worker goes on to the produce the next unit of output is 94%. Across all specifications, I find that the longer a participant works, the probability of her quitting increases. We also find that the more income accumulated at a level of output, the less likely this worker is to quit. This pattern, consistent with canonical labour supply behaviour, is similar to that reported in Table 2.6 for the earlier replication experiment. Depending on the specification in the full sample, Columns (1) – (6), accumulating income higher than that paid in the first experiment increases the probability of quitting by 3.0–5.3%, very large changes when compared to the mean of 6%. Similarly, working for a longer duration in the second experiment than in the first also increases the probability of quitting by 5.0–6.2%. Although both of these measures appear important in the full sample, the average results are driven by two subsamples. The quitting hazard of those who were paid their accumulated earnings in the first experiment only responded to the expectation of income; those who received the fixed payment only responded to the expectation of effort.

3.7 Discussion

The current and past wages were both randomly assigned to workers, but neither were found to have any statistically significant direct effect on the current effort as reported in Tables 3.3 and 3.4. This result is unsurprising. During the first experiment, discussed in Chapter 2, I did not identify a strong relationship between the piece-rate wage and effort. As such, the same lack of relationship is to be expected. Furthermore, the expected relationship between the past wage and current effort is theoretically indirect: past wages changes past income, and past income becomes a worker's expectations of current income. The later analyses test this direct relationship, although the weak relationship between the treatment wage in the first experiment plagued the results for this experiment as well.

In order to understand the causal relationship between expectations and effort, rather than correlations, I needed valid instruments for the past experiences that would be defined as the adaptive expectations in these specifications. My experimental design left me just identified. I have two endogenous regressors, past income and past effort, and two instruments, the first shift wage rate and the realization of the payment lottery. In the first shift, all experimental variations were randomly assigned and thus orthogonal to any observed or unobserved determinants of first shift effort, yet I am left with only two instruments because all participants in the second shift were assigned the same fixed payment (f = 6BRL).[12] Nonetheless, the outcome of the payment lottery theoretically fills this void. The flip of a coin determines if an agent is paid f or wh. As such it is clearly correlated with the income paid in the first shift, and is randomly assigned.

Despite the flip itself being fair, the enumerator response to the coin flip was not. Even if heads and tails were being awarded with equal probability, paying f and wh were not. The correlation between receiving the f in the payment lottery and the accumulated earnings in the first session is -0.30 and significant at the 1% level.[13] The marginal effects from a probit model estimation show that the probability of receiving the fixed payment in the lottery is about 72% when accumulated earnings are equal to zero, and decreasing by about 5% for every extra accumulated BRL. The odds of the lottery were statistically different from fair when accumulated earnings were less than 3.5BRL and greater than 4.9BRL – otherwise the outcome statistically favoured the higher of the two payments. Whatever the mechanism that generated this relationship, receiving the fixed payment in the lottery is correlated with choosing to work and earn less.[14] The correlation with an unobservable that leads workers to chose less work violates the exclusion restriction and as such, the result of the theoretically fair payment lottery is not a valid instrument. The unreported specifications that use receiving the fixed payment as an instrument have the expected bias if the exclusion restriction is violated because enumerators disproportionately let people win the payment lottery. Excluding this instrument, but adding time of day indicators as additional instruments to keep from under-identification, results in specifications that all suffer from a weak instrument problem.

Ex post data analysis also shows that although the wage rate from the first shift is a valid instrument for the income earned in the first shift, it is not a valid instrument

[12]The baseline population from whom the sample was chosen was too small to draw an additional 120 adults and costs were prohibitive.

[13]Significance level determined from a regression with clustered robust standard errors.

[14]For instance, the enumerators may have been stealing the difference by awarding the low amounts and recording the high amounts, enumerators may have wanted subjects to "win", enumerators may have wanted to avoid conflict, etc.

for the amount of effort supplied. Recall from Table 2.7 that there is no significant relationship between the amount of effort supplied and the randomly assigned wage rate. Although this instrument satisfies the exclusion restriction, its relationship to the endogenous regressor is weak. This should come as no surprise given the lack of precision in the results reported from the first experiment. Weak instruments, even when the exclusion restriction holds, lead to large standard errors. Given this issue, little can be inferred from IV estimates, and as such, they are omitted.

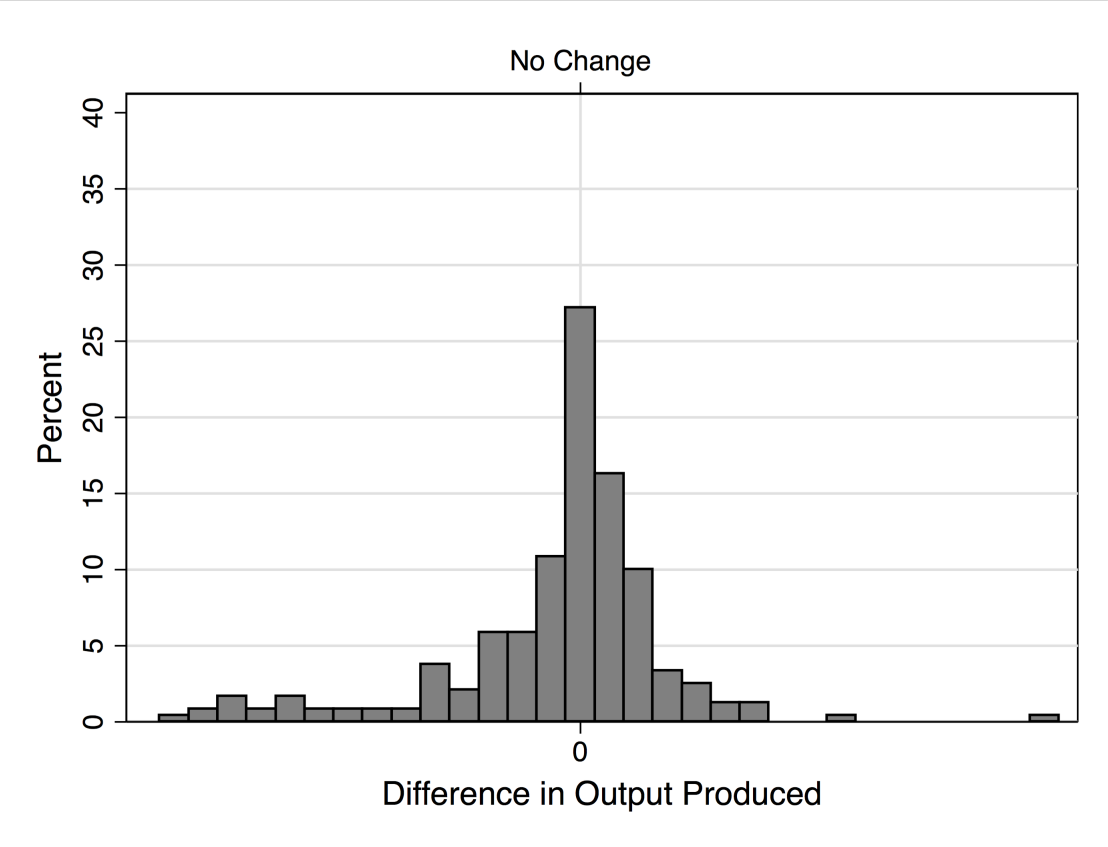
The survival analysis provides more support for adaptive expectations influencing behaviour, although it is limited. Because this dependent variable, the endogenous regressors, and the instruments are all binary, but the preliminary analysis is OLS, the estimated coefficients are, at best, constant marginal effects that approximate the true probabilities in the range of explanatory variables observed.[15]

3.8 Conclusion

While replicating the Abeler et al. (2011) experiment testing a *literal* interpretation of KR reference dependence, I found that *rational* expectations had no effect on the labour supply of Brazilian piece-rate workers, although they did not behave according to a canonical model of lifecycle labour supply. I extended the design to test if a more *natural* interpretation of the KR model applies. I found no statistically significant evidence that randomly assigned past wages, proxying for *adaptive* expectation of income, directly influence current labour supply in an experiment. Since past wages should only impact current effort in so far as they pin down expectations used as a reference point, I planned to use the randomly assigned past wage to instrument for several potential reference points, but suffered from a weak instruments problem stemming from the weak relationship between current effort and wages in the first experiment.

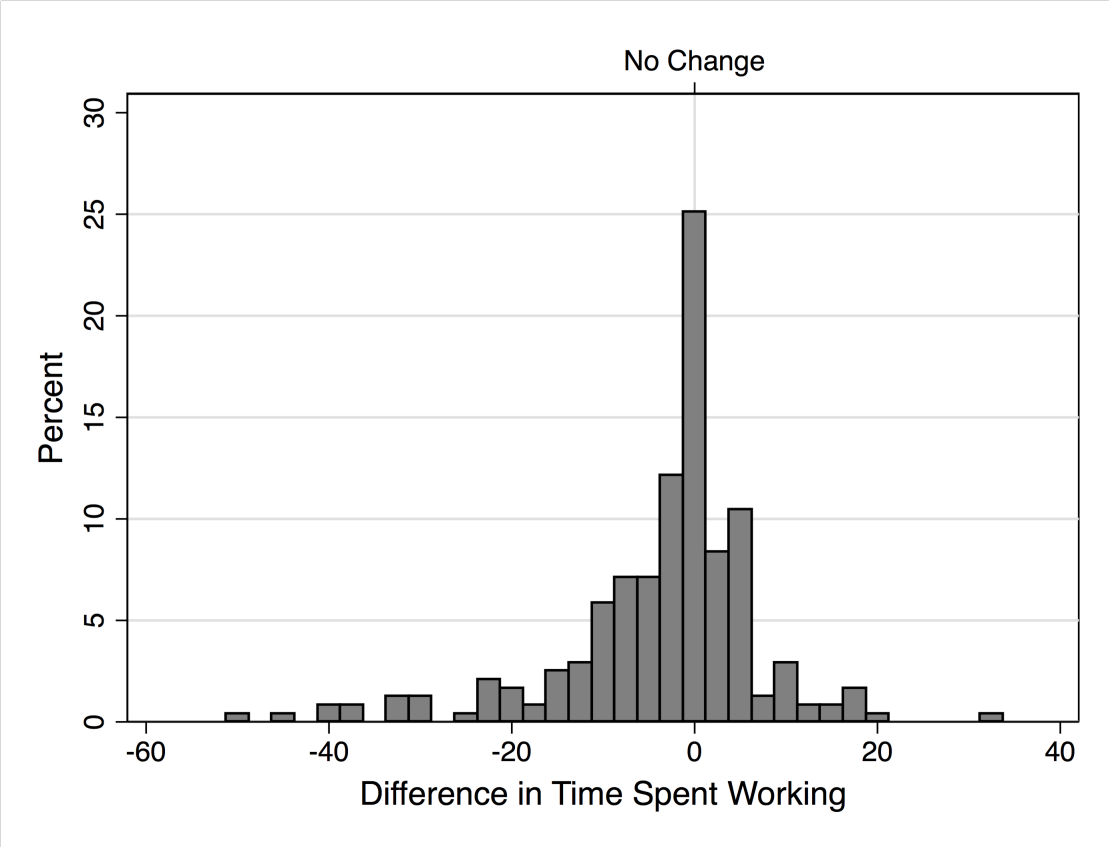
[15] I chose this analysis because the estimators are robust to misspecification in the first stage (e.g., a non-linear relationship between the instrument and the endogenous regressor, heteroskedasticity, etc.) when conducting a 2SLS and it produces the same estimator as the linear cases of the control-function approach and the fitted value approach. Neither of these are true for a two-step probit. See Arellano (2008) for a discussion.

Figure 3.1: Histogram of the difference in output produced between the second and first experiments



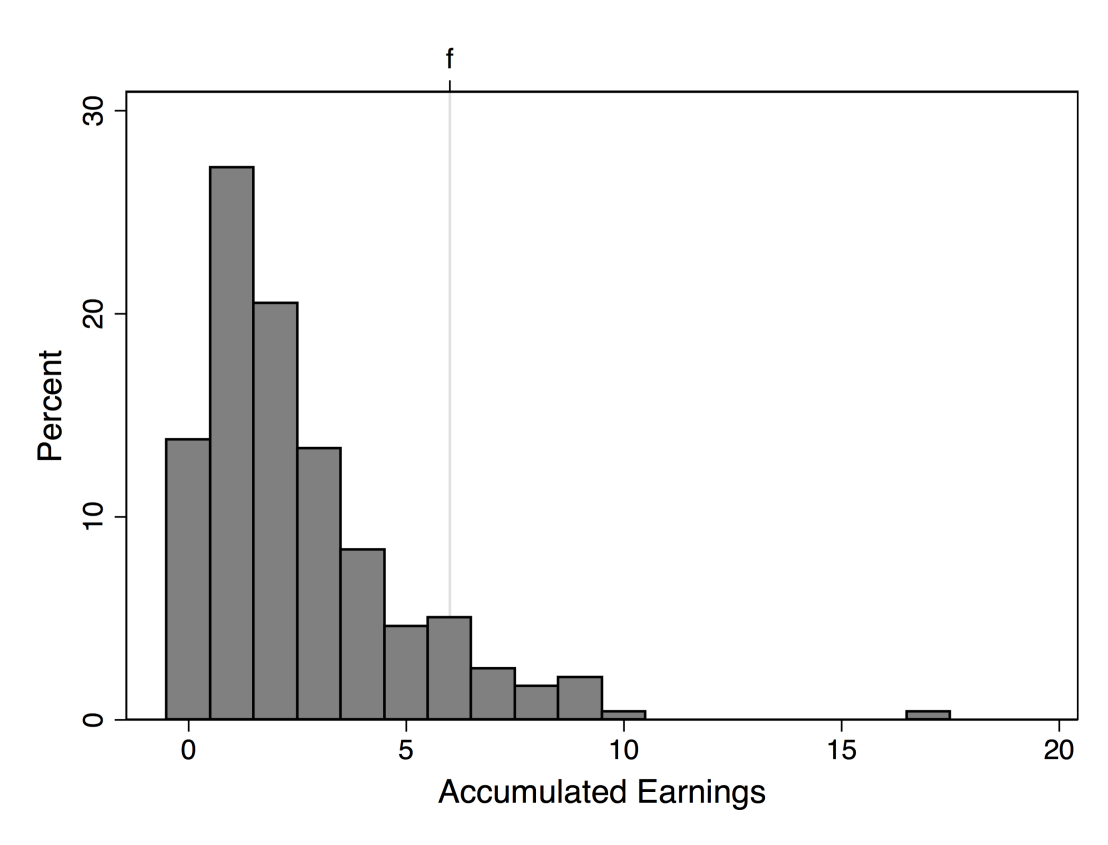
Notes: [1] Histogram of $h_t - h_{t-1}$. [2] Bin in width equal to $5h$. [3] Mean = – 3.75 , Median = 0, Minimum = – 71, Maximum = 78.

Figure 3.2: Histogram of the difference in time worked between the second and first experiments



Notes: [1] Histogram of $minutes_t - minutes_{t-1}$. [2] Bin in width equal to 2.5 *minutes*. [3] Mean = – 3.5 *minutes*, Median = –1.0 *minutes*, Minimum = – 49.0 *minutes*, Maximum = 31.7 *minutes*.

Figure 3.3: Histogram of the difference in accumulated income and the fixed payment



Notes: [1] Histogram of accumulated earnings $w_t h_t$. [2] Bin in width equal to 1BRL. [3] Mean = 2.5BRL, Median = 2.0BRL, Minimum = – 0.10BRL, Maximum = 17.0BRL.

Table 3.1: Sample Characteristics of Participants

	Current Low Wage		Current High Wage	
	(1)	(2)	(3)	(4)
Past:	Low Wage	High Wage	Low Wage	High Wage
Age	43.58	45.52	46.72	42.98
	(20.33)	(14.93)	(17.05)	(15.16)
Male	0.35	0.42	0.43	0.46
	(0.48)	(0.50)	(0.50)	(0.50)
Employed	0.32	0.38	0.36	0.44
	(0.47)	(0.49)	(0.48)	(0.50)
– works from home	0.35	0.40	0.41	0.54
	(0.49)	(0.50)	(0.50)	(0.51)
– works for a piece-rate	0.39	0.39	0.42	0.36
	(0.50)	(0.50)	(0.51)	(0.49)
Survives on a Subsistence Agriculture	**0.11**	**0.23**	0.26	0.19
	(0.31)	(0.43)	(0.44)	(0.39)
Survives on a Minimum Salary	0.32	0.35	0.33	0.24
	(0.47)	(0.48)	(0.47)	(0.43)
Survives on a Retirement Pension	0.26	0.23	0.31	0.20
	(0.44)	(0.43)	(0.47)	(0.41)
Household Receives Bolsa Familia	**0.08**	**0.20**	0.18	0.12
	(0.27)	(0.40)	(0.39)	(0.33)
Observations	65	60	61	59

Notes:

[1] Reported values are the mean (sd) of each variable across treatment arms of the extension experiment.

[2] All measures are self reported.

[3] "Survives on" an income does not necessarily mean that the participant is the one earning that income (i.e., it may be another household member's income).

[4] The standard retirement pension is equal to the state mandated minimum salary.

[5] Bolsa Familia is a conditional cash transfer program.

[6] Bolded values are statistically different from each other at 10%.

Table 3.2: Average Output by Current Wage × Past Wage Treatment Cells

		Past Piece-rate: w_{t-1}	
		0.10/unit	**0.20/unit**
Current Piece-rate: w_t	**0.10/unit**	16.3 (13.2)	15.6 (13.7)
	0.20/unit	16.5 (12.1)	17.1 (12.7)

Notes:
[1] Reported values are the unconditional mean (standard deviation) of units of output produced in each treatment cell in the follow-up extension experiment.
[2] Reported piece-rates are the number of BRL per units of output used to calculate accumulated income.
[3] At the time of the experiment, 1BRL ≈ 0.45USD and local minimum wage for formal employment was 724BRL per month.

Table 3.3: Elasticity of Effort with Respect to Current and Past Wages – Tasks Completed

	ln(output produced)					
	(1)	(2)	(3)	(4)	(5)	(6)
Current Wage High	0.0776	0.0731	0.0723	0.0112	0.00485	0.128
	(0.126)	(0.127)	(0.170)	(0.148)	(0.191)	(0.178)
Past Wage High	–	-0.0675	–	–	–	-0.0118
	–	(0.137)	–	–	–	(0.219)
Current Wage < Past Wage	–	–	-0.0101	–	-0.0118	–
	–	–	(0.218)	–	(0.219)	–
Current Wage > Past Wage	–	–	–	0.123	0.124	–
	–	–	–	(0.145)	(0.146)	–
Current Wage High × Past Wage High	–	–	–	–	–	-0.112
	–	–	–	–	–	(0.253)
Constant	0.938**	0.916*	0.937*	0.910*	0.909*	0.909*
	(0.461)	(0.468)	(0.466)	(0.467)	(0.471)	(0.471)
Productivity	Yes	Yes	Yes	Yes	Yes	Yes
Age & Sex	Yes	Yes	Yes	Yes	Yes	Yes
Time of Day FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	238	238	238	238	238	238
Adjusted R^2	0.207	0.204	0.203	0.205	0.202	0.202

Notes:
[1] Site-clustered standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
[2] OLS estimation; interpretation of coefficients – having a high current (past) wage changes the dependent variable by $e^{\beta} - 1$ percent.

Table 3.4: Elasticity of Effort with Respect to Current and Past Wages – Minutes Worked

	ln(minutes worked)					
	(1)	(2)	(3)	(4)	(5)	(6)
Current Wage High	0.169	0.165	0.144	0.142	0.116	0.165
	(0.126)	(0.127)	(0.155)	(0.167)	(0.193)	(0.156)
Past Wage High	–	-0.0488	–	–	–	-0.0484
	–	(0.133)	–	–	–	(0.207)
Current Wage < Past Wage	–	–	-0.0471	–	-0.0484	–
	–	–	(0.207)	–	(0.207)	–
Current Wage > Past Wage	–	–	–	0.0479	0.0492	–
	–	–	–	(0.154)	(0.155)	–
Current Wage High × Past Wage High	–	–	–	–	–	-0.000760
	–	–	–	–	–	(0.252)
Constant	1.647***	1.627***	1.640***	1.634***	1.627***	1.627***
	(0.416)	(0.421)	(0.415)	(0.425)	(0.424)	(0.424)
Productivity	Yes	Yes	Yes	Yes	Yes	Yes
Age & Sex	Yes	Yes	Yes	Yes	Yes	Yes
Time of Day FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	233	233	233	233	233	233
Adjusted R^2	0.025	0.021	0.021	0.021	0.017	0.017

Notes:

[1] Site-clustered standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] OLS estimation; interpretation of coefficients – having a high current (past) wage changes the dependent variable by $e^{\beta} - 1$ percent.

Table 3.5: Elasticity of Effort with Respect to Past Income and Past Effort – Tasks Completed

	(1)	(2)	(3)	(4)	(5)	(6)
Current Wage High	0.367	0.796	1.109	1.471	0.808	1.216
	(1.770)	(1.708)	(1.787)	(1.724)	(1.670)	(1.628)
Income_{t-1}	1.348***	1.157***	–	–	0.736**	0.602**
	(0.277)	(0.258)	–	–	(0.272)	(0.266)
Effort_{t-1}	–	–	0.426***	0.389***	0.351***	0.329***
	–	–	(0.0885)	(0.0817)	(0.0882)	(0.0846)
Constant	9.061***	-2.264	9.173***	-4.948	6.916**	-5.840
	(2.779)	(7.243)	(2.925)	(6.948)	(2.821)	(7.066)
Productivity	No	Yes	No	Yes	No	Yes
Age & Sex	No	Yes	No	Yes	No	Yes
Time of Day FE	No	Yes	No	Yes	No	Yes
Observations	238	238	238	238	238	238

Notes:

[1] Site-clustered standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] OLS estimation; interpretation of coefficients – having a high current wage, past income, or past effort changes the dependent variable by $e^{\beta} - 1$ percent.

[3] Dependent variable: ln(Number of outputs produced).

[4] Current Wage High is an indicator that the current wage was high, $w_t = 0.20$BRL.

[5] Income_{t-1}: BRL paid in the first experiment; Effort_{t-1}: Minutes worked in first experiment.

Table 3.6: Elasticity of Effort with Respect to Past Income and Past Effort – Minutes worked

	(1)	(2)	(3)	(4)	(5)	(6)
Current Wage High	0.156	0.303	0.493	0.637	0.406	0.556
	(0.996)	(0.911)	(0.909)	(0.874)	(0.873)	(0.835)
Income_{t-1}	0.558***	0.527***	–	–	0.212	0.193
	(0.131)	(0.132)	–	–	(0.156)	(0.142)
Effort_{t-1}	–	–	0.220***	0.217***	0.198***	0.198***
	–	–	(0.0416)	(0.0402)	(0.0488)	(0.0447)
Constant	6.252***	5.183	5.689***	3.318	5.039***	3.033
	(1.643)	(3.146)	(1.560)	(3.144)	(1.591)	(3.170)
Productivity	No	Yes	No	Yes	No	Yes
Age & Sex	No	Yes	No	Yes	No	Yes
Time of Day FE	No	Yes	No	Yes	No	Yes
Observations	238	238	238	238	238	238

Notes:

[1] Site-clustered standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] OLS estimation; interpretation of coefficients – having a high current wage changes the dependent variable by $e^{\beta} - 1$ percent.

[3] Dependent variable: ln(Number of minutes worked).

[4] Current Wage High is an indicator that the current wage was high, $w_t = 0.20$BRL.

[5] Income_{t-1}: BRL paid in the first experiment; Effort_{t-1}: Minutes worked in first experiment.

Table 3.7: Survival Analysis – The Probability of Stopping as a Function of Expectations - Linear Probability Model

	Full Sample						Paid wh		Paid f	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Cumulative Income	-0.0149***	-0.00811*	-0.00991**	-0.00351	-0.0130***	-0.00655	-0.0138**	-0.0116**	-0.0121**	-0.00263
	(0.00388)	(0.00416)	(0.00418)	(0.00448)	(0.00421)	(0.00460)	(0.00593)	(0.00570)	(0.00556)	(0.00678)
Cumulative Time	0.00676***	0.00506***	0.00475***	0.00316**	0.00528***	0.00370***	0.00602***	0.00570***	0.00459**	0.00323*
	(0.00124)	(0.00121)	(0.00120)	(0.00126)	(0.00116)	(0.00126)	(0.00156)	(0.00159)	(0.00174)	(0.00185)
Income > E(Income)	0.0526***	0.0474***	–	–	0.0332*	0.0296*	0.0562***	0.0563***	0.0370	0.0191
	(0.0156)	(0.0143)	–	–	(0.0168)	(0.0155)	(0.0183)	(0.0191)	(0.0311)	(0.0332)
Effort > E(Effort)	–	–	0.0617***	0.0574***	0.0526***	0.0495***	0.0178	0.0198	0.0630***	0.0556**
	–	–	(0.0146)	(0.0145)	(0.0152)	(0.0153)	(0.0251)	(0.0257)	(0.0196)	(0.0208)
Constant	0.0348***	0.142***	0.0344***	0.148***	0.0341***	0.141***	0.0219***	0.0397	0.0418***	0.185***
	(0.00618)	(0.0389)	(0.00687)	(0.0424)	(0.00663)	(0.0432)	(0.00718)	(0.0458)	(0.00944)	(0.0559)
Productivity	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Age & Sex	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Time of Day FE	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Person× Output Obs.	3976	3976	3976	3976	3976	3976	2058	2058	1989	1989
Adjusted R-Squared	0.0151	0.0225	0.0194	0.0264	0.0212	0.0278	0.0242	0.0277	0.0215	0.0366
Dep. Var. Mean	0.0601	0.0601	0.0601	0.0601	0.0601	0.0601	0.0530	0.0530	0.0659	0.0659
Dep. Var. Std. Deviation	0.238	0.238	0.238	0.238	0.238	0.238	0.224	0.224	0.248	0.248

Notes:

[1] Site-clustered robust standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] Reported coefficients interpretation: The change in probability of quitting after producing output h.

[3] Cumulative Income is the total accumulated earnings after output h was produced.

[4] Cumulative Time is the estimated total time spent working after output h was produced.

[5] Income > E(Income): Is an indicator that the accumulated earnings at output h are greater than the amount paid in the first experiment.

[6] Effort > E(Effort): Is an indicator that the time worked at output h is greater than the total time worked in the first experiment.

Chapter 4

Regret Matching and Effort Provision

4.1 Introduction

The results of the replication experiment discussed in Chapter 2, and the extension experiment discussed in Chapter 3, generated more questions than answers. They did not provide evidence in favour of a KR model of behaviour, but they did not support a model of canonical labour supply either. The most interesting patterns of behaviour are not well explained by the aforementioned models. They can be characterized by these two stylized facts:

1. Agents seem to choose the same action again and again (inertia in decision-making).

2. Agents choose effort levels in the second experiment that would have increased their utility in the first experiment had they made that effort choice instead *if, and only if*, they lost the payment lottery.

First, workers across all treatments frequently choose the same effort in both experiments, even when the conditions (i.e., the piece-rate wage) have changed. Second, it seems the workers used ex post rationality to update their effort in response to the outcome of the payment lottery if, and only if, they lost. That is, workers who were awarded the fixed payment in the first experiment chose to work less in the second experiment, and those who were awarded their accumulated earnings chose to work more if, and only if, that payment was the lesser of the two. The winners kept their effort the same across both experiments.

Hart and Mas-Colell's (2000) *regret matching* may rationalize the first stylized fact and the behaviour of the losers. Regret matching is defined by the decision rule to "[s]witch next period [in a repeated game] to a different action with a probability *proportional* to the *regret* for that action, where *regret* is defined as the increase in payoff had such a change been made in the past."[1] Hart (2005) refers to regret matching as the most basic *adaptive heuristic* – a simple, unsophisticated, and myopic rule of thumb that individuals use to move their decisions in a "good" direction when playing repeated games. Individuals update away from behaviours that cause regret, and maintain behaviours that did not. A model of this simple heuristic can explain the general inertia of behaviour, and the updated behaviour amongst lottery losers.

To rationalize the lack of updating amongst the lottery winners, we must consider that although these workers are able to identify their (lack of) feelings of regret, that they may misidentify the source of those feelings. If the worker misattributes the happiness from "winning" the lottery to the utility from how hard she worked, she mistakenly underestimates her regret for her effort and is proportionally more likely continue to do the same thing again. Within the KR framework, this means winning may lead her to misattribute part of her "gain-loss" utility to her "consumption utility," resulting in another sub-optimal effort choice.

In this chapter, I will discuss these stylized facts, and then combine regret matching and the misattribution of lottery happiness as a potential explanation for these behaviours. I do not claim this is the true model underlying the Brazilian piece-rate workers behaviour. This is purely speculation and would require much further research to confirm. Still, it provides a valuable lens for interpreting these findings.

Although this rationale is important for understanding the results of the previously discussed experiments, it is also an important contribution to the growing literature regarding the determinants of labour supply. These patterns suggest that the intersection of adaptive heuristics and reference dependence may better fit the labour supply behaviour of these Brazilian workers than either alone. Furthermore, these results highlight a limitation from generalizing from experiments to natural situations: if individuals provide effort using different rules in new experiences, like these experiments, than in practiced contexts, then extrapolating behaviours from the lab to the outside world is particularly dangerous. The precise, but foreign, mechanisms that allow us to test theory – like a lottery payment contract – can change the heuristics a participant uses to supply their effort, and limit the external validity of the results.

The paper is organized as follows. The following sections outline the observations

[1] Hart, 2000, p. 1405, emphasis original.

from the earlier two experiments prompting this discussion, including a description of the empirical methodology and anomalous results that define the two stylized facts. Section 4.4 outlines a speculative theoretical lens for interpreting these results. Section 4.5 concludes.

4.2 Fact 1: Inertia in effort choice

4.2.1 Empirical Methodology

I start by examining the inertia of labour supply. I explore the change in effort between experiments, $\Delta_h \equiv h_t - h_{t-1}$, graphically. Two measures of effort are reported: the count of units of output produced, and the amount of time spent working. Although the general trend towards inertia exists across all treatments, as is demonstrated in Figures 3.1 and 3.2, I present the most interesting subsamples as mined from the data by brute force. It appears that inertia of those who experienced a wage shock and those who were awarded the fixed payment was different than their counterparts. The formal correlations are explored in the following logit regression:

$$\mathbb{1}(\Delta_h \approx 0) = \alpha + \gamma_{shock}\text{WageShock}_{i,t,c} + \gamma_f \text{Paid}f_{i,t-1,c} + \boldsymbol{X_{i,c}\gamma} + \epsilon_c. \quad (4.1)$$

The dependent variable is an indicator that effort has not changed between the two experiments. For the count of output, the indicator equals 1 if output in the second experiment is equal to the first experiment output, plus or minus one card, and 0 otherwise. For the minutes worked, the indicator equals 1 if minutes worked in the second experiment is equal to the minutes worked in the first experiment, plus or minus 1.25 minutes, and 0 otherwise. I will estimate this equation using a logit function. As such the coefficients can be used to infer the odds ratio as a result of treatment. The odds ratio is the probability of the event divided by the probability of the non-event. For example, if $e^{\gamma_3} = 2$, than a one unit increase in X_3 would make the event twice as likely.

The are two coefficients of interest. The variable $\text{WageShock}_{i,t,c}$ is an indicator that individual i from cluster c was randomly assigned a different wage in both experiments, $w_t \neq w_{t-1}$. The coefficient γ_{shock} thus estimates the relationship between experiencing a new wage, high or low, and the change in effort. The variable $\text{Paid}f_{i,t-1,c}$ is an indicator that individual i from cluster c was paid the fixed payment as a result of the coin-flip in the first experiment. The coefficient γ_f thus estimates the relationship between having been paid the fixed payment and current effort.

4.2.2 Results

To illustrate the inertia of labour supply, consider the histograms plotted in Figures 4.1 through 4.4. Figure 4.1 and Figure 4.2 plot the difference in *output produced* between the first and second experiments, dividing the sample by whether or not subjects experienced a wage shock and whether or not they were paid the fixed payment in the first experiment respectively. Although the median worker produces the same output in the first and second experiments, this pattern is most pronounced amongst the workers who received the randomly assigned wage shock and amongst those who were awarded the fixed payment. Figure 4.3 and Figure 4.4 plot the difference in *time worked* between the first and second experiments, dividing the sample by whether or not subjects experienced a wage shock and whether or not they were paid the fixed payment in the first experiment respectively. Although the median worker works for about the same amount of time in the first and second experiments, this pattern is most pronounced amongst the workers who received the fixed payment in the first experiment lottery.

The results of the logit estimation of Equation (4.1) for output produced are reported in Table 4.1. Consistent with the histograms we see that those who experience a wage shock are, on average, 2.6–2.9 times more likely to quit producing at the same level of output in both experiments than those paid the same wage.[2] This average result is driven by the strong relationship between the randomly assigned wage cut and output amongst people paid the low wage. For this subsample, a worker who received the unexpected wage cut is 3.3–4.2 times more likely to produce the same output in the second experiment as the first, when compared to those who did not receive a wage cut.[3] Put another way, workers who faced the same wages again were 3.3–4.2 times more likely to update their behaviour than those who were facing a new wage.

The results of a logit estimation of Equation (4.1) for time worked are reported in Table 4.2. Consistent with the histograms we see that those who were paid the fixed payment in the first experiment lottery are, on average, 1.9–2.0 times more likely to quit at the same time in both experiments than those paid their accumulated earnings.[4] This average result is driven by the strong relationship between the randomly lottery payment and output amongst people paid the low wage. For this subsample, a worker who received the fixed payment is 2.5–2.6 times more likely to quit after the same duration in the second experiment as the first, when compared to those who were paid their accumulated

[2]Log odds (e^{β}) calculated from Columns (1) and (2) in Table 4.1.
[3]Log odds (e^{β}) calculated from Columns (3) and (4) in Table 4.1.
[4]Log odds (e^{β}) calculated from Columns (1) and (2) in Table 4.2.

earnings.[5]

4.2.3 Discussion

The general inertia in behaviour is a necessary feature in any speculative rationale for the results of these experiments. More so, the different propensities to keep effort constant due to wage shocks or receiving the fixed payment in the lottery suggest the possibility that these workers do not know the function that produces their utility. If workers are able to correctly identify the level of their ex post utility, but not identify the source of this happiness, this could explain both of these responses.

If workers do not know which component of their past experience generated a correctly observed past level of satisfaction, keeping effort constant when offered a new piece-rate wage helps pin down this function. By choosing the same effort again, they can learn about the underlying elasticity of their utility with respect to the piece-rate wage.

Furthermore, keeping effort constant after receiving the fixed payment may also indicate a misattribution of satisfaction. One potential explanation for this pattern is related to the disproportionate number of fixed payment recipients that were winners. In the first experiment lottery, 208 of the 366 subjects (57%) in the first experiment were awarded the fixed payment. Of these 208 subjects, 178 of them (86%) were winners. That is, they were awarded the higher of the two potential payments at the time of the coin flip. Although ex post rationality would suggest they should have worked even less had they known that they were going to win the fixed payment in the lottery, the satisfaction of winning may have driven them to keep their behaviour the same. Still, plotting these histograms by winners and losers, or running these regressions with a winner indicator instead of the fixed payment indicator does not produce as strong of a result. Regardless of the reason, if those who were awarded the fixed payment were more likely to feel satisfied with the outcome than those awarded the accumulated earnings, it seems perfectly reasonable that they would keep acting the same in the next experiment in hopes of achieving the same outcome.

[5]Log odds (e^{β}) calculated from Columns (3) and (4) in Table 4.2.

4.3 Fact 2: Losers regret their effort choices and update accordingly

4.3.1 Empirical Methodology

I next explore the within subject change in effort between the first and second experiments using the following regression.

$$\Delta_h = \alpha + \beta_{t-1}\text{WageLow}_{i,t-1,c} + \beta_t\text{WageLow}_{i,t,c} + \beta_{shock}\text{WageShock}_{i,t,c} + \beta_L\text{Lost}_{i,t-1,c} + \boldsymbol{X_{ic}\gamma} + \epsilon_c. \quad (4.2)$$

Where the dependent variable, $\Delta_h \equiv h_t - h_{t-1}$ is the difference in effort produced by individual i from neighbourhood cluster c in the second experiment less the first. Two measures of effort are reported: the count of units of output produced, and the amount of time spent working. Included in this specification is a vector of individual characteristics, $\boldsymbol{X_{ic}}$, to control for a subject's age, sex, and other characteristics outlined in the regression tables. The are 4 coefficients of interest. The variable $\text{WageLow}_{i,\tau,c}$ is an indicator that the period τ wage was low. The variable $\text{WageShock}_{i,t,c}$ is an indicator that individual i from cluster c was randomly assigned a different wage in both experiments, $w_t \neq w_{t-1}$. The coefficient β_{shock} thus estimates the relationship between experiencing a new wage, high or low, and the change in effort. The variable $\text{Lost}_{i,t-1,c}$ is an indicator that individual i from cluster c was paid the lower of her fixed payment and accumulated earnings as a result of the coin-flip in the first experiment. The coefficient β_L thus estimates the relationship between having been lost a past lottery and a future change in effort.

4.3.2 Results

Tables 4.3 and 4.4 report the estimates of Equation (4.2) for output and time respectively. Firstly, we see that the second experiment wages, whether they were anticipated or not, have no impact on the within-person change in effort. Still, we see that there is a positive relationship between past wages and the change in effort. That is, workers who were paid the low wage in the first experiment, reduce the number of output they produce by 12.7 cards and 6.4 minutes more than those who were paid the high wage, conditional on having received their accumulated earnings.[6] In the subsample of individuals who had been awarded the fixed payment in the first experiment, the low wage participants

[6]See columns (4) of Table 4.3 and 4.4.

reduced effort by 4.0 cards and 3.3 minutes more than the high wage participants.[7]

Secondly, we see that those who lost the payment lottery in the first experiment update their behaviour to a strategy that would have increased their utility in the first experiment had they known the outcome of the lottery in advance. Conditional on losing, those who lost by being awarded their accumulated earnings, increased their effort by 31.2 units of output and 15.6 minutes of time spent working.[8] Those who lost because they were awarded the fixed payment, decreased their effort by 11.0 units of output (although, statistically insignificant) and 7.3 fewer minutes of work.[9]

4.3.3 Discussion

Most formal models of learning impose ex post rationality – the idea that hindsight is 20/20 – to explain updates in behaviour. Had the subjects known the outcome of the payment lottery while they were working, they would have made different choices. If a subject knew the lottery would award the fixed payment, she would have been better off doing less work. Had she know she would be awarded the accumulated earnings, she would have been better off doing more work.

We observe precisely this rationality when we look at the intersection between losing the coin flip and the type of payment awarded. Those who lost because they were paid their accumulated earnings in the first experiment increased their effort in the second. Those who lost because they were awarded the fixed payment in the first decreased their effort in the second. The disappointment with losing in the first experiment led them to update their behaviour in the second.

The same ex post rationality cannot be applied to those who won the payment lottery in the first experiment. Those who won by being awarded the fixed payment did not change their effort at all. This suggests that they misattribute the satisfaction from the lottery to the satisfaction from the amount of effort they produced. Like a novice archer hitting the bullseye on the first shot, there is no reason to fix what doesn't feel broken.

The idea that feelings of (lack of) *regret* skew individuals decisions is not unheard of in studies of reference dependent behaviour. For instance, Haggag and Pope (2016) find people value a new beverage higher if they first tasted it while thirsty, and are more likely to return to an amusement park if they were there on a day with good weather. People misattribute their satisfaction, and regret, based on exogenous factors to the intrinsic value of the good or experience. Bushong and Gagnon-Bartsch (2016) suggest

[7]See columns (6) of Table 4.3 and 4.4.
[8]See columns (4) of Table 4.3 and 4.4.
[9]See columns (6) of Table 4.3 and 4.4.

that when individuals learn from experience, they also often neglect the degree to which their realized satisfaction was shaped by their expectations. They find that their workers misattribute the feelings from positive or negative surprises. This distorts the disutility of effort and changes behaviour. That is, those that regret a past experience for reasons independent of the marginal return and cost of effort update the next time around.

This rationale may explain the behaviour I observe. This purely speculative explanation is tightly linked to the reason I tested *adaptive* in addition to *rational* expectations of income with this population. Formal definitions of *rationality* may not be appropriate for everyday decision making, but heuristics (like adaptive expectations) that approximate the same outcomes as rational optimization may be what are truly relevant. A heuristic is a rule of thumb – or more formally, "heuristics are efficient cognitive processes, conscious or unconscious, that ignore part of the information. Because using heuristics saves effort, the classical view has been that heuristic decisions imply greater errors than do 'rational' decisions as defined by logic or statistical models."[10] The heuristic in this environment may have simply been ex post *regret* with the outcome.

Secondly, although second experiment wages – anticipated or not – have no influence over second experiment effort, past wages do. The participants who were paid the low wage in the first experiment reduce their effort for the second experiment more than those who received the high wages, regardless of the lottery outcome. This pattern again suggests that the workers are learning about their utility function. As we saw in Chapter 2, there was no strong relationship between the wages in the first experiment and the average amount of effort exerted in that experiment. We know that the average worker believed they did too much work in the first experiment, from the average decrease in effort between the first and second experiments.[11] The feeling that the first experiment effort was excessive was likely magnified for those who were awarded the lower marginal benefit for that work.

4.4 Regret Matching with an Unknown Degree of Reference Dependence

Regret matching was originally introduced as a simple adaptive heuristic by Hart and Mas-Colell (2000). To illustrate this heuristic, consider an agent deciding her action in time period t in a repeated game where she makes decisions myopically (i.e., one-shot

[10] Gigerenzer and Gaissmaier, 2011, p.451.

[11] The mean within-worker change in output was a decrease of 3.75 cards and a decrease of 3.54 minutes worked between the two experiments. See Tables 4.3 and 4.4 respectively.

at a time). Let U be the average payoff she accumulated playing this game in all earlier periods, and let j denote the action she took in the last period. For each alternative action k that is different from j, let $V(k)$ be the alternative average payoff had she played k instead of j every time she had played j in the past.

Her "regret" for action k is defined as:

$$R(k) = \begin{cases} V(k) - U & \text{if } V(k) \geq U \\ 0 & \text{if } V(k) < U. \end{cases}$$

In this way, her regret is asymmetrical. It is the difference in utility she would have experienced had she played k instead of j so long as playing k would have made her better off. The regret matching heuristic stipulates that the probability this agent choses any action k in the current period is proportional to her regret $R(k)$. Then, whatever probability remains is assigned to playing j again. In this way, the model captures the well documented inertia in decision-making.[12] This model generates behaviour where agents choose the same actions over and over again because of the strictly positive probability of not switching. This is the first stylized fact.

In terms of nomenclature, this model means that regret is different that disappointment. Regret comes from the wish that the agent herself made a different choice. Disappointment is often used to describe wishing for a different outcome given the same choices. In the context of this experiment, a person regrets her effort choice given the outcome of the lottery, but is disappointed in the lottery given her effort.[13] Only regret is a signal to learn from past mistakes.

Consider how this heuristic applies to the workers in my experiment. Consider that worker i had chosen to work h_{t-1} in the first experiment and was paid $\omega_{t-1} \in \{f_{t-1}, w_{t-1}h_{t-1}\}$ as a result of the coin flip. Her average payoff from this experiment is her only payoff since she has only played this game once: $U(h_{t-1}, \omega_{t-1})$. Before she decides on her effort in the second experiment, h_t, she evaluates all of the other levels of effort she could have chosen, like k_{t-1}, and considers whether or not she regrets choosing h_{t-1} instead of k_{t-1} given what she knows now – including the outcome of the lottery. Although there is a chance she will continue to choose the same effort (i.e., $h_t = h_{t-1}$), she will deviate to alternative effort k_{t-1} depending on the magnitude of regret, $R(k_{t-1})$, she feels for not having choose effort k_{t-1} the last time.

Consider the two types of workers who lost the payment lottery: those who were awarded the fixed payment when it was the lower of the two possible outcomes, $\omega_{t-1} =$

[12] Hart and Mas-Colell, 2013, p.xxiii.

[13] Marcatto, Cosulich and Ferrante (2015)

$f_{t-1} < w_{t-1}h_{t-1}$, and those who lost by being awarded the accumulated earnings, $\omega_{t-1} = w_{t-1}h_{t-1} < f_{t-1}$. The former would be disappointed for not choosing a lower level of effort, $k_{t-1} < h_{t-1}$, since effort is costly and expending the extra effort resulted in no higher returns to income. Similarly, the latter would be disappointed for not choosing a higher level of effort, $k_{t-1} > h_{t-1}$, now that she knows the marginal return to each unit of effort will be $1.0 \times w_{t-1}h_{t-1}$ instead of the previously expected $0.5 \times w_{t-1}h_{t-1}$. Regret matching tells us that the former losers will reduce their effort between the first and second experiment, and the latter losers will increase their effort if they mistake this disappointment for regret. This is the second stylized fact.

But regret matching suggests the same result should be true for winners as well. The above prediction is solely dependent on the outcome of the payment lottery, not its relative magnitude. But as we know from the second stylized fact, this is not what I observed. Winners did not update their behaviour.

Suppose instead that workers misattribute the happiness from the feelings of "winning" to the disutility of their effort. Bushong and Gagnon-Bartsch (2016) propose that workers who learn from past experiences, although correctly able to identify their level of satisfaction, may retroactively misidentify their utility function. In the notation that lies at the core of this thesis, outlined in Chapter 1, Section 1.5, this notion is the idea that a worker knows the level of her own ex post utility, $u(Y_{t-1}, h_{t-1})$, but doesn't understand the source of that utility. She may misattribute some of her "gain-loss" utility to the "consumption" component of her utility function because she believes she has a diminished reference dependent parameter $\hat{\alpha} \in [0, \alpha)$. My speculative rationale is that the workers correctly encode how happy they feel, but they misinterpret the underlying source of that happiness.

Consider the workers in my pair of experiments. If those who lost the lottery in the replication experiment discussed in Chapter 2 correctly identified that they were unhappy with result, but misattributed their disappointment in the lottery as regret for their effort choice, they would decrease their effort in the second experiment. If they misattributed their happiness (lack of disappointment) from the lottery to diminish their regret in their effort choice, they would be disproportionately likely to make the same effort choice again.

Furthermore, the possibility that workers do not know the function that produces their utility again lends itself to keeping effort constant when the conditions change. If workers do not know which component of their past experience generated a correctly observed past level of satisfaction, keeping effort constant when offered a new piece-rate wage helps pin down this function.

4.5 Conclusion

In the experimental design, I had to make tradeoffs. By using the production of a foreign output rather than something more locally familiar in the experiment, I gained control over expectations but also risked that the experience was so new that participants used a labour supply heuristic that is particular to new experiences, and evolves with experience. If these workers were able to correctly able to identify their ex post feelings of regret (i.e., ex post utility), but unable to identify the source of this regret, their behaviour the second time around might be based upon their (wrong) beliefs about the sources of that regret.

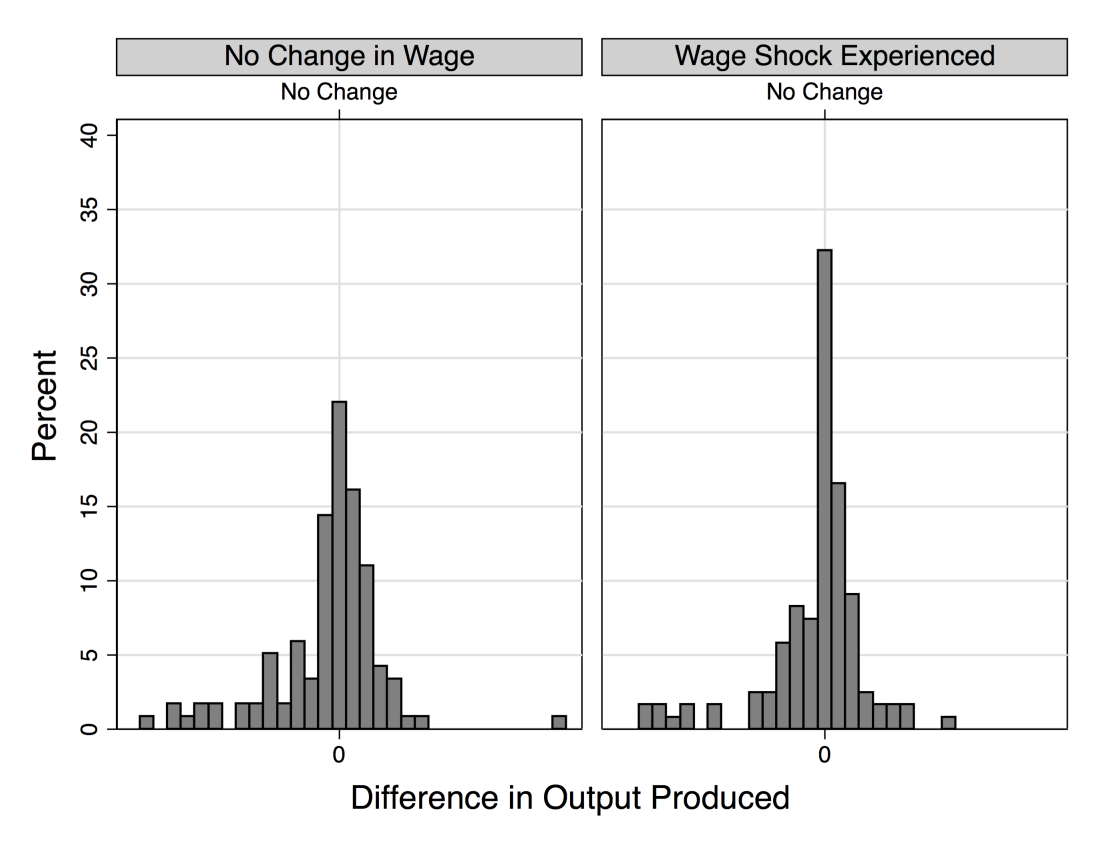
Many of those who received the fixed payment in the first experiment tended to be satisfied with that outcome because it was a "winning" payment in the lottery. Misattributing that satisfaction to the effort provided would lead them to do the same thing again in hopes of getting the same satisfaction. On the other hand, those who lost the lottery in the first experiment, updated their behaviour in the second experiment to reflect the effort they would have been better off choosing the first time around.

In general, those facing the same circumstances in the second experiment as the first were able to learn about their utility function for this new experience. But there was more to be identified than just the the relationship between the lottery and satisfaction. The average worker reduced their effort in the second experiment, suggesting they were learning about their costs of effort from their first experience. Those workers who faced the same circumstances again updated their behaviour in 91% of cases. But amongst those whose wages changed, only 79% updated behaviour.[14] If the workers' goal was to learn the *source* of their regret, it is completely rational to maintain effort when facing changed parameters.

The recognition that workers may be able to correctly identify their regret from a new experience ex post, but are still learning the sources of that regret, is sufficient to explain the anomalous findings in the first and second experiments.

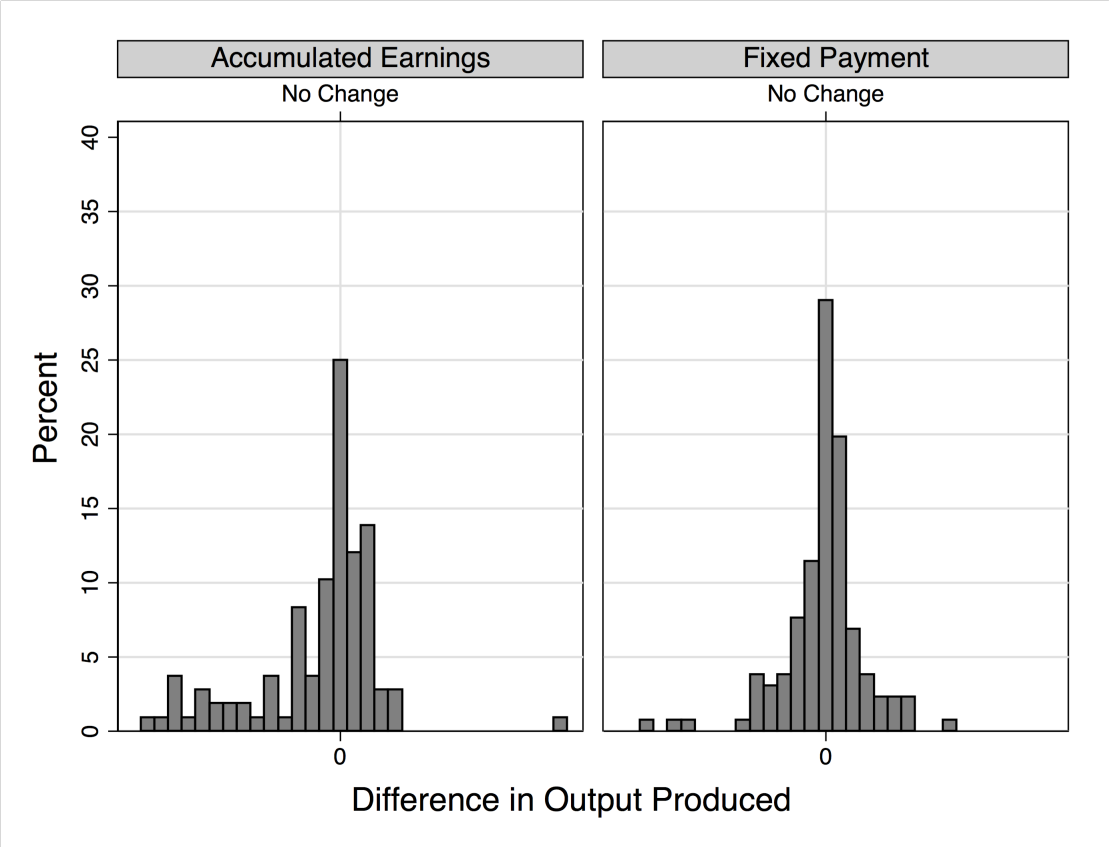
[14]The marginal effect of a wage shock on the probability of $h_t = h_{t-1} \pm 1$ is 0.11 (significant at 5 percent confidence) when estimated by Probit with clustered standard errors.

Figure 4.1: Histogram of the difference in output produced between the second and first experiments – by Wage Shock



Notes: [1] Histogram of $h_t - h_{t-1}$. [2] Bin in width equal to $5h$. [3] Mean = – 3.75 , Median = 0, Minimum = – 71, Maximum = 78.

Figure 4.2: Histogram of the difference in output produced between the second and first experiments – by First Experiment Lottery Payment

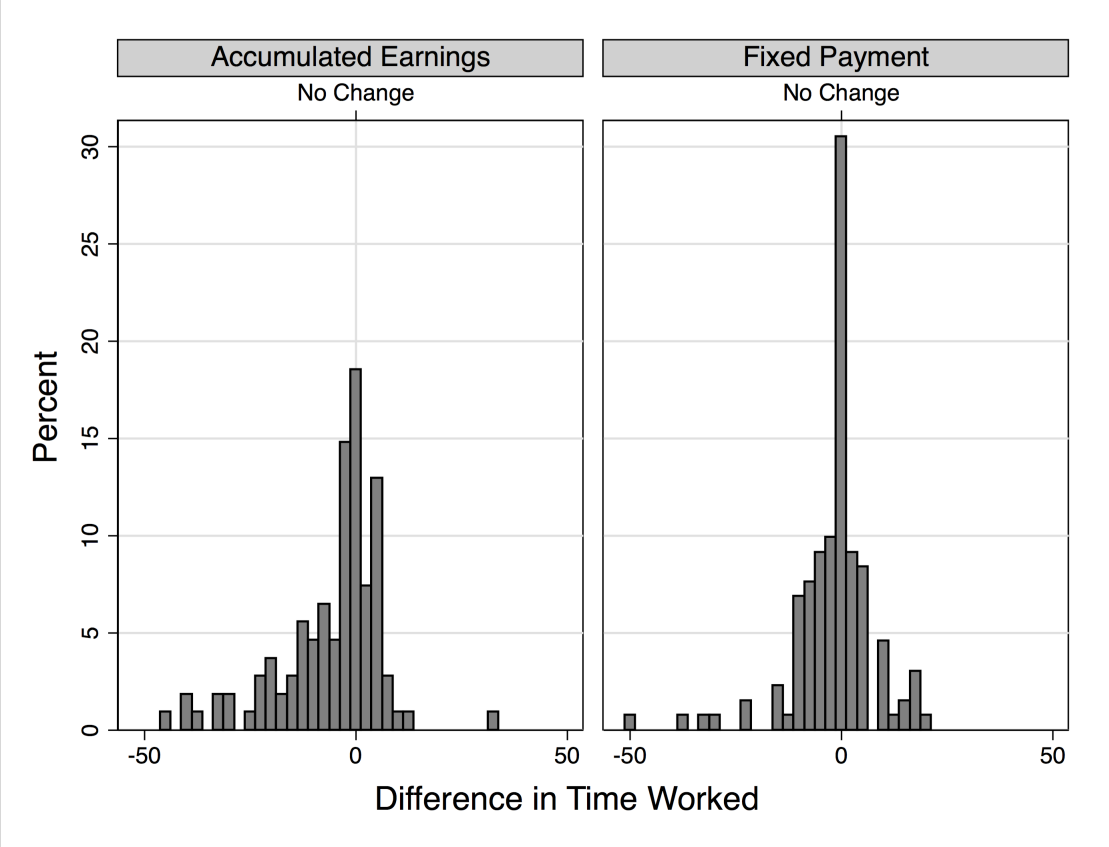


Notes: [1] Histogram of $h_t - h_{t-1}$. [2] Bin in width equal to $5h$. [3] Mean = – 3.75 , Median = 0, Minimum = – 71, Maximum = 78.

Figure 4.3: Histogram of the difference in time worked between the second and first experiments – by Wage Shock

Notes: [1] Histogram of $minutes_t - minutes_{t-1}$. [2] Bin in width equal to 2.5 *minutes*. [3] Mean = – 3.5 *minutes*, Median = –1.0 *minutes*, Minimum = – 49.0 *minutes*, Maximum = 31.7 *minutes*. [4] McCrary test p-value = 0.00 (b = 5 units of output, cut = -2.5 cards, h = 19.54)

Figure 4.4: Histogram of the difference in time worked between the second and first experiments – by First Experiment Lottery Payment



Notes: [1] Histogram of $minutes_t - minutes_{t-1}$. [2] Bin in width equal to 2.5 *minutes*. [3] Mean = – 3.5 *minutes*, Median = –1.0 *minutes*, Minimum = – 49.0 *minutes*, Maximum = 31.7 *minutes*. [4] McCrary test p-value = 0.00 (b = 5 units of output, cut = -2.5 cards, h = 19.54)

Table 4.1: Propensity to Produce the Same Output in the First and Second Experiments

	Pooled Shocks		LowWage_t		HighWage_t	
	(1)	(2)	(3)	(4)	(5)	(6)
Wage Shock	0.950**	1.053**	1.201***	1.443***	0.597	0.384
	(0.377)	(0.413)	(0.464)	(0.517)	(0.574)	(0.634)
Paid f in Past Lottery	0.246	0.190	0.164	0.205	0.446	0.0161
	(0.372)	(0.379)	(0.341)	(0.318)	(0.767)	(0.774)
Constant	-2.400***	-1.070	-2.307***	-0.666	-2.534***	-1.108
	(0.395)	(1.835)	(0.367)	(2.210)	(0.773)	(3.728)
Productivity	No	Yes	No	Yes	No	Yes
Age & Sex	No	Yes	No	Yes	No	Yes
Time of Day FE	No	Yes	No	Yes	No	Yes
Observations	239	239	121	121	117	117
Dep. Var. Mean	0.155	0.155	0.182	0.182	0.128	0.128
Dep. Var. SD	0.362	0.362	0.387	0.387	0.336	0.336

Notes:

[1] Site-clustered robust standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] Dependent Variable: an indicator if the worker quit in the second experiment when her current output equalled her previous output $\pm$ 1 card.

[3] Logit regression. Interpretation of the coefficients of the exogenous indicators: e^{β} is the odds ratio. For instance, if $e^{\beta_3} = 2$, than a one unit increase in X_3 would make the event twice as likely.

[4] Wage Shock: an indicator if the first and second experiment wages were different, $w_t \neq w_{t-1}$

[5] Paid f in Past Lottery: an indicator that the subject was paid f_{t-1}, not $w_{t-1}h_{t-1}$, in the first experiment payment coin toss.

[6] LowWage_t subsample includes all individuals currently receiving the low piece-rate. The individuals in that sample who had received a wage shock received a wage reduction.

[7] HighWage_t subsample includes all individuals currently receiving the high piece-rate. The individuals in that sample who had received a wage shock received a wage increase.

Table 4.2: Propensity to Work for the Same Duration in the First and Second Experiments

	Pooled Shocks		LowWage_t		HighWage_t	
	(1)	(2)	(3)	(4)	(5)	(6)
Wage Shock	-0.120	-0.230	-0.253	-0.230	0.143	-0.265
	(0.310)	(0.339)	(0.441)	(0.489)	(0.337)	(0.435)
Paid f in Past Lottery	0.676*	0.646*	0.972**	0.930*	0.242	0.180
	(0.354)	(0.353)	(0.496)	(0.540)	(0.510)	(0.487)
Constant	-1.431***	-1.833	-1.365***	-1.408	-1.517***	-5.623**
	(0.310)	(1.682)	(0.461)	(1.718)	(0.401)	(2.537)
Productivity	No	Yes	No	Yes	No	Yes
Age & Sex	No	Yes	No	Yes	No	Yes
Time of Day FE	No	Yes	No	Yes	No	Yes
Observations	239	239	121	121	117	117
Dep. Var. Mean	0.251	0.251	0.289	0.289	0.214	0.214
Dep. Var. SD	0.435	0.435	0.455	0.455	0.412	0.412

Notes:

[1] Site-clustered robust standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

[2] Dependent Variable: an indicator if the worker quit in the second experiment when her current duration equalled her previous duration $\pm$ 1.25 minutes.

[3] Logit regression. Interpretation of the coefficients of the exogenous indicators: e^{β} is the odds ratio. For instance, if $e^{\beta_3} = 2$, than a one unit increase in X_3 would make the event twice as likely.

[4] Wage Shock: an indicator if the first and second experiment wages were different, $w_t \neq w_{t-1}$

[5] Paid f in Past Lottery: an indicator that the subject was paid f_{t-1}, not $w_{t-1}h_{t-1}$, in the first experiment payment coin toss.

[6] LowWage_t subsample includes all individuals currently receiving the low piece-rate. The individuals in that sample who had received a wage shock received a wage reduction.

[7] HighWage_t subsample includes all individuals currently receiving the high piece-rate. The individuals in that sample who had received a wage shock received a wage increase.

Table 4.3: Change in Output Produced Between the First and Second Experiments

	Pooled		Paid $w_{t-1}h_{t-1}$		Paid f_{t-1}	
	(1)	(2)	(3)	(4)	(5)	(6)
Low 1st Exp. Wage	-3.930	-4.140	-12.82***	-12.73***	-4.779***	-3.983**
	(2.478)	(2.461)	(3.315)	(3.170)	(1.681)	(1.952)
Low 2nd Exp. Wage	-0.777	-0.988	0.501	-1.044	-2.495	-2.298
	(2.435)	(2.625)	(3.295)	(3.565)	(2.285)	(2.368)
Wage Shock	1.197	0.565	-0.343	-0.514	0.366	-0.588
	(2.401)	(2.509)	(3.243)	(3.398)	(2.285)	(2.393)
Loser	5.802***	5.308***	33.14***	31.16***	-10.32	-10.99
	(1.883)	(1.881)	(4.084)	(4.379)	(10.49)	(10.71)
Constant	-4.067	-5.053	-25.94***	-22.09	3.637	-12.90
	(2.599)	(11.02)	(3.708)	(18.92)	(2.567)	(11.61)
Productivity	No	Yes	No	Yes	No	Yes
Age & Sex	No	Yes	No	Yes	No	Yes
Time of Day FE	No	Yes	No	Yes	No	Yes
Observations	239	239	108	108	131	131
R-Squared	0.0358	0.0783	0.452	0.495	0.0436	0.0768
Mean of Dep. Var.	-3.749	-3.749	-7.417	-7.417	-0.725	-0.725
SD of Dep. Var.	18.79	18.79	22.37	22.37	14.63	14.63

Notes:

[1] Site-clustered robust standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[2] Dependent Variable: The change in output between the first and second experiments, $h_t - h_{t-1}$.

[3] OLS regression. Interpretation of the coefficients of the exogenous indicators: A unit increase in X results in a beta change in the level of the dependent variable.

[4] Wage Shock: an indicator if the first and second experiment wages were different, $w_t \neq w_{t-1}$

[5] Loser: an indicator that the subject was paid the lower of f_{t-1} or $w_{t-1}h_{t-1}$ in the first experiment payment coin toss.

[6] Paid $w_{t-1}h_{t-1}$ subsample includes all individuals who were awarded $w_{t-1}h_{t-1}$ in the first experiment payment lottery. Thus, those who are "Losers" in this subsample must have chosen effort such that $w_{t-1}h_{t-1} < f_{t-1}$.

[7] Paid f_{t-1} subsample includes all individuals who were awarded f_{t-1} in the first experiment payment lottery. Thus, those who are "Losers" in this subsample must have chosen effort such that $w_{t-1}h_{t-1} \geq f_{t-1}$.

Table 4.4: Change in Time Worked Between the First and Second Experiments

	Pooled		Paid $w_{t-1}h_{t-1}$		Paid f_{t-1}	
	(1)	(2)	(3)	(4)	(5)	(6)
Low 1st Exp. Wage	-2.286	-2.650*	-5.864**	-6.387***	-3.318**	-3.294*
	(1.461)	(1.465)	(2.160)	(2.043)	(1.467)	(1.633)
Low 2nd Exp. Wage	-1.313	-1.674	-1.018	-0.874	-1.988	-2.218
	(1.438)	(1.569)	(2.064)	(2.271)	(1.533)	(1.545)
Wage Shock	2.353*	1.785	1.429	1.671	2.148	1.462
	(1.389)	(1.410)	(2.037)	(1.842)	(1.533)	(1.538)
Loser	1.796	1.799	14.77***	15.63***	-7.132*	-7.252*
	(1.213)	(1.129)	(2.216)	(2.234)	(3.664)	(3.929)
Constant	-3.551***	-5.137	-13.93***	-21.85	0.307	-6.891
	(0.946)	(8.073)	(1.884)	(17.83)	(1.539)	(8.495)
Productivity	No	Yes	No	Yes	No	Yes
Age & Sex	No	Yes	No	Yes	No	Yes
Time of Day FE	No	Yes	No	Yes	No	Yes
Observation	239	239	108	108	131	131
R-squared	0.0313	0.0642	0.305	0.364	0.0665	0.113
Mean of Dep. Var.	-3.537	-3.537	-5.666	-5.666	-1.782	-1.782
SD of Dep. Var.	11.04	11.04	12.19	12.19	9.686	9.686

Notes:

[1] Site-clustered robust standard errors in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

[2] Dependent Variable: The change in output between the first and second experiments, $h_t - h_{t-1}$.

[3] OLS regression. Interpretation of the coefficients of the exogenous indicators: A unit increase in X results in a beta change in the level of the dependent variable.

[4] Wage Shock: an indicator if the first and second experiment wages were different, $w_t \neq w_{t-1}$

[5] Loser: an indicator that the subject was paid the lower of f_{t-1} or $w_{t-1}h_{t-1}$ in the first experiment payment coin toss.

[6] Paid $w_{t-1}h_{t-1}$ subsample includes all individuals who were awarded $w_{t-1}h_{t-1}$ in the first experiment payment lottery. Thus, those who are "Losers" in this subsample must have chosen effort such that $w_{t-1}h_{t-1} < f_{t-1}$.

[7] Paid f_{t-1} subsample includes all individuals who were awarded f_{t-1} in the first experiment payment lottery. Thus, those who are "Losers" in this subsample must have chosen effort such that $w_{t-1}h_{t-1} \geq f_{t-1}$.

Conclusion

In this thesis, I experimentally explored the motivations underlying effort provision of a group of impoverished individuals involved in piece-rate work in Northeast Brazil. This work was motivated by the failures of a canonical life-cycle model to explain observed labour supply behaviour across datasets and methodologies since the 1970s. The KR theory of reference dependent preferences appeared to be a disciplined way to unify the conflicting elasticity estimates, and recent laboratory and natural experiments suggested this theory may work in practice as well.

Abeler et al. (2011) created an experimental mechanism that is a clear test of KR preferences in an effort provision context. In Chapter 2, I replicated this methodology in the first test of the KR model in a real-effort framed field experiment. I manipulated Brazilian piece-rate workers' rational expectations of income with a lottery-based payment contract for an open-ended shift of work. I used this mechanism to engineer workers' probabilistic beliefs about income and test if these expectations determine labour supply. I found that workers narrowly bracketed their labour supply choices in this context, consistent with reference dependence but not with canonical lifecycle labour supply. Still, this narrow bracket created income effects in the experiment that dominated results, masking any further evidence of KR preferences.

The experiment discussed in Chapter 2 tested how *rational* expectations of income influence behaviour. In Chapter 3, I presented an experiment that tested how *adaptive* expectations of income influence effort provision. I revisited a subsample of participants from the first experiment and offered them a second shift of employment with a similar lottery payment contract, but I randomly assigned unanticipated piece-rate wage shocks. Since the income earned in the first experiment defined participants' adaptive expectations of income for the second experiment, I tested if their past incomes determined their current behaviour. Again, I found only weak support for KR preferences, but strong indications of inertia in effort provision.

The final chapter of this thesis explored a pair of interesting findings from the previously discussed pair of experiments: (1) there is inertia in behaviour, even when the

conditions haved changed, and (2) losers of the payment lottery update behaviours they regretted given the outcome of the lottery. I propose that Hart and Mas-Colell's (2000) *regret matching* combined with the misattribution of that regret may rationalize these stylized facts. This is a purely speculative adaptive heuristic that helps individuals approximate rational behaviour with a simple and unsophisticated rule of thumb that helps agents iterate towards "better" decisions.

This thesis starts firmly grounded in theories of rational behaviour, and follows empirical evidence away from these formal theories towards heuristics that may better fit the way people actually behave. The history of labour supply estimates showed that the lifecycle model was underperforming expectations when taken to the data. Since models of reference dependence have improved the connection between theory and practice, I took one of these theories to the field in a pair of laboratory-like experiment. I found that neither the canonical models, or reference dependent models, explained behaviour when I leaned heavily on the rationality embedded within them. When I expanded my design to consider adaptive expectations as a proxy for rational expectations, the observed behaviour still did not match theory. Ultimately, an even more unsophisticated "rule of thumb" seems to best explain the way workers update their behaviour.

Understanding how workers respond to changes in compensation, and uncovering the set of determinants of labour supply, is an active course of research. This thesis itself would have been improved by more iterations of the experiment to see if worker decision making evolves further with experience. Although the results of these experiments raise more questions then they answered, further experiments can be designed and conducted to test the robustness of the results and the speculative rationale they inspired. Although the results of this experiment did not drastically push the frontier on our understanding of labour supply behaviour, it has paved the way for a fruitful research agenda going forward.

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Appendices

Enumerator Script in Portuguese

Introdução

Aproximar do participante trazendo um envelope da sessão 1, uma caneta para registrar respostas, uma prancheta para ser usada como superfície de trabalho, um cronômetro e um recipiente cheio de moedas para facilitar o troco.

Olá! Nós da Universidade de Toronto estamos aqui para estudar como as pessoas respondem a incentivos monetarios. Nós gostaríamos que você participasse de duas simples atividades em que você pode ganhar dinheiro por cada tarefa que completar. Você será pago em dinheiro ao final de cada atividade.

A tarefa é simples. – *Enquanto estiver demonstrando*- Você simplesmente tem que cobrir os pontos pretos desta cartela com estes adesivos. Para participar, nós somente precisamos de alguns minutos do seu tempo, mas se você quiser participar por mais tempo com a oportunidade de ganharmais dinheiro, você também pode.

Essa sessão consistirá em duas atividades em que você ganhará dinheiro. Nós vamos lhe pagar pelo seu esforço e pelo seu tempo. Você não tem que nos dar nada.

A primeira atividade vai durar 4 minutos e nós pediremos que você complete quantas cartelas você quiser dentro desse tempo. Nós vamos dar a você R**$0,05** por cada cartela completada.
A segunda atividade não tem hora para acabar, a sua duracao vai depender de você: se quer participar por menos ou mais tempo. Isso envolve repetir a mesma atividade, embora a cada repeticao, o pagamento será diferente. Vamos-lhe explicar quando começarmos.

Existem 460 pessoas (incluindo você) no nordeste do Brasil que serão chamadas para participar destas atividades. Todas elas foram recrutadas da mesma forma que você e elas também receberam as mesmas instruções. Nós vamos retornar a pelo menos 200 dessas pessoas no futuro para pedir que elas participem dessas atividades uma segunda vez. – *Considerar dar essa informação quando (i) for questionado por uma pessoa sobre como você a escolheu ou (ii) enquanto se conversa durante as atividades. Certificar-se de que essa informação é mencionada, mas não há problema em deixá-la surgir naturalmente.*

Você quer participar? Se sim, lembre-se, você pode desistir a qualquer momento.

Se não, perguntar por quê? Se for algo que você possa assegurar a eles não ser um problema (ex. Isso é legal e nós não vamos tirar nenhum dinheiro de vocês), tentar.

Se for pelo fato deles estarem muito ocupados, perguntar qual seria um melhor momento para voltar lá. Remarcar um dia para retornar. Registrar a hora que você esteve lá e o porquê deles estarem ocupados.

Sessão 1 - Ficha de Dados

(1) Nome:

(2) Idade:

(3) Localização:

(4) Data:

(5) Dia da semana:

(6) Hora de início:

(7) Hora do término:

(8) Sessão #:

(9) Recusou-se, e razão:

Atividade 1:
(10) w:

(11) Cartelas tentadas:

(12) Cartelas completadas:

(13) Pago: R$

(14) Comentários:

Possui trabalho remunerado?
(15) Sim / Não / NR
(16) Informada/Estimada Pelo Entrevistador

Trabalha em casa?
(17) Sim / Não / NR
(18) Informada/Estimada Pelo Entrevistado

Salário por peça?
(19) Sim / Não / NR
(20) Informada/Estimada Pelo Entrevistado

(21) Indústria:

(22) Salários:

O que determina como e quando trabalha-objetivo :
(23) tempo/renda/ esforço

Atividade 2:
(24) w:
(25) pf:

(26) Cartelas tentadas:

(27) Cartelas completadas:

(28) **w** x Cartelas completadas: R$

(29) Pago: R$

(30) Duração de tempo: min seg

(31) Comentários

(32) Por que parou?
Resposta espontânea e múltipla.

- Entediado
- Cansado
- Sem material
- Interrompido
- Teve que fazer outra coisa - trabalhar
- Teve que fazer outra coisa - algo diverso de trabalho
- A quantidade minima de dinheiro que posso ganhar e suficiente
- Livrar-se do risco no sorteio
- Não gosta de se arriscar/não faz apostas
- Sorte
- Deus
- ~~Mesmas cartelas da última vez~~
- ...
- ~~Mais tempo que da última vez~~
- Outra pessoa, especificar:
- Outro, especificar:

(33) Voce sabe o que vai fazer com o seu premio?
Sim/Nao/NR

(34) O que vai fazer com o seu premio?

(35) Lisa estava presente na:
Resposta múltipla.

- Introdução
- Atividade 1
- Atividade 2
- Cara/Coroa

Atividade 1

Para esta atividade, você terá 4 minutos para completar quantas cartelas você quiser. Ao final dos 4 minutos, nós vamos contar o número de cartelas que você completou e lhe daremos **(10) 5 centavos** por cada cartela finalizada.

*Registrar **(1)-(6) & (8)** durante os 4 minutos.*

Indicar ao participante o quanto ele já ganhou.

Parabéns!

Você completou **(12)**_____cartelas e então ganhou $ **(13)**_____.

*Pagar ao participante o que ele ganhou. Registrar os dados e qualquer comentário na ficha de dados **(10)-(14).***

Atividade 2

Esta atividade levará quanto tempo você quiser. Nesta atividade, queremos que você faça a mesma tarefa – colocando adesivos nos pontos pretos, mas nós lhe pagaremos de modo um pouco diferente.

No final da atividade, quando você tiver decidido que já completou cartelas suficientes, nós iremos jogar uma moeda. Se a moeda der cara, nós vamos pagar a você **(24)R$0,20** por cada cartela completada. Se der coroa, nós lhe pagaremos **(25)R$6,00**, não importa quantas cartelas você tenha completado.

Se voce nao completar nehuma cartela, nós iremos jogar uma moeda nesse mesmo instante e você terá uma chance igual (50/50) de ganhar (**25)R$6,00** ou nada. Ou, você pode trabalhar até ter completado **80** cartelas e então, nós jogaremos a moeda e tera a chance de ganhar **R$ 6,00** ou **R$16**. Ou ainda, você pode optar por completar qualquer número de cartelas dentro do seu tempo. Vai depender totalmente de você.

Eu vou iniciar o cronômetro agora, e você me diz quando tiver terminado de completar as cartelas

Iniciar o tempo.

Entrevistador conduza uma conversa sobre emprego e tente captar as respostas às perguntas que forem feitas, quer através de observação ou porque foram diretamente informadas pelo participante.

Possui trabalho remunerado	***(15)** Sim / Não / NR*	***(16)** Informada/Estimada Pelo Entrevistador*
Trabalha em casa?	***(17)** Sim / Não / NR*	***(18)** Informada/Estimada Pelo Entrevistador*
Salário por peça?	***(19)** Sim / Não / NR*	***(20)** Informada/Estimada Pelo Entrevistador*

***(21)** Indústria:*

(22) Salários:

(23) O que determina como e quando trabalha- objetivo: tempo/renda/ esforço

Parar o tempo quando eles disserem que terminaram. Registrar as respostas (30).

Você completou **(27)**_____cartelas. Assim, a **(24) 20 centavos** por cartela, da **R$(28)** _____ em pagamento.

Agora vamos jogar a moeda. Se der cara, eu pagarei a você o valor de **R$(28)**_____ que você ganhou. Se der coroa, eu lhe pagarei **(25)R$6,00**.

Você gostaria de verificar a moeda? *Deixe o participante examinar a moeda e trocá-la por outra se reclamar. Lançar a moeda e pagar ao participante o que ele ganhou da atividade.*

Acompanhamento:

Parabéns pelo que você ganhou **R$(29)**_____.

Se você não se importa em que eu pergunte, por que você parou na **(27)**_____ cartela na atividade2?

(32) Por que parou?
NÃO LEIA AS ALTERNATIVAS. Resposta espontânea e múltipla.

- ○ Entediado
- ○ Cansado
- ○ Sem material
- ○ Interrompido
- ○ Teve que fazer outra coisa - trabalhar
- ○ Teve que fazer outra coisa - algo diverso de trabalho
- ○ A quantidade minima de dinheiro que posso ganhar e suficiente
- ○ Livrar-se do risco no sorteio
- ○ Não gosta de se arriscar/não faz apostas
- ○ Sorte
- ○ Deus
- ~~○ Mesmas cartelas da última vez~~
- ~~○ Menos cartelas que da última vez~~
- ~~○ Mais cartelas que da última vez~~
- ~~○ Mesma quantidade de tempo da última vez~~
- ~~○ Menos tempo que da última vez~~
- ~~○ Mais tempo que da última vez~~
- ○ Outra pessoa, especificar:
- ○ Outro, especificar:

(33) Voce sabe o que vai fazer com o seu premio? Sim/Nao/NR

(34) O que vai fazer com o seu premio?

Nós finalizamos! Como mencionei no início, há uma chance de eu voltar para fazer essa atividade novamente no futuro. Muito obrigado(a) pelo seu tempo!

Registrar (7): Hora do término

Sessão 2 - Ficha de Dados

(1) Nome:

(2) Idade:

(3) Localização:

(4) Data:

(5) Dia da semana:

(6) Hora de início:

(7) Hora do término:

(8) Sessão #:

(9) Recusou-se, e razão:

Atividade 1:
(10) w:

(11) Cartelas tentadas:

(12) Cartelas completadas:

(13) Pago: R$

(14) Comentários:

~~Possui trabalho remunerado?~~
~~(15) Sim / Não / NR~~
~~(16) Informada/Estimada Pelo Entrevistador~~
~~Trabalha em casa?~~
~~(17) Sim / Não / NR~~
~~(18) Informada/Estimada Pelo Entrevistado~~
~~Salário por peça?~~
~~(19) Sim / Não / NR~~
~~(20) Informada/Estimada Pelo Entrevistado~~
~~(21) Indústria:~~
~~(22) Salários:~~
~~O que determina como e quando trabalha-objetivo:~~
~~(23) tempo/renda/ esforço~~

Atividade 2:
(24) w:
(25) pf:

(26) Cartelas tentadas:

(27) Cartelas completadas:

(28) **w** x Cartelas completadas: R$

(29) Pago: R$

(30) Duração de tempo: min seg

(31) Comentários:

(32) Por que parou?
Resposta espontânea e múltipla.

- ○ Entediado
- ○ Cansado
- ○ Sem material
- ○ Interrompido
- ○ Teve que fazer outra coisa - trabalhar
- ○ Teve que fazer outra coisa - algo diverso de trabalho
- ○ A quantidade minima de dinheiro que posso ganhar e suficiente
- ○ Livrar-se do risco no sorteio
- ○ Não gosta de se arriscar/não faz apostas
- ○ Sorte
- ○ Deus
- ○ Mesmas cartelas da última vez
- ○ Menos cartelas que da última vez
- ○ Mais cartelas que da última vez
- ○ Mesma quantidade de tempo da última vez
- ○ Menos tempo que da última vez
- ○ Mais tempo que da última vez
- ○ Outra pessoa, especificar:
- ○ Outro, especificar:

(33) Voce sabe o que vai fazer com o seu premio?
Sim/Nao/NR
(34) O que vai fazer com o seu premio?

(35) Lisa estava presente na:
Resposta múltipla.

- ○ Introdução
- ○ Atividade 1
- ○ Atividade 2
- ○ Cara/Coroa

Introdução

Aproximar-se do participante trazendo um envelope da sessão 2, verificar se o formulário foi atualizado com os resultados de pagamento da última sessão, uma caneta para registrar respostas, uma prancheta para ser usada como superfície de trabalho, um cronômetro e um recipiente cheio de moedas para facilitar o troco.

Olá novamente! Nós da Universidade de Toronto estamos aqui para estudar como as pessoas respondem a incentivos monetarios. Nós gostaríamos que você participasse de duas simples atividades em que você pode ganhar dinheiro por cada tarefa que completar. Você será pago em dinheiro ao final de cada atividade.

Você se lembra da atividade? A tarefa é simples. – *Enquanto estiver demonstrando*- Você simplesmente tem que cobrir os pontos pretos desta cartela com estes adesivos. Para participar, nós somente precisamos de alguns minutos do seu tempo, mas se você quiser participar por mais tempo com a oportunidade de ganharmais dinheiro, você também pode.

Assim como antes, esta sessão consistirá em duas atividades em que você ganhará dinheiro. Nós vamos lhe pagar pelo seu esforço e pelo seu tempo. Você não tem que nos dar nada.

A primeira atividade vai durar 4 minutos e nós pediremos que você complete quantas cartelas você quiser dentro desse tempo. Nós vamos dar a você R**$0,05** por cada cartela completada.
A segunda atividade não tem hora para acabar, a sua duracao vai depender de você: se quer participar por menos ou mais tempo. Isso envolve repetir a mesma atividade, embora a cada repeticao, o pagamento será diferente. Vamos-lhe explicar quando começarmos.

Existem 240 pessoas (incluindo você) no nordeste do Brasil que serão chamadas para participar destas atividades. Todas elas foram recrutadas da mesma forma que você e elas também receberam as mesmas instruções. – *Considerar dar essa informação quando (i) for questionado por uma pessoa sobre como você a escolheu ou (ii) enquanto se conversa durante as atividades. Certificar-se de que essa informação é mencionada, mas não há problema em deixá-la surgir naturalmente.*

Da última vez que jogamos juntos, você ganhou **(S1-13)**_____ na primeira atividade e **(S1-29)**_____ na segunda e levou aproximadamente **(S1-7 – S1-6)**_____ minutos no total.

Você quer participar? Se sim, lembre-se, você pode desistir a qualquer momento.

Se não, perguntar por quê? Se for algo que você possa assegurar a eles não ser um problema (ex. Isso é legal e nós não vamos tirar nenhum dinheiro de vocês), tentar.

Se for pelo fato deles estarem muito ocupados, perguntar qual seria um melhor momento para voltar lá. Remarcar um dia para retornar. Registrar a hora que você esteve lá e o porquê deles estarem ocupados.

Atividade 1

Essa atividade é exatamente igual a da última vez!

Para esta atividade, você terá 4 minutos para completar quantas cartelas você quiser. Ao final dos 4 minutos, nós vamos contar o número de cartelas que você completou e lhe daremos **(10) 5 centavos** por cada cartela finalizada.

*Registrar **(1)-(6) & (8)** durante os 4 minutos*

Indicar ao participante o quanto ele já ganhou.

Parabéns!

Você completou **(12)**_____cartelas e então ganhou $ **(13)**_____**.**

*Pagar ao participante o que ele ganhou. Registrar os dados e qualquer comentário na ficha de dados **(10)-(14).***

Atividade 2

- Essa atividade é exatamente igual a da última vez!
- Essa atividade é exatamente igual a que fizemos da última vez também!

Esta atividade levará quanto tempo você quiser. Nesta atividade, queremos que você faça a mesma tarefa – colocando adesivos nos pontos pretos, mas nós lhe pagaremos de modo um pouco diferente.

No final da atividade, quando você tiver decidido que já completou cartelas suficientes, nós iremos jogar uma moeda. Se a moeda der cara, nós vamos pagar a você **(24)R$0.20** por cada cartela completada. Se der coroa, nós lhe pagaremos **(25)R$6,00**, não importa quantas cartelas você tenha completado.

Se voce nao completar nehuma cartela, nós iremos jogar uma moeda nesse mesmo instante e você terá uma chance igual de ganhar **R$6,00** ou nada. Ou, você pode trabalhar até ter completado **80** cartelas e então, nós jogaremos a moeda e tera chance igual de ganhar **R$6** ou **R$16**. Ou ainda, você pode optar por completar qualquer número de cartelas dentro do seu tempo. Vai depender totalmente de você.

Só para lembrar, da última vez você completou **(S1-27)**_____ cartelas em **(S1-30)**_____ minutos, e assim seus ganhos acumulados foram no valor de **(S1-28)**_____**,** porque seu salário foi somente (também) de **(S1-24)R$0.20**/cartela da última vez. Quando jogamos a moeda, você ganhou de nós **(S1-29)**_____**.**

Eu vou iniciar o cronômetro agora, e você me diz quando tiver terminado de completar as cartelas
Iniciar o tempo -- Parar o tempo quando eles disserem que terminaram (30).

Você completou **(27)**_____cartelas. Assim, a **(24) 20 centavos** por cartela, da **R$(28)** _____ em pagamento.

Agora vamos jogar a moeda. Se der cara, eu pagarei a você o valor de **R$(28)**_____ que você ganhou. Se der coroa, eu lhe pagarei **R$6**.

Você gostaria de verificar a moeda? *Deixe o participante examinar a moeda e trocá-la por outra se reclamar. Lançar a moeda e pagar ao participante o que ele ganhou da atividade*

Acompanhamento: Parabéns pelo que você ganhou **R$(29)**_____.

Se você não se importa em que eu pergunte, por que você parou na **(27)**_____ cartela na atividade2?
*NÃO LEIA AS ALTERNATIVAS. Resposta espontânea e múltipla. Registrar as respostas **(32).***

- ○ Entediado
- ○ Cansado
- ○ Sem material
- ○ Interrompido
- ○ Teve que fazer outra coisa - trabalhar
- ○ Teve que fazer outra coisa - algo diverso de trabalho
- ○ A quantidade minima de dinheiro que posso ganhar e suficiente
- ○ Livrar-se do risco no sorteio
- ○ Não gosta de se arriscar/não faz apostas
- ○ Sorte
- ○ Deus
- ○ Mesmas cartelas da última vez
- ○ Menos cartelas que da última vez
- ○ Mais cartelas que da última vez
- ○ Mesma quantidade de tempo da última vez
- ○ Menos tempo que da última vez
- ○ Mais tempo que da última vez
- ○ Outra pessoa, especificar:
- ○ Outro, especificar:

Registrar as respostas.

(33) Voce sabe o que vai fazer com o seu premio? Sim/Nao/NR

(34) O que vai fazer com o seu premio?

Nós finalizamos! Essa foi definitivamente a última vez que nós precisamos da sua ajuda com o projeto. Muito obrigado(a) pelo seu tempo.

Enumerator Script in English

Session 1

Introduction

Approach the participant bringing the Session 1 envelope, a pen to record answers, a lap board for a working surface, the counter, and a container full of change.

Hello, We are from the University of Toronto and we are here to study effort responses to incentives. We'd like you to participate in two simple activities where you can earn money for every task you complete. You will be paid in cash at the end of each activity.

The task is simple. *-While demonstrating-* You simply have to cover the black dots on this card with these stickers. To participate we only need 10 minutes of your time, but if you want to participate for longer and potentially earn more money, you can do so.

This session will consist of two activities where you will earn money. The activities seem like a simple game, but it's more like a simple job because there are no risks at all. We will pay you for your effort and your time. You will not have to give us anything.

The first activity will take 4 minutes and you will be asked to complete as many tasks as you would like within that period. You will be paid **$0.10** for every task you complete.

The second activity has an open ended time period – how little or how much time you want to devote to it is up to you. It involves doing the same task again, but your payment will be different. We can explain when we start.

There are 300 people (including yourself) in the Northeast of Brazil that will be asked to participate in these activities. They have all been recruited in the same way as you and they have all been given the same instructions. We will return at least 30 of these people in the future to ask them to participate in these activities a second time. – *Consider leaving this information for when (i) questioned by a person how you chose them or (ii) chatting during the tasks. Make sure this is mentioned, but it is okay to let it come up organically*

Do you want to participate? If yes, remember, you can quit at anytime.

If no, ask why. If it is something you can assure them isn't a problem (ie. this is legal and we will not take any money from them), try.

If it is because they are too busy, ask what would be a better time to return and plan to return. Record the time you are there and why they were busy.

FHWLWL 2

Data Sheet

Sbjnum:

Name:

Age:

Location:

Date:

Day of week:

Time Start:

Time End:

Session #:

Declined, and reason:

Activity 1:

w: $0.10

Tasks Attempted:

Tasks Completed:

Paid:

Comments:

Activity 2:

w: $0.20

F: $7.50

Tasks Attempted:

Tasks Completed:

Duration in time: min sec

Paid:

Why stop when did?:

Comments:

FHWLWL 3

Activity 1

For this activity, you will have 4 minutes to complete as many cards as you would like. At the end of the 4 minutes, we will count up the number of cards you have completed and I will give you **$0.10** for every completed card.

Use the counter system to indicate to the participant how much they have earned.

Congratulations!

You completed _____ cards and so you have earned $_____.

*Pay the participant their winnings. Record the number of tasks completed, the number of tasks attempted, **w**, total amount paid, and any additional comments (including, but not limited to, if there was anyone else present while they completed the tasks, etc) on data sheet.*

Activity 2

The second activity will take as much or as little time as you would like. In this activity, we want you to do the same task – putting stickers on the black dots, but we will pay you a little differently.

At the end of the activity, whenever you have decided you have done enough cards, we will flip a coin. If the coin comes up heads, we will pay you **$0.20** for every card completed. If it comes up tails, we will pay you **$7.50** no matter how many cards you completed.

So, if you do no cards at all, then we will flip a coin right now and you have a 50/50 chance of getting **$7.50** or nothing. Or, you can work until there you've done **50** cards and so we'd flip the coin and it's a 50/50 chance of getting **$7.50** or **$10**. Or, you can choose to do any number of cards in between. It's totally up to you.

I'm going to start the timer now, and you let me know when you are done completing cards.

Start timer.

Use the same counter to count completed cards so they have a running total of how much money they can earn.

*Leave the **R$7.50** out with the coin you will flip.*

End timer when they say they are done.

You have completed _____cards. So at **$0.20** per card, that is $_____ in payment.

Now lets flip this coin. If it comes up heads, I will pay you the $_____ you earned. If it comes up tails, I will pay you the **R$7.50**.

Would you like to examine the coin? *Let the participant examine the coin and switch it for another coin if they complain. Flip coin and pay the participant their winnings.*

Follow up: Congrats on your winnings. If you don't mind my asking, why did you stop at _____ cards in activity 2?

Record answers.

We are done! As I mentioned at the beginning, there is a chance I will be back to play this task again in the future. Thank you for your time!

Session 2

Introduction

Approach the participant bringing the Session 2 envelope (check that the form has been updated with the payment results from the last Session, a pen to record answers, a lap board for a working surface, the counter, and a container full of change.

Hello again! We are back! We are still from the University of Toronto and we are here to study effort responses to incentives. We'd like you to participate in the same two simple activities, just like last week, where you can earn money for every task you complete. Again, You will be paid in cash at the end of each activity.

Do you remember the simple task? *-While demonstrating-* You simply have to cover the black dots on this card with these stickers. To participate we only need 10 minutes of your time, but if you want to participate for longer and potentially earn more money, you can do so.

This session will also consist of two activities where you will earn money. The activities seem like a simple game, but it's more like a simple job because there are no risks at all. We will pay you for your effort and your time. You will not have to give us anything.

Last time we played together, you earned _____ in the first activity and _____ in the second and it took about _____minutes in total.

Do you want to participate?

If no, ask why. If it is something you can assure them isn't a problem (ie. this is legal and we will not take any money from them), try.

If it is because they are too busy, ask what would be a better time to return and plan to return. Record the time you are there and why they were busy.

FHWLWL 6

Data Sheet

Sbjnum:

Name:

Age:

Location:

Date:

Day of week:

Time Start:

Time End:

Session #:

Declined, and reason:

Activity 1:

w: $0.10

Tasks Attempted:

Tasks Completed:

Paid:

Comments:

Activity 2:

w: $0.50

F: $7.50

Tasks Attempted:

Tasks Completed:

Duration in time: min sec

Paid:

Why stop when did?:

Comments

FHWLWL 7

Activity 1

This activity is the exact same as last time!

For this activity, you will have 4 minutes to complete as many cards as you would like. At the end of the 4 minutes, we will count up the number of cards you have completed and I will give you **$0.10** for every completed card.

Use the counter system to indicate to the participant how much they have earned.

Congratulations! You completed _____ cards and so you have earned $_____.

*Pay the participant their winnings. Record the number of tasks completed, the number of tasks attempted, **w**, total amount paid, and any additional comments (including, but not limited to, if there was anyone else present while they completed the tasks, etc).*

Activity 2

This activity is just like last time too!

This activity will take as much or as little time as you would like. In this activity, we want you to do the same task – putting stickers on the black dots, but we will pay you a little differently than we did in activity 1.

At the end of the activity, whenever you have decided you have done enough cards, we will flip a coin. If the coin comes up heads, we will pay you **$0.50** for every card completed. If it comes up tails, we will pay you **$7.50** no matter how many cards you completed.

So, if you do no cards at all, then we will flip a coin right now and you have a 50/50 chance of getting **$7.50** or nothing. Or, you can work until there you've done **50** cards and so we'd flip the coin and it's a 50/50 chance of getting **$7.50** or **$25.** Or, you can choose to do any number of cards in between. It's totally up to you.

As a reminder Last time, you completed _____ cards in _____ minutes, and so your accumulated earnings were _____, because your wage was only **$0.20**/card last time. When we flipped the coin, you were paid _____.

I'm going to start the timer now, and you let me know when you are done completing cards.

Start timer. / Use the same counter to count completed cards so they have a running total of how much money they can earn. / End timer when they say they are done.

You have completed _____cards. So at **$0.50** per card, that is $_____ in payment.

Now lets flip this coin. If it comes up heads, I will pay you the $_____ you earned. If it comes up tails, I will pay you the **$7.50**.

Would you like to examine the coin? *Let the participant examine the coin and switch it for another coin if they complain*

Flip coin and pay the participant their winnings.

Record on the data sheet

Follow Up: Congrats on your winnings. If you don't mind my asking, why did you stop at _____ cards in activity 2?

Record answers.

We are done! This is definitely the last time we will need your help on this project. Thanks for your time.

Materials From Pilot at the University of Toronto

3.1. Session 1

3.1.a. Materials:

Each participant has a file folder. This folder contains envelopes for Session 1 and Session 2.

Session 1 envelope contains:

- Label saying the individual's name, sex, location, and rough age
- The data collection sheet with the *Name, age, sbjnum* prerecorded
- 30 sheets for Activity 1
- 40 sheets for Activity 2 if f = R$2
- 70 sheets for Activity 2 if f = R$5
- 10 sheets of stickers if f = R$2
- 25 sheets of stickers if f = R$5

3.1.b. Introduction

Approach the participant bringing the Session 1 envelope, a pen to record answers, a lap board for a working surface, the counter, and a container full of change.

Hello, We are from the University of Toronto and we are here to study effort responses to incentives. We'd like you to participate in two simple activities where you can earn money for every task you complete. You will be paid in cash at the end of each activity.

The task is simple. *-While demonstrating-* You simply have to cover the black dots on this card with these stickers. To participate we only need 10 minutes of your time, but if you want to participate for longer and potentially earn more money, you can do so.

This session will consist of two activities where you will earn money. The activities seem like a simple game, but it's more like a simple job because there are no risks at all. We will pay you for your effort and your time. You will not have to give us anything.

The first activity will take 4 minutes and you will be asked to complete as many tasks as you would like within that period. You will be paid R$$\mathbf{w_1}$ for every task you complete.

The second activity has an open ended time period – how little or how much time you want to devote to it is up to you. It involves doing the same task again, but your payment will be different. We can explain when we start.

There are 300 people (including yourself) in the North East of Brazil that will be asked to participate in these activities. They have all been recruited in the same way as you and they have all been given the same instructions. We will return at least 30 of these people in the future to ask them to participate in these activities a

second time. – *Consider leaving this information for when (i) questioned by a person how you chose them or (ii) chatting during the tasks. Make sure this is mentioned, but it is okay to let it come up organically*

Do you want to participate? If yes, remember, you can quit at anytime.

If no, ask why. If it is something you can assure them isn't a problem (ie. this is legal and we will not take any money from them), try.

If it is because they are too busy, ask what would be a better time to return and plan to return. Record the time you are there and why they were busy.

3.1.c. Activity 1

For this activity, you will have 4 minutes to complete as many cards as you would like. At the end of the 4 minutes, we will count up the number of cards you have completed and I will give you R$**$w_1$** for every completed card.

Use the counter system to indicate to the participant how much they have earned.

Congratulations! You completed _____ cards and so you have earned R$_____.

*Pay the participant their winnings. Record the number of tasks completed, the number of tasks attempted, **w**, total amount paid, and any additional comments (including, but not limited to, if there was anyone else present while they completed the tasks, etc).*

3.1.d. Activity 2

The second activity will take as much or as little time as you would like. In this activity, we want you to do the same task – putting stickers on the black dots, but we will pay you a little differently.

At the end of the activity, whenever you have decided you have done enough cards, we will flip a coin. If the coin comes up heads, we will pay you **R$2x$w_1$** for every card completed. If it comes up tails, we will pay you **R$$F_1$** no matter how many cards you completed.

So, if you do no cards at all, then we will flip a coin right now and you have a 50/50 chance of getting **R$$F_1$** or nothing. Or, you can work until there you've done **MAX#CARDS$_1$** cards and so we'd flip the coin and it's a 50/50 chance of getting **R$$F_1$** or **R$(2 x w_1 x MAX#CARDS$_1$)**. Or, you can choose to do any number of cards in between. It's totally up to you.

I'm going to start the timer now, and you let me know when you are done completing cards.

Start timer.

Use the same counter to count completed cards so they have a running total of how much money they can earn.

*Leave the **R$F** out with the coin you will flip.*

End timer when they say they are done.

You have completed _____cards. So at **R$2xw$_1$** per card, that is R$_____ in payment.

Now lets flip this coin. If it comes up heads, I will pay you the R$_____ you earned. If it comes up tails, I will pay you the **RF_1$**.

Would you like to examine the coin? *Let the participant examine the coin and switch it for another coin if they complain*

Flip coin and pay the participant their winnings.

Record the number of tasks completed, the number of tasks attempted, $2w_1$, F_1, total amount paid, and any additional comments (including, but not limited to, if there was anyone else present while they completed the tasks, etc).

3.1.e. Follow up

Congrats on your winnings. If you don't mind my asking, why did you stop at _____ cards in activity 2?

Record answers.

We are done! As I mentioned at the beginning, there is a chance I will be back to play this task again in the future. Thank you for your time!

*Record the results of this Session 1 on the information sheet for Session 2. This includes what **F** and **w** were (it should already be there and be correct), the two potential payments from Activity 2 and the payment from Activity 1 and the amount of time you spent with the participant.*

3.2 Session 2

3.2.a. Materials:

Each participant has a file folder. This folder contains envelopes for session 1 and session 2

Session 2 envelope contains:

- Label saying the individual's name, sex, location, and rough age
- The data collection sheet with the *Name, age, sbjnum* prerecorded
- Record of the conditions of Session 1
- 30 sheets for Activity 1
- 40 sheets for Activity 2 if f = R$2
- 70 sheets for Activity 2 if f = R$5
- 10 sheets of stickers if f = R$2
- 25 sheets of stickers if f = R$5

3.2.b. Introduction

Approach the participant bringing the Session 2 envelope (check that the form has been updated with the payment results from the last Session, a pen to record answers, a lap board for a working surface, the counter, and a container full of change.

Hello again! We are back! We are still from the University of Toronto and we are here to study effort responses to incentives. We'd like you to participate in the same two simple activities, just like last week, where you can earn money for every task you complete. Again, You will be paid in cash at the end of each activity.

Do you remember the simple task? *-While demonstrating-* You simply have to cover the black dots on this card with these stickers. To participate we only need 10 minutes of your time, but if you want to participate for longer and potentially earn more money, you can do so.

This session will also consist of two activities where you will earn money. The activities seem like a simple game, but it's more like a simple job because there are no risks at all. We will pay you for your effort and your time. You will not have to give us anything.

Last time we played together, you earned _____ in the first activity and _____ in the second and it took about _____minutes in total.

Do you want to participate?

If no, ask why. If it is something you can assure them isn't a problem (ie. this is legal and we will not take any money from them), try.

If it is because they are too busy, ask what would be a better time to return and plan to return. Record the time you are there and why they were busy.

3.2.c. Activity 1

This activity is the same as last time!

For this activity, you will have 4 minutes to complete as many cards as you would like. At the end of the 4 minutes, we will count up the number of cards you have completed and I will give you R$$\mathbf{w_2}$ for every completed card.

Use the counter system to indicate to the participant how much they have earned.

Congratulations! You completed _____ cards and so you have earned R$_____.

*Pay the participant their winnings. Record the number of tasks completed, the number of tasks attempted, **w**, total amount paid, and any additional comments (including, but not limited to, if there was anyone else present while they completed the tasks, etc).*

3.2.d. Activity 2

This activity is just like last week's activity too!

The second activity will take as much or as little time as you would like. In this activity, we want you to do the same task – putting stickers on the black dots, but we will pay you a little differently.

At the end of the activity, whenever you have decided you have done enough cards, we will flip a coin. If the coin comes up heads, we will pay you **R$2xw$_2$** for every card completed. If it comes up tails, we will pay you **RF_2$** no matter how many cards you completed.

So, if you do no cards at all, then we will flip a coin right now and you have a 50/50 chance of getting **RF_2$** or nothing. Or, you can work until there you've done **MAX#CARDS$_2$** cards and so we'd flip the coin and it's a 50/50 chance of getting **RF_2$** or **R$(2 x w$_2$ x MAX#CARDS$_2$)**. Or, you can choose to do any number of cards in between. It's totally up to you.

I'm going to start the timer now, and you let me know when you are done completing cards.

Start timer.

Use the same counter to count completed cards so they have a running total of how much money they can earn.

*Leave the **RF_2$** out with the coin you will flip.*

End timer when they say they are done.

You have completed _____cards. So at **R$2xw$_2$** per card, that is R$_____ in payment.

Now lets flip this coin. If it comes up heads, I will pay you the R$_____ you earned. If it comes up tails, I will pay you the **RF_2$**.

Would you like to examine the coin? *Let the participant examine the coin and switch it for another coin if they complain*

Flip coin and pay the participant their winnings.

*Record the number of tasks completed, the number of tasks attempted, **2w, F,** total amount paid, and any additional comments (including, but not limited to, if there was anyone else present while they completed the tasks, etc).*

3.2.e. Follow up

Congrats on your winnings. If you don't mind my asking, why did you stop at _____ cards in activity 2?

Record answers. Record any additional comments on the data sheet.

We are done! This is definitely the last time we will need your help on this project. Thanks for your time.

4. Data Sheet

Sbjnum: *Prefilled*

Name: *Prefilled*

Age: *Prefilled*

Location: *Prefilled*

Date:

Day of week:

Time Start:

Time End:

Session #: *Prefilled*

Declined, and reason:

Activity 1:

w: *Prefilled*

Tasks Attempted:

Tasks Completed:

Paid:

Comments:

Activity 2:

w: *Prefilled*

F: *Prefilled*

Tasks Attempted:

Tasks Completed:

Duration in time: min sec

Paid:

Why stop when did?:

Comments:

Project Time line

- Research site identified & population selected (October 2013)
- Exploratory interviews of population in Brazil (November 2013)
- Instrument design finalized & development of protocol (January 2014)
- Approval from Ethics Committees (March – April 2014)
- Piloting with University of Toronto undergraduate students (April 2014)
- Treatment assignment & sample selection from identified population (May 2014)
- Materials Acquisition (June 2014)
- Data Analysis Plan (June 2014)
- On-site enumerator hiring and training (July 2014)
- On-site instrument piloting (July 2014)
- On-site data collection (July–September 2014)
- Data analysis (September–December 2014)
- Draft paper and present findings (January 2015–December 2017)