Do the objectives of firms reflect the psychologies of owners? Evidence of loss averse firms in a competitive industry

Julian Emami Namini and Sacha Kapoor*

March 1, 2023

Abstract

The behavioral theory of the firm has long recognized the importance of losses for the participation of firms. But then how credible is the assumption of symmetric weights on gains and losses in owner preference and ultimately the objective of the firm? We put forth three distinct pieces of evidence supporting the argument that the objective of the small firm reflects loss averse preferences of prospect theory rather than vNM preferences of expected utility theory. We present survey evidence of loss averse owners, whose loss aversion increases with experience, and whose firms are 18-21 percentage points *less* likely to exit after five years. We next use market level data to establish the manifestation of loss aversion in market equilibrium more broadly, showing firm behavior is more loss averse for small firms, during recessions, and in politically conservative states. Finally, We use insider data to show firm behavior is loss averse at small scale but loss neutral at large scale. Loss averse behavior cannot be attributed solely to differences across firms, therefore.

JEL: D22, L21, L83

Keywords: Profit Maximization, Loss Aversion

*Emami Namini (emaminamini@ese.eur.nl), Kapoor (kapoor@ese.eur.nl): Erasmus University Rotterdam, Erasmus School of Economics, Burgemeester Oudlaan 50, 3062 PA Rotterdam, The Netherlands. We thank Georgios Angelis, Suzanne Bijkerk, Han Bleichrodt, Robert Dur, Aksel Erbahar, Jonathan Hall, Arvind Magesan, Robert Oxoby, Ivan Png, Vincent Rebeyrol, Laura Rondi, Dirk Schindler, Dana Sisak, Otto Swank, and Dinand Webbink for valuable comments. The paper has benefited from excellent research assistance by Willem-Pieter Looijen, Marit van Staveren, and Kelly Winters. All omissions and errors are our own.

Losses have always played a central role in the behavioral theory of the firm. Under the neoclassical paradigm, competitive firms operate on the margin between gains and losses, where potential entrants stay out because of the prospect of loss, and where adverse demand or supply shocks generate losses that can cause incumbents to exit [Marshall, 1920]. In evolutionary economics firms can survive without maximizing profits, by charging the lowest prices while covering costs, but cannot survive with losses [Alchian, 1950]. The neoclassical paradigm has been foundational for several academic literatures, including a macroeconomic literature on aggregate implications of firm behavior, and an industrial organization literature that relies on structural models for measurement. The evolutionary paradigm has been used to explain the survival of large businesses that separate claims to residual cash flows from control over decisions that affect cash flow risk [Fama and Jensen, 1983], and helped spawn an enormous literature relating to the separation of ownership from control.

The importance of losses for firm behavior in these theories begs questions about the credibility of an objective - profit - that weighs gains and losses symmetrically, especially for small firms that tightly integrate ownership and control, often within a single individual. If owners are active in business decisions and guided by preference maximization, then the objective of the firm should reflect the preferences of the owner. But if losses are so important, these preferences may weigh losses more heavily than equivalent gains and, by implication, so too may the objective of the firm. In these regards, the importance of losses begs the more specific question of *which* preferences are reflected in this objective: vNM preferences of expected utility theory or loss averse preferences of prospect theory. In this study, We contend the objective of the small firm is grounded in the loss averse preferences of prospect theory.[1]

Our venue for testing this contention is the restaurant industry. The industry is a useful testing ground for several reasons. First, for many owners, preferences are a significant determinant of the ownership decision. Ownership reflects non-pecuniary advantages such as menu development and autonomy that can and likely do induce many owners to accept a lower wage relative to their outside option.[2] Second, local market structures are incubators for

[1] The explanatory power of loss aversion for anomalies in firm behavior has been considered theoretically. It has been used by Herweg [2013], for example, to rationalize laboratory evidence of behavioral deviations from risk neutral profit maximization in inventory problems [Schweitzer and Cachon, 2000]. Angelis [2021] has used it to microfound price stickiness among price-setters, a key ingredient in theoretical models of the macroeconomy.

[2] Hamilton [2000] shows entrepreneurs tend to earn less than they would have in paid employment. Benz and Frey [2004] show entrepreneurs are happier than subordinate employees because of autonomy, despite earning less money. Hurst and Pugsley [2011] show approximately half of new business owners cite nonpecuniary motives relating to flexibility or control. 34 percent cite income generation as the primary motive.

preference maximization. These markets are full with producers of horizontally and vertically differentiated goods. Product differentiation can generate market power even if the local market is highly competitive. Market power enables departures from profit maximization. Third, owner preference plausibly manifests in routine as well as more deliberate decisions because active participation is normal behavior for many owners. Fourth, the industry can engender loss aversion among owners or influence their selection. Characteristically high chances of exit can engender fear or anxiety relating to failure, a fear that has been conceptualized as a form of loss aversion [Morgan and Sisak, 2016]. The prospect of loss can deter entry and promote exit, or vice versa, as We illustrate in Section 3.

We put forth three distinct pieces of evidence in support of an objective grounded in loss aversion. We survey firms in the Netherlands to measure loss aversion directly. We use county level aggregates from the United States to look for the manifestation of loss aversion in market equilibrium. We use insider data from a Canadian retail chain to look for the manifestation of loss aversion in day to day decisions. We will show the three datasets yield comparable loss aversion estimates despite yielding measurements at different levels of aggregation and despite being generated in different countries.[3]

The surveys were administered via personal interviews to ensure questions were answered by owners themselves rather than by their assistants. We used the Abdellaoui et al. [2016] method to elicit loss aversion around zero, a natural and exogenous reference point for firms in highly competitive markets. A loss aversion coefficient greater than 1 implies loss aversion, equal to 1 implies loss neutrality, and less than 1 implies gain seeking. We show the mean owner has a loss aversion coefficient of 10.1, implying they weigh losses 10.1 times more than gains. The median is 1.6, commensurate though slightly smaller than lab medians for university students [Abdellaoui et al., 2016]. The mean-median discrepancy in our setting implies the existence of some very loss averse owners. 74 percent have loss aversion coefficients greater than 1. 30 percent have coefficients above 3.

We correlate owner loss aversion with their perception of the price elasticity of demand, propensity for risk taking, industry experience, etc. Most correlations are statistically insignificant. The lone statistically significant and robust correlation is with industry experience - more experienced owners are more loss averse. A positive correlation aligns with the

[3] We use datasets at three levels of aggregation because we want to learn whether loss aversion was endemic to the industry. We use datasets from three countries because they were the best datasets we could obtain for the industry at these three levels of aggregation. From this last perspective, any variation in loss aversion estimates across contexts may reflect technological or institutional differences across countries.

environment engendering loss aversion or attracting loss averse owners.[4]

We estimate the effect of owner loss aversion on the exit probability of the firm. The firm of a loss averse owner is 18-21 percentage points less likely to exit after approximately five years (mean=0.28), relative to the firm of a gain-seeking or loss neutral owner. The estimate suggests owner loss aversion is important for firm selection.

With the survey in mind, we turn to the market data. We use the Melitz [2003] model of monopolistic competition model for closed economies to establish a relationship between the number of firms in equilibrium and gains and losses. We exploit the highly localized nature of the industry to estimate the relationship using payroll aggregates from U.S. counties, and find implied loss aversion ranges from 1.87 and 2.91, supporting the manifestation of loss aversion in market equilibrium. While to our knowledge there is no benchmark for market level estimates, the estimates are commensurate with our survey estimates and insider evidence from this and other studies.

We inspect variation across firms of different sizes, over time, and across states. We find evidence of loss aversion for small but not large firms. Firm behavior becomes more loss averse around the internet bubble collapse and Great Recession, consistent with a heightened fear of failure during economic recessions. Firm behavior is more loss averse in politically conservative states, consistent with the aversion to change and attachment to traditional values which define conservatism.[5]

A key question relates to whether the empirical patterns reflect unobserved constraints of firms rather than preference heterogeneity. For instance, small firms may weigh losses more heavily than equivalent gains because they are more credit constrained and susceptible to exit. More weight on losses during recessions may then reflect heightened scarcity of credit. More weight on losses in conservative states may reflect scarcity of government assistance. To speak to this concern, we look for the manifestation of loss aversion in firm behavior using high frequency insider data. The insider data is useful because it holds fixed across firm differences such as credit constraints.[6]

In these businesses worker hours are not predetermined. End times are under owner discretion and depend on their expectations concerning consumer demand later in a shift. We model this intensive margin labor demand decision structurally as an optimal stopping

[4] Engendered loss aversion aligns with experience fostering bias [Griffin and Tversky, 1992, Rabin, 1998].

[5] The correlations are not obvious *ex ante*. Failure may be more normal during recessions, leading to behavior which is *less* loss averse. A similar argument can be made for failure in conservative states.

[6] One can debate the relevance of the distinction between apparent loss aversion due to resource constraints and "true" loss aversion. The distinction may be secondary if the goal is a descriptive representation of the firm's objective function. See footnote 5 of [Herweg and Schmidt, 2014] for a related discussion.

problem following Crawford and Meng [2011], where the firm can exhibit loss averse behavior in the revenue or cost domain, and where reference points vary dynamically with coworker averages or together with static reference points from the same day last week or year.

We show evidence of loss aversion with respect to costs but not revenues. In fact the weight on costs in the stopping problem is 71 times the weight on revenue. The benchmark loss aversion parameter for costs is 2.55. The loss aversion estimate from our stopping problem is commensurate with the state of the art for taxi drivers [Thakral and Tô, 2021], which equals 2.03 and 2.62 with and without adaptive learning.

Firm behavior becomes less loss averse, even loss neutral, when the scale of production increases. This suggests loss averse behavior cannot be explained by across firm differences alone. We consider potential explanations, focusing in particular on managerial team size.

This study contributes to a literature which examines the assumption that firms maximize profit empirically. Most studies look for departures from profit maximization [Byrne, 2015, Hortaşçu and Puller, 2008, Levitt, 2006, Massey and Thaler, 2013, Sweeting, 2012], by comparing marginal benefits and costs,[7] with some detecting more significant departures in small firms [Byrne, 2015, Hortaşçu and Puller, 2008]. Recent work has identified specific anomalies in firm behavior, relating to the adoption of management techniques [Bloom et al., 2013], technology [Atkin et al., 2017], or uniform pricing [Cho and Rust, 2010, Dellavigna and Gentzkow, 2019, Kapoor, 2020]. Much of this work has based explanations for the anomalies on indirect evidence. The present study combines direct (survey) and indirect (market-based and insider) evidence. It moves beyond documenting departures from profit maximization towards a descriptive representation of the objective function of the firm.

The survey evidence is related to Liu [2014], who measures risk and loss aversion among Chinese farmers, and documents the predictive power for agricultural technology adoption. We document loss averse firm behavior in an arguably more developed context and explore the relationship to experience, firm survival, and labor demand. The connection between firm survival and loss aversion complements Goldfarb and Yang [2009] and Goldfarb and Xiao [2011], which structurally estimate strategic thinking or ability by managers and document positive correlations with subsequent survival and performance, or by Aguirregabiria and Magesan [2020], which allows for biased assessments of strategic uncertainty in the identification and estimation of dynamic games of entry and exit.

The study contributes to a broader literature which measures loss aversion in the field,

[7] One can test profit maximization without marginal analysis, using the weak axiom of profit maximization (WAPM) [Varian, 1984], for example.

for taxi drivers [Camerer et al., 1997, Crawford and Meng, 2011, Farber, 2005, 2008, 2015, Thakral and Tô, 2021], marathon runners [Allen et al., 2017, Markle et al., 2018], financial professionals [Abdellaoui, Bleichrodt, and Kammoun, 2013], job search [DellaVigna et al., 2017], tax filers [Rees-Jones, 2018], etc.[8] The present study documents loss aversion among small business owners. The findings speak to the idea that experts are loss averse [Genesove and Mayer, 2001, Pope and Schweitzer, 2011]. It goes further by exploring implications for the behavior and objective function of the firm.

1 Baseline conceptual framework

1.1. Profit maximization. Under neoclassical theory the objective of the firm is

$$\pi(y) = p(y)y - c(y) - F,$$

where $\pi(y)$ is profit, $p(y)$ is the maximum price consumers are willing to pay for y units of output. It is decreasing in y by the law of demand. $c(y)$ is the variable cost. It is increasing in y. F is a fixed cost. The formulation nests economic profit under perfect competition ($p(y) = p$), monopolistic competition, and monopoly. It also nests economic profit in the very short run (at the daily level *e.g.*) where prices are fixed $p(y) = p$ even if the market is monopolistic or monopolistically competitive. Uncertainty can be introduced into this objective via $p(y)$, $c(y)$, or additively via F.

For restaurants the primary costs are food, direct and opportunity costs of equipment and commercial space, and labor. Food is a variable cost. Capital costs are fixed in the short run and variable in the very long run. In the very short run, at the daily level, labor costs are fixed.[9] In the longer run labor is a variable cost. In the very short run uncertainty in $p(y)$ and $c(y)$ can be generated by the number of consumer arrivals or bottlenecks in production. In the longer run it is generated by variation in tastes or fixed production costs.

Profit maximization has been justified by the fact that business owners are themselves consumers [Mas-Colell, Whinston, and Green, 1995], who

$$\begin{aligned} \underset{x_i \geq 0}{\text{maximize}} \quad & u(x_i) \\ \text{subject to} \quad & p x_i \leq w_i + \theta_i \pi. \end{aligned}$$

[8] For applications of loss aversion in the field see Camerer [2001] and O'Donoghue and Sprenger [2018].

[9] Online Appendix Figure A.3.1 confirms this using historical insider data.

where i is the consumer, u is utility, x_i is consumption, w_i is non-profit income, $\theta_i \in [0,1]$ is their ownership share of the firm, and where $\theta_i = 1$ means i is the sole owner. Since profit expands the budget set, and utility is increasing in consumption, the owner or ownership group will try to maximize profit themselves or instruct managers to do so. The basis for this justification dates back at least to Cournot in 1838, who wrote "we shall invoke but a single axiom, or, if you prefer, make but a single hypothesis, *i.e.* that each one seeks to derive the greatest possible value from his goods or his labour."

The objective of the firm has no direct grounding in preference maximization. Rather, it is grounded in the objectives and utility functions of owners and residual claimants [Mas-Colell, Whinston, and Green, 1995], which are themselves grounded in preference maximization. A departure from profit maximization cannot violate the axioms of choice directly, it can only reflect a violation taking place within the firm at the level of the individual.

Early debates of the profit maximization assumption centered on its plausibility under uncertainty, and specifically on the notion that humans possess the foresight and computational capacity to maximize profit in every state of the world [Alchian, 1950, Cyert and March, 1963, Friedman, 1953, Hall and Hitch, 1939, Machlup, 1946, March and Simon, 1958, Simon, 1952, 1955, 1979, Simon and Barnard, 1947]. The debates led to the now workhorse assumption of a risk neutral firm that maximizes expected profit. From this perspective, we can interpret π as the expected profit function, and departures from expected profit maximization will reflect within firm violations of the axioms of choice under uncertainty.

1.2. Loss aversion. The classical literature provides the null hypothesis. Our alternative is that decision making is guided by the next function or close variants thereof

$$V = (1-\eta)\pi + \eta v(\pi|\pi^r) \tag{1}$$

where $1-\eta$ is the utility weight assigned to profit, η is the gain-loss utility weight [Kőszegi and Rabin, 2006], $v(\pi|\pi^r)$ is a reference dependent utility function, and π^r the referent. $\eta = 0$ gives the default objective function for studies in industrial economics. We assume $0 \leq \eta < 1$.

The referent is the benchmark by which outcomes are coded as gains or losses. The referent can be based on the status quo or expectations [Kahneman and Tversky, 1979]. In the latter case the referent can refer to a point or distribution [Kőszegi and Rabin, 2006]. A natural reference point over the longer run is $\pi^r = 0$, which aligns with the zero profit condition in perfectly or monopolistically competitive markets with profit maximizers.

Assume v is differentiable at π^r, with derivative $v'_{\uparrow}(\pi^r|\pi^r)$ as π approaches π^r from below, and derivative $v'_{\downarrow}(\pi^r|\pi^r)$ as π approaches π^r from above. The loss aversion coefficient is

$$\frac{v'_{\uparrow}(\pi^r|\pi^r)}{v'_{\downarrow}(\pi^r|\pi^r)}. \tag{2}$$

Firm behavior is classified as loss averse if $\frac{v'_{\uparrow}(\pi^r|\pi^r)}{v'_{\downarrow}(\pi^r|\pi^r)} > 1$, loss neutral if it equals 1, and gain seeking if it is less than 1. η and $\frac{v'_{\uparrow}(\pi^r|\pi^r)}{v'_{\downarrow}(\pi^r|\pi^r)}$ capture the extent to which firm decisions reflect the loss aversion of primary decision makers.

The loss aversion coefficient in Equation 2 was developed in Kobberling and Wakker [2005]. It differs from the Kahneman and Tversky [1979] formulation where, if $v(\pi|\pi^r) = u(\pi - \pi^r)$, then loss aversion is $-u(-(\pi - \pi^r)) > u(\pi - \pi^r)$ for $\pi > \pi^r$. The survey relies on the Kobberling and Wakker [2005] formulation because it can be obtained quickly via methods developed in Abdellaoui et al. [2016], and because owners demanded quick interviews. Both formulations nest a familiar representation

$$v(\pi|\pi^r) = \begin{cases} \pi - \pi^r, & \text{if } \pi \geq \pi^r \\ \lambda(\pi - \pi^r), & \text{if } \pi < \pi^r \end{cases} \tag{3}$$

where $\lambda > 1$ denotes loss aversion, $\lambda = 1$ loss neutrality, and $\lambda < 1$ gain seeking.

The survey in the next section focuses on loss aversion at $\pi^r = 0$ for good reason. A firm which fails to break even cannot pay all factors of production (labor, lenders, suppliers). Unpaid factors will pressure the firm to pay, moreso when the outstanding debts are substantial. The added pressure steepens the utility slope on the side of losses directly and indirectly via any incidental mental or physical strain on management and employees. The existence of a compensatory analog on the side of gains is not obvious.

The framework above will serve as the baseline for the remainder of the study. We will adapt it when discussing the survey, evaluating the manifestation of loss aversion in market equilibrium, and more directly in firm behavior.

2 Survey

2.1. Sampling and representativeness. We first scraped a customer review website `iens.nl` which allows customers to evaluate restaurants on the basis of price, food quality, service, and decor. The website provided me with a large list of restaurants and addresses, mostly in the cities of Rotterdam and Utrecht, including addresses of restaurants with no ratings information. Together with our research assistants, we then telephoned restaurants to schedule in-person interviews or visited the restaurants and conducted interviews on site.

Overall, we interviewed the owners of 107 restaurants in the Netherlands during the summer of 2016. The restaurants make up 15 percent of the population covered by `iens.nl` (basically all restaurants) in the targeted cities. These restaurants employee 1870 people.

We explore the representativeness of the sample in Online Appendix Table A.3.1. We take the subset of restaurants with ratings in our sample and compare them with non-sampled restaurants on the `iens.nl` website. We show that sampled and non-sampled are similar in terms of average price food, service, and decor ratings. Knowing this, it is worth keeping in mind that the sample is selected on the basis of the willingness and ability of owners to participate in the survey.

2.2. Loss aversion measurement. The measurement procedure follows Abdellaoui et al. [2016]. The questions used in the procedure can be found in Online Appendix A.1. Let $v(\pi|\pi^r) = u(\pi - \pi^r)$, $\pi^r = 0$, and $u(0) = 0$. The procedure has several steps:

1. Pick a gain g.
2. Solicit the loss l that would make the subject indifferent between $u(0) = 0$ and a mixed prospect paying g with probability p or l with probability $1-p$ ($(g, p; l, 1-p)$ for short), *i.e* which satisfies:
$$w^+(p)u(g) + w^-(1-p)u(l) = 0, \tag{4}$$
where $w^+(p)$ and $w^-(1-p)$ are strictly increasing probability weighting functions equal to 0 at a probability of 0 and to 1 at a probability of 1.
3. Solicit the certainty equivalent ce_g for the gain prospect $(g, p; 0, 1-p)$:
$$w^+(p)u(g) = u(ce_g). \tag{5}$$
4. Solicit the certainty equivalent ce_l for the loss prospect $(0, p; l, 1-p)$:
$$w^-(1-p)u(l) = u(ce_l). \tag{6}$$

In each case the subject works through several examples to help identify their indifference point. The choices are framed as a choice between businesses to decrease the level of abstraction. The stakes are high to make the amounts meaningful. Equations 4-6 imply

$$u(ce_g) = -u(ce_l). \tag{7}$$

This is relevant because the Kobberling and Wakker [2005] definition of loss aversion in Equation 2 can be operationalized via

$$\frac{u(ce_l)/ce_l}{u(ce_g)/ce_g} = \frac{ce_g}{ce_l}, \tag{8}$$

where the equality follows from Equation 7. Owners are classified as loss averse if $\frac{ce_g}{ce_l} > 1$.

To facilitate understanding and expediency, the decision problem was explained as either a coin flip or 50-50 chance ($p = 0.5$). We are therefore measuring loss aversion in decision under risk, where objective probabilities exist and are known. We do not measure loss aversion in decision under ambiguity, where objective probabilities do not exist or are unknown, as is done in Abdellaoui et al. [2016]. Fortunately, the evidence in Abdellaoui et al. [2016] implies measurements under risk and ambiguity yield similar loss aversion coefficient estimates.

The Abdellaoui et al. [2016] method allows the researcher to measure loss aversion and the curvature of utility together. It facilitates measures of concavity in the gain domain and convexity in the loss domain as prospect theory predicts. Loss aversion and curvature were not measured together because in pilot interviews it increase interviewed times substantially. We instead asked owners about their propensity to take on risk in a separate question.

2.3. Loss aversion estimates. The first row of Table 1 summarizes the loss aversion estimates. Between the first two rows is the median and interquartile range. The mean loss aversion coefficient is 10.14. The median is 1.57.[10] We tested the hypothesis that owners are gain seeking or loss neutral ($\lambda \leq 1$), against the alternative of loss aversion ($\lambda > 1$). The test was applied to the interquartile range, as well as full sample. Both applications led to rejection of gain seeking and loss neutrality ($p < 0.01$).

The remaining rows of Table 1 summarizes additional information collected during the interviews. On average, owners are 36 years of age, have approximately 12 years of experience, have 17.5 employees, and report a willingness to take risks of 6.67 on a scale from 0 (risk averse) to 10 (fully prepared to take risks).

Owners were asked the following questions: how many customers do you serve per week? how many would you lose if (current) prices went up by 5 percent? 10 percent? 20 percent?

[10] The median and interquartile range are in line with estimates in Abdellaoui et al. [2016].

The questions yield perceived elasticities at current prices, at 105 percent of current prices, and 110 percent of current prices. The middle panel of Table 1 shows owners perceive an elasticity of -0.98 at current prices, an elasticity of -1.81 at 105 percent of current prices, and of -1.94 at 110 percent of current prices. Owners appear to be setting prices on an inelastic segment of their residual demand curves, which is what we would expect from a firm with at least some market power, and in particular from a differentiated firm operating in a monopolistically competitive market. The alignment with the theory of monopolistic competition is consistent with an expert understanding of market conditions among owners.

2.4. Owner experience and loss aversion. Table 2 reports estimates of the correlation between $ln(1+\lambda)$ and the other covariates. The natural logarithmic transformation of loss aversion limits the influence of owners with large and extreme λ. The transformation $1+\lambda$ prevents the introduction of new outliers due to taking logs of values between 0 and 1. The $ln(1+\lambda)$ transformation facilitates use of the full sample.

The only statistically significant correlate of loss aversion is experience. The first column shows one more year of experience is associated with the owner being 2 percent more loss averse ($p < 0.05$).[11] The remaining columns show a robust correlation to controls for their perceptions of demand, firm size, propensity to engage in risk, and age.

What explains the positive and robust correlation with experience? One explanation is experience causes owners to become more loss averse. For instance, experienced owners may have learned losses are especially unpleasant, perhaps creditors are especially unpleasant. This explanation is difficult to validate empirically. Another explanation relates to selection. Survival probabilities may be higher for firms with loss averse owners because they have a greater propensity for avoiding losses.

2.5. Owner loss aversion and firm survival. As a first step towards understanding the role of selection, we tracked down the firms of surveyed owners in October of 2021, more than 5 years after the original survey. We looked for evidence of closures using various online sources including Google, Facebook, some local newspapers, and the firm's website. Some firms announced their closure on Facebook. For other firms, Google indicates if the firm has been closed permanently. Local newspapers reported closures of several long-standing firms or who blamed the government for their demise during COVID-19. For survivors, we looked

[11] Here We describe how the point estimate for a percentage change in $1+\lambda$ is transformed into a percentage change in λ. Take the differential $dln(1+\lambda) = \beta dln(x)$, which implies $\frac{d\lambda}{(1+\lambda)} = \beta\frac{dx}{x}$, and $\frac{d\lambda}{(1+\lambda)}\frac{x}{dx} = 0.17$. Multiply both sides by $\frac{1+\bar{\lambda}}{\bar{\lambda}}$ to get 0.19. Multiply this by 0.083, which is equivalent to one additional year of experience (over the mean).

for recent posts on Facebook, opening hours information on Google, as well as whether reservations were still possible.

We then constructed an indicator $Exit_i$ for whether firm i exited by October 2021. $Exit_i$ has a mean of 0.28, as 30 firms exited. The mean is 0.42 for firms with a gain seeking or loss neutral owner ($\lambda \leq 1$) and 0.22 for firms with a loss averse owner. The 20 percentage point contrast suggests owner loss aversion induces the firm to stay in.

To further evaluate the selection narrative, we estimate

$$Exit_i = \beta_0 + \beta_1 LossAverse_i + \mathbf{X}_i\Gamma + \varepsilon_i$$

where $LossAverse_i = \mathbf{1}(\lambda_i > 1)$, $\mathbf{1}$ denotes the indicator function, $\mathbf{X}_i$ is the set of controls described in the Subsection 2.4, and ε_i is a mean 0 and variance σ^2 random variable. The identifying assumption here is $\mathbb{E}[\varepsilon_i|LossAverse_i, \mathbf{X}_i] = \mathbb{E}[\varepsilon_i|\mathbf{X}_i] = 0$. The timing of events facilitates identification, as $LossAverse_i$ is measured 5 years prior to the exit decision.

While the timing facilitates identification, it is insufficient for a causal interpretation because $LossAverse_i$ likely correlates with other relevant but unobserved traits. For example, loss aversion, risk seeking in the loss domain, and framing together explain the sunk cost fallacy at the individual and group levels [Whyte, 1986, 1993]. If sunk costs lead decision makers to frame decisions as a choice between losses, *e.g.* between a loss of \$50 or a gamble which pays \$0 with probability $p > 0$ and -\$100 with probability $1 - p > 0$, then decision makers will opt for the latter riskier lottery. Risk seeking propensity in the loss domain and susceptibility to framing are then in ε_i, their influence is loaded into the estimand for β_1, likely reinforcing the negative correlation between loss aversion and exit decisions.

Regression estimates are found in Table 3. Column 1 reports the unconditional estimate. Column 2 reports the *ceteris paribus* estimate. The latter implies an 18 percentage point contrast between firms with and without loss averse owners after the full control set is included. The point estimate is substantive. It is 64 percent of the exit mean in the sample.

3 Loss aversion and market equilibrium

We model the restaurant sector as a dynamic industry model, drawing heavily on the heterogeneous firms models developed in Hopenhayn [1992] and Melitz [2003]. We adopt the assumption of a monopolistically competitive sector from Melitz [2003], but we deviate from Hopenhayn [1992] and Melitz [2003] in two dimensions. First, we allow for firm heterogeneity not only in marginal costs, but also in fixed costs. Second, we allow for loss aversion with respect to fixed costs. We then derive the steady state relationship between the number of firms and average gains and losses in fixed costs. We use county level aggregates for the United States restaurant industry from 1998–2019 to estimate this relationship and to draw inferences about the presence of loss aversion in the sector.

3.1. Melitz model with loss aversion. There is a continuum of firms identified by the variety ω they produce. A producer of variety ω has productivity $\varphi(\omega)$ and fixed cost $F(\omega) = wf(\omega)$, where w is a wage. They use $\ell(\omega) = q(\omega)/\varphi(\omega) + f(\omega)$ labor units to produce quantity $q(\omega)$. They choose price $p(\omega)$ to maximize

$$V(\omega) =(1-\eta)\pi(\omega) + \eta v(F(\omega)|F^r)$$

where $\pi(\omega) = r(\omega) - w\ell(\omega)$ and

$$v(F(\omega)|F^r) = [F(\omega) - F^r]^- + \lambda[F(\omega) - F^r]^+.$$

$[F(\omega) - F^r]^- = \min\{F(\omega) - F^r, 0\}$ measures a fixed cost gain relative to the reference point F^r, $[F(\omega) - F^r]^- = \max\{F(\omega) - F^r, 0\}$ measures a fixed cost loss, and $\lambda > 1$. We assume

$$(1-\eta)F(\omega) + \eta v(F(\omega)|F^r) > 0.$$

$\eta = 0$ nests the firm's objective in Melitz [2003]. The per-period objective is then

$$V(\varphi, F) = (1-\eta)\Big\{(\frac{R}{\sigma})\Big[\frac{\sigma}{\sigma-1}\varphi P\Big]^{\sigma-1} - F\Big\} - \eta\Big\{[F-F^r]^- + \lambda[F-F^r]^+\Big\}. \quad (9)$$

where $\sigma > 1$ is the elasticity of substitution between varieties for consumers, R is aggregate revenue and income for consumers, and P is an aggregate price index. We have suppressed the ω in $\varphi(\omega)$ and $F(\omega)$ for notational convenience.

The setup assumes fixed labor costs, loss aversion in fixed costs, and loss neutrality in revenue. The assumptions are motivated by the insider evidence. Online Appendix Figure A.3.1 uses the insider data to plot the average wage bill per customer against the number of customers. The average wage bill decreases quickly at low customer volumes before flattening out at high customer volumes, consistent with a curve generated by fixed labor costs. Section 4 shows insider decision makers are loss averse in the (fixed) cost domain and gain seeking in the revenue domain, and that the weight placed on costs is more than 70 times the weight placed on revenue. By this token, loss aversion in costs and loss neutrality in revenue is a reasonable approximation to the objective function guiding firm decisions.

Equation 9 is critical for determining the set of entrants, or equivalently the joint distribution for (φ, F) conditional on entry. An example of how loss aversion affects the set of entrants is depicted in Figure 1. The left figure identifies the set of entrants if producers are motivated purely by profit, *i.e.* if $\eta = 0$. The right figure identifies the set of entrants under loss aversion. Loss aversion increases entry by low productivity producers who would have not entered had they been motivated purely by profit. These producers earn negative operating profit but stay in because of the additional utility gain from being below the reference fixed cost. They can stay in with negative operating profit if $\overline{u} > 0$ and the owner makes a positive wage. Loss aversion decreases entry by high productivity producers who would have entered had they been motivated purely by profit. These producers stay out despite earning positive profit because of the utility loss from being below the reference fixed cost. The equilibrium number of firms M in a market will decrease if decreased entry by high productivity producers dominates increased entry by low productivity producers.

Online Appendix A.2 shows the number of firms in a stationary equilibrium is

$$M = \frac{wL}{\frac{1}{1-\eta}\tilde{V}(\Lambda) + \tilde{F}(\Lambda) + \frac{\eta}{1-\eta}(\tilde{g}(\Lambda) + \lambda\tilde{l}(\Lambda))}, \tag{10}$$

where L is total industry labour, $\tilde{V}(\Lambda)$ is the value derived by the owner of the average producing firm, $\tilde{F}(\Lambda)$ is the fixed cost of this firm, $\tilde{g}(\Lambda)$ is the average gain in fixed cost, $\tilde{l}(\Lambda)$ is the average loss, and Λ is the set of productivity and fixed costs of producing firms in the industry. Equation 10 is the basis for the main estimating equation in this section.

3.2. County data and empirical specification. Our primary source here is County Business Pattern (CBP) data from 1986-2019. The data includes the total number of establishments, employees, and total annual payroll (in thousands of U.S. dollars) per county across the U.S. An establishment is defined by a physical location. The number of employees is measured annually in March. Annual payroll covers all forms of compensation, including wages, salaries, bonuses, commissions, dismissal pay, vacation pay, sick pay, paid employee contributions to pensions. Most of these compensation costs are fixed from the employer's perspective, particularly the costs of front line restaurant employees (kitchen workers, servers), whose compensation typically depends on hourly wages and in many cases tips. The CBP data is merged with a housing price index constructed by the Federal Housing Finance Agency (FHSA) and county population estimates by the U.S. Census Bureau.

Our sample is restricted to 1998-2019 because the Census Bureau changed the industry classification system in 1998 from the 4-digit Standard Industry Classification (SIC) system to the 6-digit North American Industry Classification System (NAICS), and because there is no accepted conversion from SIC to NAICS codes. Our primary estimation sample is restricted to NAICS codes 7221, 7222, and 7223 for years 1998 to 2011 and NAICS code 7225 for years 2012 to 2019. These codes cover "Full-Service Restaurants", "Limited-Service Restaurants", "Cafeterias, Grill Buffets, and Buffets", "Snack and Nonalcoholic Beverage Bars", and "Special Food Services". Summary statistics can be found in Table 4.

These data are used to estimate

$$ln(M_{it}) = \beta_1 ln(L_{it}) + \beta_2 W_{it} + \beta_3 D_{it} + \beta_4 F_{it-1} + \beta_g [F_{it} - F_{it-1}]^- + \beta_l [F_{it} - F_{it-1}]^+ + \varepsilon_{it} \tag{11}$$

where i is the county and t the year, W_{it} is the housing price index and D_{it} is population density, and F_{it-1} is total annual payroll cost last year. F_{it-1} also serves as the reference point for the total annual payroll cost this year. $[F_{it} - F_{it-1}]^-$ equals $F_{it} - F_{it-1}$ if $F_{it} - F_{it-1} < 0$ and $[F_{it} - F_{it-1}]^+$ equals $F_{it} - F_{it-1}$ if $F_{it} - F_{it-1} \geq 0$. $\varepsilon_{it} = \alpha_i + \gamma_t + u_{it}$, where α_i and γ_t are fixed effects, and u_{it} is an idiosyncratic error term.

The estimating equation can be interpreted as a linearization of Equation 10 which lets the outside option depend linearly on housing prices and population density, observables covary with unobserved heterogeneity across counties and over time, and includes F_{it-1} to account for level effects in total annual payroll. $[F_{it} - F_{it-1}]^-$ and $[F_{it} - F_{it-1}]^+$ can be interpreted as the fixed cost changes in the low and high fixed cost states of the world, respectively. β_g and β_l can then be interpreted as gain and loss coefficients.

The interpretation depends on the assumption that payroll costs are fixed. While we provide evidence of this in Online Appendix Figure A.3.1, if payroll costs are variable, then above average payroll $[F_{it} - F_{it-1}]^-$ may reflect an expansion of economic activity rather than a loss. An expansion would probably increase the number of firms in equilibrium. We will see shortly this is not the case and that the evidence supports our fixed costs assumption.

3.3. Equilibrium number of firms and loss-gain coefficients. Estimates are found in Table 5. Moving left to right shows how the estimates change as fixed effects and lagged controls are added. Estimates of β_l/β_g are in the bottom panel.

The estimated relationship between the number of firms and industry labor in Column 1 aligns with the log of the theoretical relationship predicted in Equation 10. The estimated coefficient is 0.843. The predicted coefficient is 1. The housing price index and population density exhibit positive correlations with the number of establishments. Positive correlations are unsurprising if housing price index reflects wealth and population density reflects variety in the substitute options for consumers. Log population also adjusts for the assumption that labor supply is inelastic, which is a stronger assumption at the industry level than at a more aggregate level, as in the original Melitz [2003] model. The negative coefficients on lagged payroll, below average payroll (gain), and above average payroll (loss) are also consistent with their position in the denominator of Equation 10. The estimates change as we add fixed effects and lagged controls but the signs remain similar.

The gain coefficient on below average payroll in Column 1 shows a standard deviation gain increase is associated with approximately 2.4% more establishments. A standard deviation loss increase is associated with approximately 6.9% fewer establishments. Both magnitudes are smaller with county and year fixed effects as well as lagged establishments and employees. The loss-gain ratio varies from between 1.87 to 2.91.

The estimates fit with global evidence on the relationship between entrepreneurship and personal characteristics. Using data generated by the Global Entrepreneurship Monitor, Ardagna and Lusardi [2010] document a robust negative correlation between the propensity to start or own a new business and the answer to the statement "fear of failure would prevent you from starting a business." Ardagna and Lusardi [2010] interpret the answer as a measure of risk aversion. However, one can alternatively interpret it as measuring loss aversion, if fear of failure is coded as a loss relative to some internal yardstick [Morgan and Sisak, 2016].

3.4. Robustness of benchmark loss-gain coefficients. Our interpretation relies on there being no unobservables which track gains (losses) and the number of firms. The assumption can fail if there are county level time varying factors which correlate with gains (losses) and number of firms, such as payroll gains and losses at rival firms in nearby markets. We evaluate this possibility in Online Appendix Table A.3.2, which correlates payroll gains and losses with average payroll gains and losses in neighbouring counties within 25, 50, or 100 miles. We see some correlation, particularly in the domain of payroll gains. However, F-tests with each distance band reveal very weak correlations across counties. The tests are inconsistent with a violation of the identifying assumption for Equation 11.

Online Appendix Table A.3.3 looks further for a violation of the identifying assumption. Using county level IRS tax information, we estimate the effects of payroll gains and losses on the number tax returns filed, number of exemptions, adjusted gross income, wages and salaries, dividends, and interest income. The regressions condition on the number of employees, housing prices, population density, annual payroll, and fixed effects for the county and state-year combination. The estimates show some correlation between employees, house prices, and annual payroll. It consistently shows no correlation with gains and losses in payrolls. No correlations with gains and losses further supports the identification of Equation 11.

3.5. Loss-gain coefficients over time, space, and firm size. We study variation in the loss/gain coefficients over time and across states. Starting with time, we estimate Equation 11 for every year from 1998-2009 exploiting cross sectional variation across counties (and implicitly by states). The procedure yields loss and gain coefficient estimates $\widehat{\beta}_{lt}$ and $\widehat{\beta}_{gt}$. The estimates are plotted in Figure 2.

Figure 2 exhibits two noteworthy patterns. First, the loss coefficient appears more stable or stable for longer durations relative to the gain coefficient, which tends to oscillate year to year. Second, the loss coefficient decreases sharply when the internet bubble collapsed and at the Great Recession onset. This is consistent with increased loss aversion during recessions.

Figures 3(a) and 3(b) investigate whether these patterns reflect entry/exit of small or large firms. Specifically, we partition the number of firms into the number with less than 20 employees (small firms) and the number with 20 or more (large firms), and estimate Equation 11 separately for each size classification. The figures show the baseline patterns in Figure 2 are driven by small firms. The gain and loss coefficients, especially the loss coefficients, are both more extreme than in Figure 2. With large firms we see starkly different patterns. The loss coefficient for large firms always hovers around 0. The gain coefficient is negative initially but eventually tracks the loss coefficient around 0 towards the end of the sample.

We examine the cross sectional variation in loss/gain coefficients as well. We estimate Equation 11 separately for each state s, using across county variation within states and over time. The procedure yields loss and gain coefficient estimates $\widehat{\beta}_{ls}$ and $\widehat{\beta}_{gs}$.

To validate the construction of these estimates, we compute the ratio, take logs, and compare the log ratio with the percentage of conservative adults according to 2014 PEW survey. The ordered pairs can be found in Figure 4, which shows the ratio of loss to gain coefficients has a statistically significant correlation of 0.074 with the state's percentage of conservative adults. This consistent with a greater aversion to losses among conservatives. It is also consistent with our expectation based on the definition of a conservative, as someone "tending or disposed to maintain existing views, conditions, or institutions."[12]

3.6. Entry/exit rates and loss-gain coefficients. The model assumes exits are exogenous. All action relating to firm turnover takes place at the point of entry. Exogenous exits are unrealistic, as exits likely depend on firm attributes, including biases of key decision agents.

For this reason, we draw on Business Dynamics Statistics (BDS) from the US Census

[12] See https://www.merriam-webster.com/dictionary/conservative.

Bureau to estimate the effects of losses and gains on entry and exit rates. We estimate the effects for the broader 2-digit NAICS code, which includes accommodation as well as food service (code=72), because entry and exit rates per county are only reported at the 2-digit level. Estimates are found in Table 6. Both specifications mimic the last column of Table 5.

Most entry and exit rate coefficients in Columns 1 and 2 have opposite signs. The long run effect of total industry labor decreases entry rates but increases exit rates. The housing price index and population increase entry rates but decrease exit rates. These contrasts are intuitive if industry labor, housing prices, and population reflect relevant supply and demand factors. The other coefficients have opposite signs as well. The lone exceptions are the lagged dependent variable coefficients. Both are positive, perhaps reflecting complementarity in entry decisions and increased competition in exit decisions.

Table 5 shows annual payroll decreases entry rates but increases exit rates. A gain in payroll increases entry rates and decreases exit rates. A loss decreases entry rates and increases exit rates. The loss-gain coefficient for entry rates is 0.623, which is consistent with gain seeking in entry decisions, though the estimate is not statistically different from 1 at conventional significance levels. The loss-gain coefficient for entry rates is 7.683, which is consistent with loss aversion in exit decisions. The estimate is also not statistically different from 1 at conventional significance levels, but substantively it is quite large relative to 1.

There is a stark contrast between the owner survey results and Table 5. The surveys shows loss aversion decreases the probability of exit. Table 5 shows losses increase the probability of exit. One simple explanation for the contrast relates to the fact that while loss averse owners may want to stay in they are constrained in their capacity to do so by the losses themselves. From this perspective it would be intuitive for losses to increase the probability of exit, regardless of owner preference, as is the case in Table 5. Indeed, this is why we made the assumption $\eta < 1$. However, the owners we surveyed in 2016 were supported financially by the Dutch government during COVID-19 and the associated lockdowns. The financial support enabled them to stay in when they would normally be forced to exit. The support enabled the manifestation of their loss aversion in a decreased probability of exit.

4 Loss aversion and firm behavior

We use internal transactions data from two large full service restaurants to look for evidence of loss aversion in a frequent labor demand decision, namely when to send waiters home.

4.1. Context. The restaurants are franchises in the same large Canadian "big-box" retail chain. The restaurants are only open for dinner. They are designed for scale and accordingly provide consumers with uniform product and service quality. The scale is reflected in Table A.3.4, which summarizes consumer arrival data by day of week for one of the restaurants, and which implies approximately 2800 consumers arrive per week. Each consumer spends approximately \$45 dollars. Total potential revenue per week is then around \$120000.

There are 71 waiters in total. Waiters each handle 2-4 tables, or 10-16 seats, depending on the day, and do not share tables. The number of waiters in a shift ranges from between 10-20. There are 690 shifts. There are 10-15 managers/residual claimants making stopping decisions. The data are taken from 2 years: 2008-2009 and 2009-2010. Hereafter we will refer to waiters as workers and managers/residual claimants as the firm. Additional contextual details can be found in Kapoor [2020] and Kapoor and Magesan [2019].

4.2. Utility specification. Owner utility from the revenue and wage bill of the worker is:

$$V = (1-\eta)\pi + \eta v(r, F|r^r, F^r)$$

where r^r and F^r reference points for revenue and fixed costs, and $v(r, F|r^r, F^r)$ equals

$$\beta_{rl}\mathbf{1}_{r-r^r<0}(r-r^r) + \beta_{rg}\mathbf{1}_{r-r^r\geq 0}(r-r^r) + \beta_{Fl}\mathbf{1}_{F-F^r\geq 0}(F^r-F) + \beta_{Fg}\mathbf{1}_{F-F^r<0}(F^r-F),$$

$\mathbf{1}$ denotes the indicator function, and $\lambda_r = \beta_{rl}/\beta_{rg}$ and $\lambda_F = \beta_{Fl}/\beta_{Fg}$ are loss aversion coefficients for revenue and the wage bill. To simplify the notation we will at times use $\overline{\lambda}_r = (1-\eta+\eta\lambda_r)$ and $\overline{\lambda}_F = (1-\eta+\eta\lambda_F)$. Note $(1-\eta+\eta\lambda)$ underestimates λ when $\lambda > 1$, overestimates λ when $\lambda < 1$, but equals λ when $\lambda = 1$.

The utility function for taxi drivers in Crawford and Meng [2011] provides a useful benchmark. Crawford and Meng [2011] first follow Kőszegi and Rabin [2006] in assuming separable consumption utility from income and hours, and second that drivers compartmentalize or "narrow bracket" income and hours across shifts. The utility function here assumes separable utility from revenue and costs and narrow bracketing of revenue and costs across shifts. Revenue and cost are separable by the definition of profit. Accordingly, our separability assumption is relatively uncontroversial. Narrow bracketing is grounded in realities of the production setting. The stopping decision depends exclusively on shift-specific state variables, such as the number of consumer arrivals, the number of coworkers available, etc.

Our specification assumes utility is linear away from the kink. This ignores second order forms of risk aversion which may arise if the firm were a vNM maximizer facing uncertainty. We make this assumption because the owner survey suggested risk preferences are not a confounder for loss aversion.[13] Moreover, a constant marginal utility of income seems especially reasonable for owners relative to workers like taxi drivers (*c.f.* [Crawford and Meng, 2011]). The contribution to aggregate (annual, *e.g.*) income of income from a single shift should be especially infinitesimal for a firm that operates 364 shifts per year.

4.3. Stopping model. Each shift is partitioned into 15-minute intervals. The 15-minute marker is important because the firm pays workers in accordance with these intervals. Workers who stop working at 6:14pm get paid until 6pm. Workers who stop at 6:15pm get paid until 6:15 pm. Note both start and end times are worker specific. Start times are generally staggered, except for Saturdays where all workers start at the same time. Start times are set well in advance of each work week. The order in which workers stop is the same as the order in which they start. The control problem for owners is not who to stop, only when.

The decision to stop worker i on date d is denoted by

$$Stop_{t_{id}} = \begin{cases} 1, & \text{No more new customers (handles last bill)} \\ 0, & \text{Can take on new customers} \end{cases}$$

where $t_{id} \in \{1, ..., T_{id}\}$ denotes the t_{id}^{th} time interval worked by worker i on date or equivalently shift d. Following Crawford and Meng [2011], stopping decisions are generated via

$$Stop_{t_{id}} = 1 \quad \Leftrightarrow \quad \mathbb{E}[V(r_{t_{id}+1}, F_{t_{id}+1})|r^r_{t_{id}+1}, F^r_{t_{id}+1}] - V(r_{t_{id}}, F_{t_{id}}|r^r_{t_{id}}, F^r_{t_{id}}) + \mathbf{X}_{t_{id}}\Gamma + \varepsilon_{t_{id}} > 0$$

where $r_{t_{id}}$ and $F_{t_{id}}$ are the cumulative revenue and wage bill of worker i on date d up until interval t. $\mathbf{X}_{t_{id}}$ is a set of fixed effects which we will define shortly. $\varepsilon_{t_{id}}/\sigma$ is a standard normal random variable. Rational owner expectations make the last inequality equivalent to

$$(1-\eta)\Big(r_{t_{id}+1} - r_{t_{id}} - (F_{t_{id}+1} - F_{t_{id}})\Big) + \eta\Big(\beta_{rl}a_{1t_{id}} + \beta_{rg}a_{2t_{id}}\Big) + \eta\Big(\beta_{Fl}b_{1t_{id}} + \beta_{Fg}b_{2t_{id}}\Big) + \varepsilon_{t_{id}}$$

where

- $a_{1t_{id}} = \mathbf{1}_{r_{t_{id}+1} - r^r_{t_{id}+1} < 0}(r_{t_{id}+1} - r^r_{t_{id}+1}) - \mathbf{1}_{r_{t_{id}} - r^r_{t_{id}} < 0}(r_{t_{id}} - r^r_{t_{id}})$
- $a_{2t_{id}} = \mathbf{1}_{r_{t_{id}+1} - r^r_{t_{id}+1} \geq 0}(r_{t_{id}+1} - r^r_{t_{id}+1}) - \mathbf{1}_{r_{t_{id}} - r^r_{t_{id}} \geq 0}(r_{t_{id}} - r^r_{t_{id}})$
- $b_{1t_{id}} = \mathbf{1}_{F_{t_{id}+1} - F^r_{t_{id}+1} \geq 0}(-F_{t_{id}+1} + F^r_{t_{id}+1}) - \mathbf{1}_{F_{t_{id}} - F^r_{t_{id}} \geq 0}(-F_{t_{id}} + F^r_{t_{id}})$

[13] Loss aversion can in some instances be interpreted as first order risk aversion. It can generate risk averse behavior even if utility is linear.

- $b_{2t_{id}} = \mathbf{1}_{F_{t_{id}+1} - F^r_{t_{id}+1} < 0}(-F_{t_{id}+1} + F^r_{t_{id}+1}) - \mathbf{1}_{F_{t_{id}} - F^r_{t_{id}} < 0}(-F_{t_{id}} + F^r_{t_{id}})$
- $c = (1-\eta)w = (1-\eta)(F_{t_{id}+1} - F_{t_{id}})$, and w is the prorated fixed wage for 15 minutes.

$r^r_{t_{id}+1}, F^r_{t_{id}+1}, r^r_{t_{id}}, F^r_{t_{id}}$ are endogenous reference points which reflect owner expectations.[14]

The production setting has several natural benchmarks for expectation-based reference points. At the start of each shift owners publicly post revenue, customer volume, and the wage bill from the same last day year. Owners want everyone to try to beat last year's targets. Owners can and likely do update their beliefs about these reference points during a shift. With this in mind, we use 2 main classes of reference points in our analysis. The first is based on cumulative coworker averages at 15-minute intervals: $r^r_{t_{id}} = \overline{r}_{t_{-id}}$ and $F^r_{t_{id}} = \overline{F}_{t_{-id}}$. The second is an average of the cumulative coworker average and a static reference point. For one franchise we average the cumulative average and average per worker from the same day last year ($\overline{r}_{d,y-1}$ and $\overline{F}_{d,y-1}$) and from the same day last week ($\overline{r}_{d,w-1}$ and $\overline{F}_{d,w-1}$). For the other franchise we average the cumulative average and average per worker from the same day last week ($\overline{r}_{d,w-1}$ and $\overline{F}_{d,w-1}$). We cannot use data from the same day last year for one franchise because it only opened for business in 2009-2010.

Taking everything together we have

$$(1-\eta+\eta\beta_{rl})a_{1t_{id}} + (1-\eta+\eta\beta_{rg})a_{2t_{id}} + \eta\beta_{Fl}b_{1t_{id}} + \eta\beta_{Fg}b_{2t_{id}} + c + \mathbf{X}_{t_{id}}\Gamma + \varepsilon_{t_{id}} > 0$$

because $r_{t_{id}+1} - r_{t_{id}} = a_{1t_{id}} + a_{2t_{id}}$ and $F_{t_{id}+1} - F_{t_{id}} = w$. The log-likelihood function is:

$$\sum_{i,d,t_{id}} ln\Phi\Big(\big((1-\eta+\eta\beta_{rl})a_{1t_{id}} + (1-\eta+\eta\beta_{rg})a_{2t_{id}} + \eta\beta_{Fl}b_{1t_{id}} + \eta\beta_{Fg}b_{2t_{id}} + c + \mathbf{X}_{t_{id}}\Gamma\big)/\sigma\Big)$$

where Φ is the distribution function for a standard normal random variable.

Gain and loss coefficients are unrestricted in the estimating equation above. The cost of unrestricted coefficients is an inability to separately identify the slope coefficients from σ. However, because the one period wage bill comparison equals the constant prorated fixed

[14]Stopping decisions reflect decisions of the owner and worker. Worker effort generates revenue. Owners form expectations about future revenue generation and uses them in stopping decisions. The interdependence raises questions about whether the stopping problem should be modelled as a game. We do not do this because this game is played over a much longer time horizon than a shift.

wage for the next 15 minutes, we can identify the loss aversion parameter for costs,

$$\frac{\eta\beta_{Fl}/\sigma}{\eta\beta_{Fg}/\sigma} = \frac{\beta_{Fl}}{\beta_{Fg}} = \lambda_F,$$

separate from the weight η placed on gain-loss utility relative to profit. We cannot do this with the loss aversion parameter for revenue, $\lambda_r = \beta_{rl}/\beta_{rg}$, because next period revenues are uncertain.[15] We can do what is standard in the literature and identify

$$\frac{(1-\eta+\eta\beta_{rl})/\sigma}{(1-\eta+\eta\beta_{rg})/\sigma} = \frac{(1-\eta+\eta\beta_{rl})}{(1-\eta+\eta\beta_{rg})} = \overline{\lambda}_r$$

which mixes loss aversion with the [Kőszegi and Rabin, 2006] weights on gains and losses unless $\eta = 1$. Recall however pure loss neutrality in revenue ($\beta_{rl}/\beta_{rg} = 1$) implies $\overline{\lambda}_r = 1$ for any η. We will see evidence consistent with this for some pertinent subsamples.

The Crawford and Meng [2011] specification differences out several factors which could undermine identification, including stopping determinants known by decision agents but not the econometrician. This includes worker specific determinants such as their intrinsic motivation or table assignment, calendar date specific determinants such as average temperature, as well evolving state variables such as the consumer arrival rate, production bottlenecks, or number of workers remaining. To capture some of the remaining unobserved determinants of stopping decisions, $\mathbf{X}_{t_{id}}$ includes fixed effects specific to the restaurant, day of week, and 15 minute interval. Note that the exogeneity of gains and losses is arguably more plausible here than for other contexts because workers generate revenue and costs while stopping decisions are taken unilaterally by the firm.

Figure 6(a) (top) plots one period ahead revenue and wage bill changes. It shows large revenue increases early on, smaller increases as a shift proceeds, and a precipitous decline to 0 by the end of a shift. Since there is no variability in the average wage bill, the revenue increases become smaller than the constant change in the wage bill.[16]

Figure 6(a) (bottom) shows how the stopping probability differs with the time of day. Workers are almost never stopped before 5:45pm. The stopping probability increases s-moothly from 6 until 10pm. It continues to increase thereafter, but with some volatility, reflecting the closure of the dining room at 11pm. The stopping probability equals 1 there-

[15] In Online Appendix Table A.3.4, we use data on consumer arrivals from one of the restaurants to show there is uncertainty in the number of consumer arrivals and thus in consumer demand and revenue.

[16] Revenue is lumpy because it is realized intermittently only when the bill is paid. For this reason, we interpolate revenue linearly across 15-minute intervals to reflect the fact that revenue is being generated throughout the time the customer is seated.

after, consistent with the revenue-wage comparison in Figure 6(a) (top).

A useful comparison is between revenue changes and stopping probabilities between 9 and 11pm. Revenue changes decrease gradually. Stopping probabilities increase sharply in this time. The difference aligns with an enhanced propensity to stop workers early.

We restrict the sample to 7pm or later because earlier stops are typically attributable to irrelevant reasons (sickness). Moreover, the firm is legally required to pay workers for 3 hours for showing up, even if they work less than 3 hours. Part of the wage bill is outside owner control in other words. The part owners control comes towards the end of a shift.

4.4. Structural loss aversion estimates. Structural estimates can be found in the top panel of Table 7. Reduced form estimates are in the bottom panel. Column 1 estimates are based on the full sample. Column 2 estimates are based on the subsample of slower days when excess demand for seating is rare (Sundays through Thursdays). Column 3 reports estimates based on the subsample of busier days when there is almost always excess demand for seating (Fridays and Saturdays). The partitition is justified in Online Appendix Table A.3.4, which reports the number of consumer arrivals by day of week.

The structural estimates in Column 1 shows the loss coefficient for revenue is 0.59. The estimate is statistically different from 1 (loss neutrality) and consistent with gain seeking in revenues. The loss coefficient for the wage bill is 2.55. The estimate is statistically different from loss neutrality and consistent with loss aversion with respect to costs.

The reduced form in Column 1 show cost coefficients carry lots more weight in stopping decisions. For example, the coefficient for cost losses is 71 times the coefficient for revenue losses. The emphasis on costs aligns with the separation of revenue and cost decisions in this retail chain. Revenue is generated through advertising, reputation, as well as prices. These decisions are centralized to chain headquarters. By contrast, costs are generated through labor (hours) and materials. These decisions are decentralized to stores.

Column 2 shows the coefficients for revenue and cost losses on slow days are 0.43 and 3.26 respectively. Both are statistically different from loss neutrality at the 1 percent level. The former aligns with gain-seeking in revenue and the latter with loss aversion in costs. Column 3 shows the coefficients for revenue and cost losses on busy days are 0.85 and 1.36. Neither is statistically different from loss neutrality. Online Appendix Figure A.3.5 shows similar patterns. But the conclusion is the same: loss neutrality in revenue, loss aversion in costs, but less loss aversion than on busy days.

While there are a number of potential explanations for the difference between slow and busy days, a natural one relates to managerial team size. There are more residual claimants and support staff managing the firm on busy days. The additional support facilitates joint decision making and loss neutrality.

4.5. Efficiency and equity implications. Figure 6 (top) visualizes the lost wages for workers when stopped early relative to the expected utility maximization benchmark (where gain-loss parameters are all set to 0). The mean lost wage is \$1.73 (Canadian dollars) or 4.7 percent of daily earnings from hourly wages. Figure 6 (bottom) visualizes tip rates, which are flat for the period where stopping probabilities increase most (*cf.* 6(a) - bottom), implying consumers are not made worse off by gain-loss behavior in stopping decisions.

Whether workers are harmed depends on their utility from working. Some will not be harmed because the utility from stopping compensates for the lost income. Others will be harmed because they would rather continue working. Anecdotally, part time workers fall into the former category because this job is typically secondary to other priorities (school *e.g*). Full timers are more likely to be harmed because the job provides their primary income source and consequently because they are more likely to want to continue working. If this is the case, then loss aversion induces owners to transfer rents from workers to themselves.[17]

5 Conclusion

This study puts forth three distinct pieces of evidence supporting the contention that the objective of the small competitive firm reflects the loss aversion of key decision agents.

Personal interviews with owners show average and median loss coefficients of 10.1 and 1.57 respectively. More experienced owners are more loss averse, consistent with increased survival probabilities among loss averse firms. Firms with loss averse owners were 18-21 percentage points less likely to exit 5 years after the survey.

Twenty years of market level aggregates are consistent with loss averse behavior in the payroll domain, and more specifically with loss aversion coefficients between 1.87 and 2.91. The evidence supports the presence of loss aversion in market equilibrium, particularly among small firms, during recessions, and in politically conservative states.

Data from inside the firm shows gain seeking with respect to revenues and loss averse with respect to costs in labor demand decisions. The loss aversion coefficient for costs is 2.55. Loss aversion decreases with scale within the firm, suggesting loss aversion cannot be

[17] Why continue to work for such a firm? The firm is one of the more desirable employers in the industry. For example, workers in our setting earn more than 150 dollars on average (34-35 dollars per hour with tips), quite a bit more than they would earn at other restaurants in the same localities.

explained entirely by across firm differences. It can be explained by individual loss aversion having greater influence on firm behavior when there are fewer decision agents.

References

Mohammed Abdellaoui, Han Bleichrodt, and Hilda Kammoun. Do financial professionals behave according to prospect theory? an experimental study. *Theory and Decision*, 74(3): 411–429, 2013.

Mohammed Abdellaoui, Han Bleichrodt, Olivier L'Haridon, and Dennie van Dolder. Measuring loss aversion under ambiguity: A method to make prospect theory completely observable. *Journal of Risk and Uncertainty*, 52:1–20, 2016.

Victor Aguirregabiria and Arvind Magesan. Identification and estimation of dynamic games when players' beliefs are not in equilibrium. *The Review of Economic Studies*, 87(2): 582–625, 2020.

Armen A. Alchian. Uncertainty, evolution, and economic theory. *The Journal of Political Economy*, 58(3):211–221, June 1950.

Eric J. Allen, Patricia M. Dechow, Devin G. Pope, and George Wu. Reference-dependent preferences: Evidence from marathon runners. *Management Science*, 63(6):1657–1672, 2017.

Georgios Angelis. Price setting and price stickiness: A behavioral foundation of inaction bands. *Working Paper*, 2021.

Silvia Ardagna and Annamaria Lusardi. Explaining international differences in entrepreneurship: The role of individual characteristics and regulatory constraints. In Joshua Lerner and Antoinette Schoar, editors, *International Differences in Entrepreneurship*, pages 17–62. University of Chicago Press, Chicago, 2010.

David Atkin, Azam Chaudhry, Shamyla Chaudry, Amit K. Khandelwal, and Eric Verhoogen. Organizational barriers to technology adoption: Evidence from soccer-ball producers in pakistan. *The Quarterly Journal of Economics*, 132(3):1101–1164, 2017.

Matthias Benz and Bruno S Frey. Being independent raises happiness at work. *Swedish economic policy review*, 11(2):95–134, 2004.

Nicholas Bloom, Benn Eifert, Aprajit Mahajan, David McKenzie, and John Roberts. Does management matter? evidence from india. *The Quarterly Journal of Economics*, 128(1): 1–51, 2013.

David P. Byrne. Testing models of differentiated products markets: Consolidation in the cable tv industry. *International Economic Review*, 56(3):805–850, August 2015.

Colin Camerer. Prospect theory in the wild: Evidence from the field. In Daniel Kahneman and Amos Tversky, editors, *Choices, Values, and Frames*, chapter 10, pages 266–290. Cambridge University Press, Cambridge, 2001.

Colin Camerer, Linda Babcock, George Loewenstein, and Richard Thaler. Labor supply of new york city cabdrivers: One day at a time. *The Quarterly Journal of Economics*, 112 (2):407–441, 1997.

Sungjin Cho and John Rust. The flat rental puzzle. *The Review of Economic Studies*, 77 (2):560–594, April 2010.

Augustin Cournot. *Researches into the mathematical principles of the theory of wealth*. The Macmillan Company, New York, 1897.

Vincent P. Crawford and Juanjuan Meng. New york city cab drivers' labor supply revisited: Reference-dependent preferences with rational-expectations targets for hours and income. *American Economic Review*, 101(5):1912–32, 2011.

Richard M. Cyert and James G. March. *A Behavioral Theory of the Firm*. Prentice-Hall, Incorporated, P.O. Box 500, Englewoods Cliffs, NJ 07632, 1963.

Stefano Dellavigna and Matthew Gentzkow. Uniform pricing in u.s. retail chains. *The Quarterly Journal of Economics*, 134(4):2011–2084, June 2019.

Stefano DellaVigna, Attila Lindner, Balázs Reizer, and Johannes F. Schmieder. Reference-dependent job search: Evidence from hungary. *The Quarterly Journal of Economics*, 132 (4):1969–2018, 05 2017.

Eugene F. Fama and Michael C. Jensen. Separation of ownership and control. *The Journal of Law & Economics*, 26(2):301–325, 1983.

Henry S. Farber. Is tomorrow another day? the labor supply of new york city cabdrivers. *Journal of political Economy*, 113(1):46–82, 2005.

Henry S. Farber. Reference-dependent preferences and labor supply: The case of new york city taxi drivers. *American Economic Review*, 98(3):1069–82, 2008.

Henry S. Farber. Why you can't find a taxi in the rain and other labor supply lessons from cab drivers. *The Quarterly Journal of Economics*, 130(4):1975–2026, 2015.

Milton Friedman. The methodology of positive economics. In Milton Friedman, editor, *Essays in Positive Economics*, pages 3–43. University of Chicago Press, 1953.

David Genesove and Christopher Mayer. Loss aversion and seller behavior: Evidence from the housing market. *The Quarterly Journal of Economics*, 116(4):1233–1260, 2001.

Avi Goldfarb and Mo Xiao. Who thinks about the competition? managerial ability and strategic entry in us local telephone markets. *American Economic Review*, 101(7):3130–61, December 2011.

Avi Goldfarb and Botao Yang. Are all managers created equal? *Journal of Marketing Research*, 46(5):612–622, 2009.

Dale Griffin and Amos Tversky. The weighing of evidence and the determinants of confidence. *Cognitive Psychology*, 24:411–435, 1992.

R. L. Hall and C. J. Hitch. Price theory and business behavior. *Oxford Economic Papers*, (2):12–45, May 1939.

Barton H. Hamilton. Does entrepreneurship pay? an empirical analysis of the returns to self-employment. *Journal of Political Economy*, 108(3):604–631, 2000.

Fabian Herweg. The expectation-based loss-averse newsvendor. *Economics Letters*, 120(3): 429–432, 2013.

Fabian Herweg and Klaus M. Schmidt. Loss aversion and inefficient renegotiation. *Review of Economic Studies*, 82(1):297–332, 2014.

Hugo A. Hopenhayn. Entry, exit and firm dynamics in long run equilibrium. *Econometrica*, 60(5):1127–1150, September 1992.

Ali Hortaşçu and Steven L. Puller. Understanding strategic bidding in multi-unit auctions: a case study of the texas electricity spot market. *Rand Journal of Economics*, 39(1):86–114, Spring 2008.

Erik G. Hurst and Benjamin W. Pugsley. What do small businesses do? *Brookings Papers on Economic Activity*, pages 73–143, 2011.

Daniel Kahneman and Amos Tversky. Prospect theory. *Econometrica*, 47(2):263–291, March 1979.

Sacha Kapoor. Inefficient incentives and nonprice allocations: Experimental evidence from big-box restaurants. *Journal of Economics & Management Strategy*, 29(2):401–419, 2020.

Sacha Kapoor and Arvind Magesan. Having it easy: Discrimination and specialization in the workplace. *Journal of Economic Behavior & Organization*, 166:153–173, 2019.

Botond Kőszegi and Matthew Rabin. A model of reference-dependent preferences. *The Quarterly Journal of Economics*, 121(4):1133–1165, 2006.

Vanessa Kobberling and Peter Wakker. An index of loss aversion. *Journal of Economic Theory*, 122:119–131, 2005.

Steven D. Levitt. An economist sells bagels: A case study in profit maximization. *NBER Working Papers*, (12152), April 2006.

Elaine Liu. Time to change what to sow: Risk preferences and technology adoption decisions of cotton farmers in china. *Review of Economics and Statistics*, 95(4):1386–1403, 2014.

Fritz Machlup. Marginal analysis and empirical research. *The American Economic Review*, 36(4):519–554, September 1946.

James G. March and Herbert A. Simon. *Organizations*. Wiley, New York, 1958.

Alex Markle, George Wu, Rebecca White, and Aaron Sackett. Goals as reference points in marathon running: A novel test of reference dependence. *Journal of Risk and Uncertainty*, 56(1):19–50, 2018.

Alfred Marshall. *Principles of Economics; an Introductory Volume*. MacMillan, London, 1920.

Andreu Mas-Colell, Michael Dennis Whinston, and Jerry R. Green. *Microeconomic Theory*. Oxford student edition. Oxford University Press, 1995.

Cade Massey and Richard H. Thaler. The loser's curse: Decision making and market efficiency in the national football league draft. *Management Science*, 59(7):1479–1495, 2013.

Marc J. Melitz. The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, 71(6):1695–1725, 2003.

John Morgan and Dana Sisak. Aspiring to succeed: A model of entrepreneurship and fear of failure. *Journal of Business Venturing*, 31(1):1–21, 2016.

Ted O'Donoghue and Charles Sprenger. Reference-dependent preferences. In *Handbook of Behavioral Economics: Applications and Foundations 1*, volume 1, pages 1–77. 2018.

Devin G. Pope and Maurice E. Schweitzer. Is tiger woods loss averse? persistent bias in the face of experience, competition, and high stakes. *The American Economic Review*, 101 (1):129–157, February 2011.

Matthew Rabin. Psychology and economics. *Journal of Economic Literature*, 36(1):11–46,

1998.
Alex Rees-Jones. Quantifying Loss-Averse Tax Manipulation. *The Review of Economic Studies*, 85(2):1251–1278, 04 2018.
Maurice E Schweitzer and Gérard P Cachon. Decision bias in the newsvendor problem with a known demand distribution: Experimental evidence. *Management Science*, 46(3):404–420, 2000.
Herbert A Simon. A comparison of organisation theories. *The Review of Economic Studies*, 20(1):40–48, 1952.
Herbert A. Simon. A behavioral model of rational choice. *The Quarterly Journal of Economics*, 69(1):99–118, February 1955.
Herbert A. Simon. Rational decision making in business organizations. *The American economic review*, 69(4):493–513, 1979.
Herbert A. Simon and Chester I. Barnard. *Administrative behavior: a Study of Decision-Making Processes in Administrative Organization*. Macmillan Co., 1947.
Andrew Sweeting. Price dynamics in perishable goods markets: The case of secondary markets for major league baseball tickets. *Journal of Political Economy*, 120(6):1133–1172, December 2012.
Neil Thakral and Linh T. Tô. Daily labor supply and adaptive reference points. *American Economic Review*, 111(8):2417–43, August 2021.
Hal R Varian. The nonparametric approach to production analysis. *Econometrica: Journal of the Econometric Society*, pages 579–597, 1984.
Glen Whyte. Escalating commitment to a course of action: A reinterpretation. *Academy of management review*, 11(2):311–321, 1986.
Glen Whyte. Escalating commitment in individual and group decision making: A prospect theory approach. *Organizational behavior and human decision processes*, 54(3):430–455, 1993.

Table 1: Owner survey descriptives (Firms=107).

Variable	Mean	Standard deviation	Minimum	Maximum
Loss aversion	10.14	35.06	0.0001	260.00
	Median = 1.57, Interquartile Range = [1,3.33]			
Age	35.93	10.35	20	63
Experience (months)	144.88	124.25	1.5	456
Number of employees	17.48	17.02	0	130
Willingness to take risks 0: risk averse 10: fully prepared to take risks	6.67	1.76	0	10
Customer volume (per week)	1124.21	1348.19	75	10000
Percentage change in customer volume after a				
5 percent increase in the current price	0.98	2.00	0	12
5 percent increase at 105 percent of current price	1.81	2.90	0	20
10 percent increase at 110 percent of current price	1.94	2.10	0	10

Notes:

[1] Owners are loss neutral if the estimate of their loss aversion coefficient is 1, gain seeking if it is less than 1, and loss averse if it is greater than 1.

[2] We tested the hypothesis that owners are either gain seeking or loss neutral, against the alternative where they are loss averse. The t-statistic for the test had a p-value of 0.004 over the full sample. It had a p-value of 0.000 over the interquartile range. The statistics leads us to reject the hypothesis that owners are either gain seeking or loss neutral.

Table 2: Loss aversion and experience.

	Loss Aversion, $ln(1+\lambda)$				
	(1)	(2)	(3)	(4)	(5)
Experience (months, in logs)	0.17***	0.17***	0.17***	0.18***	0.16***
	(0.06)	(0.06)	(0.07)	(0.06)	(0.06)
Percentage Change in Customer Volume after a					
5 percent increase in the current price		-0.14	-0.13	-0.13	-0.11
		(0.13)	(0.13)	(0.13)	(0.13)
5 percent increase at 105 percent of current price		0.19	0.21	0.19	0.20
		(0.29)	(0.29)	(0.30)	(0.32)
10 percent increase at 110 percent of current price		-0.02	-0.03	-0.03	-0.07
		(0.17)	(0.18)	(0.18)	(0.18)
Customer Volume (per Week, in logs)		0.02	-0.02	-0.02	-0.03
		(0.11)	(0.11)	(0.12)	(0.12)
Number of Employees (in logs)			0.08	0.08	0.12
			(0.14)	(0.14)	(0.16)
Willingness to Take Risks				-0.04	-0.04
(0: Risk Averse; 10: fully prepared to take risks)				(0.05)	(0.08)
Age					0.01
					(0.01)
Firms	107	105	105	105	102
R^2	0.05	0.06	0.07	0.07	0.08

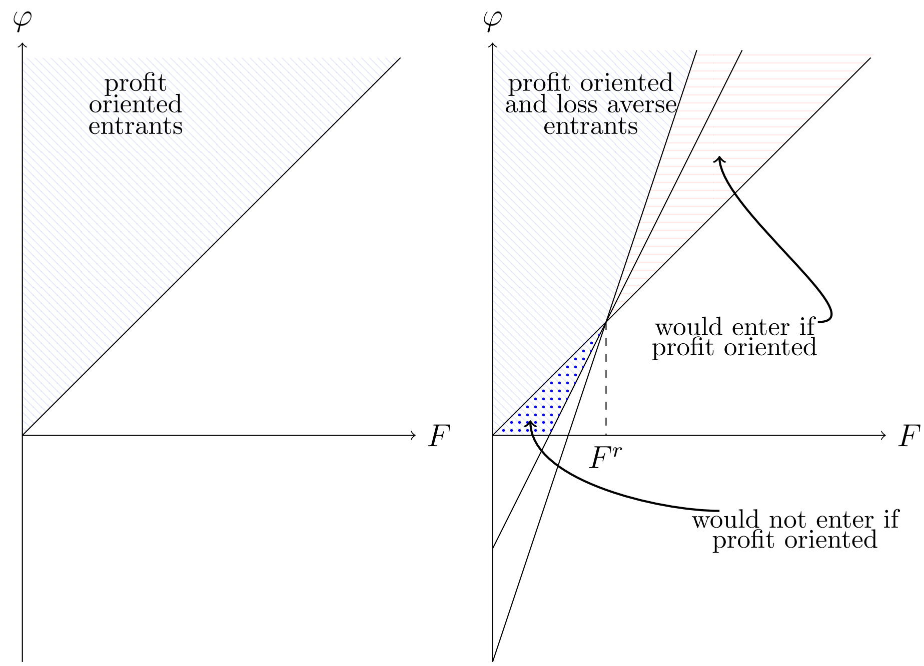
Notes:
[1] Table reports regression estimates of the effects of various covariates on the loss aversion of the owner.
[2] The transformation $ln(1+\lambda)$ reduces the influence of large outliers, without introducing new ones (a few λ are less than 1). Taking logs of Experience, Customer Volume, and the Number of Employees further reduces the influence of outliers.
[3] The elasticities are in absolute values, and standardized by their mean and standard deviation.
[4] Robust standard errors in parentheses, with *** for $p < 0.01$, ** for $0.01 < p < 0.05$, and * for $p < 0.1$.

Table 3: Exit probability and loss aversion.

	Exit	
	(1)	(2)
Loss averse ($\lambda > 1$; yes=1, no=0)	-0.21**	-0.18*
	(0.10)	(0.10)
Controls	N	Y
Firms	107	102
R^2	0.05	0.08

Notes:
[1] Table reports regression estimates of the effects of owner loss aversion on exit decision of firm.
[2] Dependent variable equals 1 if the firm closed permanently as of October 2021 and 0 otherwise, more than five years after the original survey. The mean of the exit variable is 0.28.
[3] Control variables include the log of owner experience, log of customer volume, log of number of employees, owner perceptions of the price elasticity of demand, their willingness to take risks, and their age.
[4] Robust standard errors in parenthesese, with *** for $p < 0.01$, ** for $0.01 < p < 0.05$, and * for $p < 0.1$.

Figure 1: Entrant composition under profit maximization and loss aversion.



Notes:

1 φ and F is the productivity and fixed cost of a potential entrant if they enter and stay in. Blue northwest lines describe productivity-cost combinations of potential entrants who stay in after learning φ and F.

2 Profit oriented firms have $\eta = 0$.

3 Blue northwest lines with dots are for loss averse decision makers who would have not entered had they been profit oriented.

4 Red horizontal lines are for loss averse decision makers who would have entered had they been profit oriented.

Table 4: Summary statistics for U.S. restaurant industry (1998-2019)

	Mean	SD	Min	Max	N
Establishments (total number)	163.78	562.34	1.00	20,840.00	68279
Employees (total number)	2,922.73	10,190.92	0.00	372,966.00	68279
Housing price index (base year = 100)	247.99	160.61	62.10	2,266.07	58905
Population density (per square mile)	257.46	1,733.39	0.04	71,797.63	69548
Annual payroll per establishment (US$ 1000s)	154.69	94.02	0.00	754.80	68279
Annual payroll per establishment (change)	6.01	26.88	-681.05	754.80	68169
Above average payroll (frequency)	0.69	0.46	0.00	1.00	70899
Below average payroll (frequency)	0.31	0.46	0.00	1.00	70899
Above average payroll (Amount)	11.37	19.01	0.00	754.80	68169
Below average payroll (Amount)	-5.36	15.47	-681.05	0.00	68169

Notes:

[1] Statistics based on County Business Pattern data. Data is produced and distributed by the United State Census Bureau.

[2] Unit of observation is the county and year. There are 3152 counties.

[3] Housing price index is constructed using appraisal values and sales prices for mortgages bought or guaranteed by Fannie Mae and Freddie Mac.

[4] Annual payroll per establishment (change) is the year over year first difference. Above average payroll refers to the difference between payroll in the current and last year when the difference is positive. Below average payroll refers to the difference between payroll in the current and last year when the difference is negative.

Table 5: Establishments and payroll increases and decreases

	Establishments (in logs)		
	(1)	(2)	(3)
β_1: Employees (in logs)	0.843***	0.297***	0.171***
	(0.011)	(0.011)	(0.008)
β_2: Housing price index (standardized, base year = 100)	0.133***	0.073***	0.027***
	(0.016)	(0.015)	(0.006)
β_3: Population density (standardized, per square mile)	0.032***	0.211**	0.068**
	(0.008)	(0.087)	(0.029)
β_4: Annual payroll per establishment (1 lag, standardized)	-0.220***	-0.074***	-0.030***
	(0.011)	(0.008)	(0.003)
β_g: Below average payroll (standardized)	-0.024***	-0.013***	-0.014***
	(0.004)	(0.002)	(0.002)
β_l: Above average payroll (standardized)	-0.069***	-0.030***	-0.026***
	(0.002)	(0.002)	(0.002)
β_7: Establishments (1 lag, in logs)			0.624***
			(0.009)
β_8: Employees (1 lag, in logs)			-0.047***
			(0.006)
β_0: Constant	-1.475***	1.026***	0.359***
	(0.066)	(0.074)	(0.050)
H_0: $\beta_l/\beta_g = 1$	2.907***	2.204***	1.868***
	(0.486)	(0.377)	(0.243)
County Fixed Effects	N	Y	Y
Year Fixed Effects	N	Y	Y
Observations	58777	58761	58756
R^2	0.967	0.993	0.996

Notes:
[1] Table reports estimates of the effect of year-over-year payroll increases and decreases on the number of establishments.
[2] Unit of observation is the county and year. There are 3152 counties.
[3] Standard errors clustered on the state and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5 percent levels.

Table 6: Entry and exit rates and payroll increases and decreases

	Entry Rate (1)	Exit Rate (2)
β_1: Employees (in logs)	3.342***	-7.235***
	(0.351)	(0.660)
β_2: Housing price index (standardized, base year = 100)	0.308	-0.403***
	(0.188)	(0.145)
β_3: Population density (standardized, per square mile)	0.453	-1.765*
	(0.819)	(0.880)
β_4: Annual payroll per establishment (1 lag, standardized)	-0.475**	0.387**
	(0.222)	(0.169)
β_g: Below average payroll (standardized)	-0.299***	0.120
	(0.065)	(0.081)
β_l: Above average payroll (standardized)	-0.186***	0.924***
	(0.062)	(0.061)
β_7: Establishments (1 lag, in logs)	3.887***	12.219***
	(0.715)	(0.682)
β_8: Employees (1 lag, in logs)	-5.040***	1.876***
	(0.427)	(0.358)
β_0: Constant	7.893***	-5.172**
	(2.025)	(2.519)
$H_0 : \beta_l/\beta_g = 1$	0.623	7.683
	(0.255)	(4.937)
County Fixed Effects	Y	Y
Year Fixed Effects	Y	Y
Observations	47773	47416
R^2	0.314	0.363

Notes:

[1] Table reports estimates of the effect of year-over-year payroll increases and decreases on entry and exit rates.

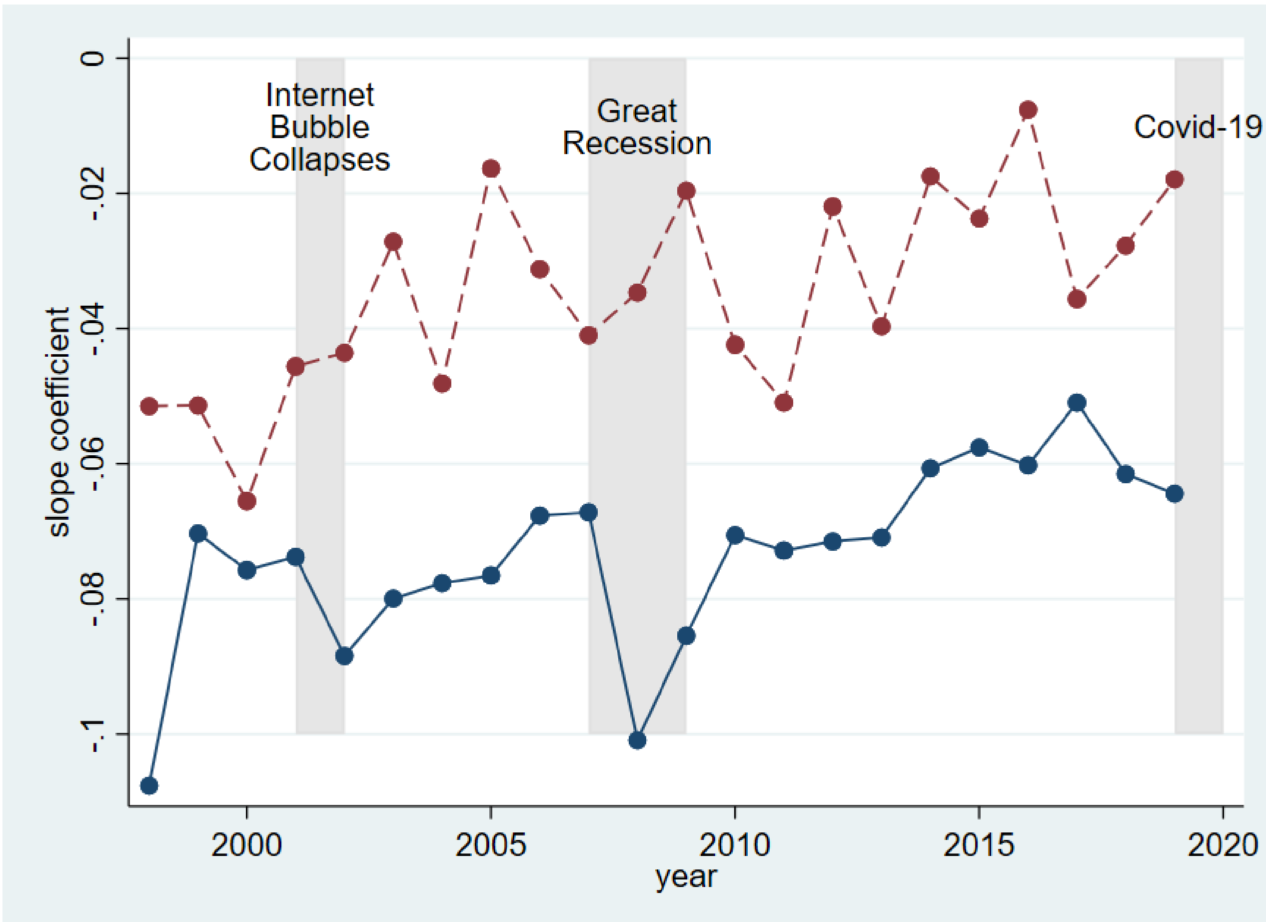
[2] Unit of observation is the county and year. There are 3152 counties.

[3] Entry and exit rates come from the Business Dynamics Statistics (BDS), produced and distributed by the U.S. Census Bureau. Entry rates are 100 multiplied the count of establishments born within the last 12 months divided by the average count for the last two years. Exit rates are constructed similarly.

[4] Entry and exit rates are based on 2-digit NAICS code number 72, which encapsulates accommodation as well as food service, and is the lowest level of aggregation available at the county level.

[5] Standard errors clustered on the state and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5 percent levels.

Figure 2: Loss and gain coefficients over time (all firm sizes)



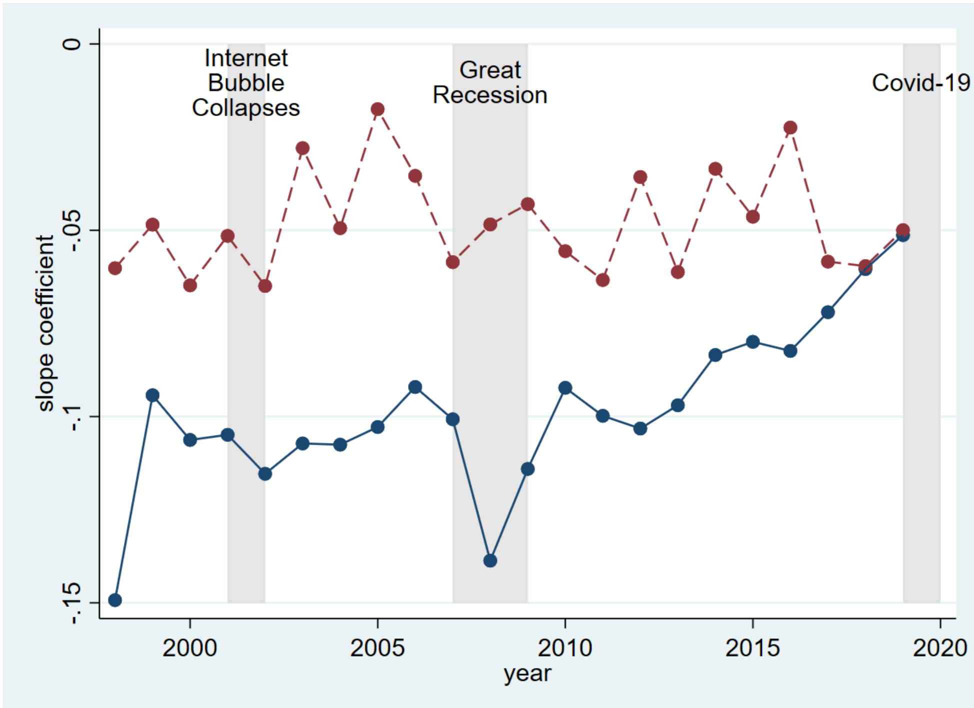
Notes:

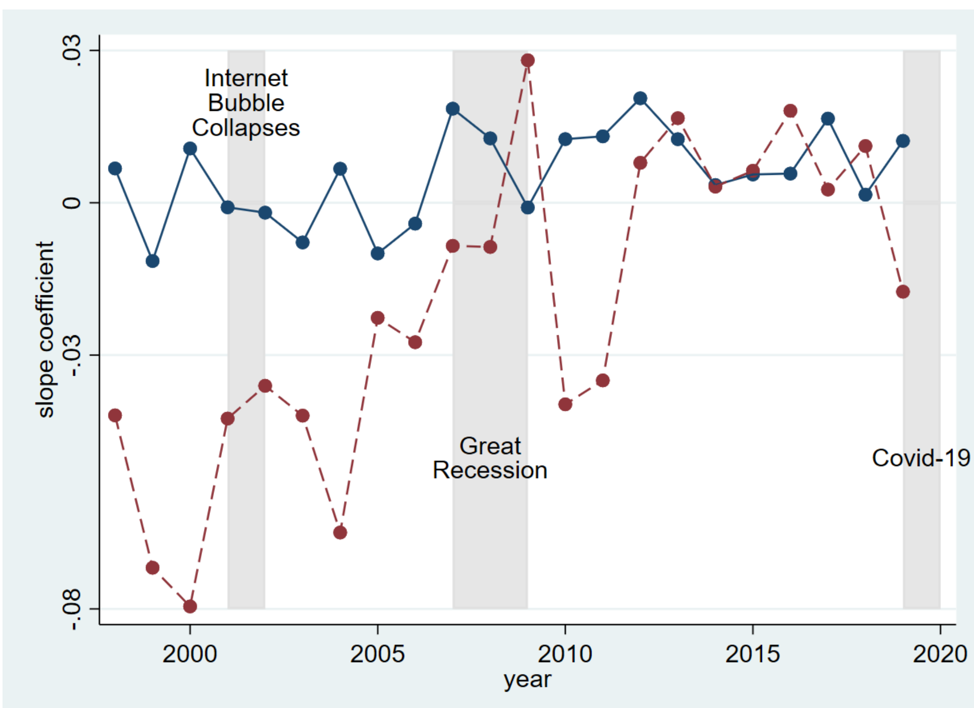
1 Estimates of the effects of year-over-year increases (losses) and decreases (gains) in annual payroll on the number of firms (in logs).

2 Each dot represents a coefficient estimates based on the cross section of counties (and states) for the relevant year.

3 Solid blue line uses estimates of loss coefficients. Dashed red line uses estimates of gain coefficients.

Figure 3: Loss and gain coefficients over time for small and large firms.

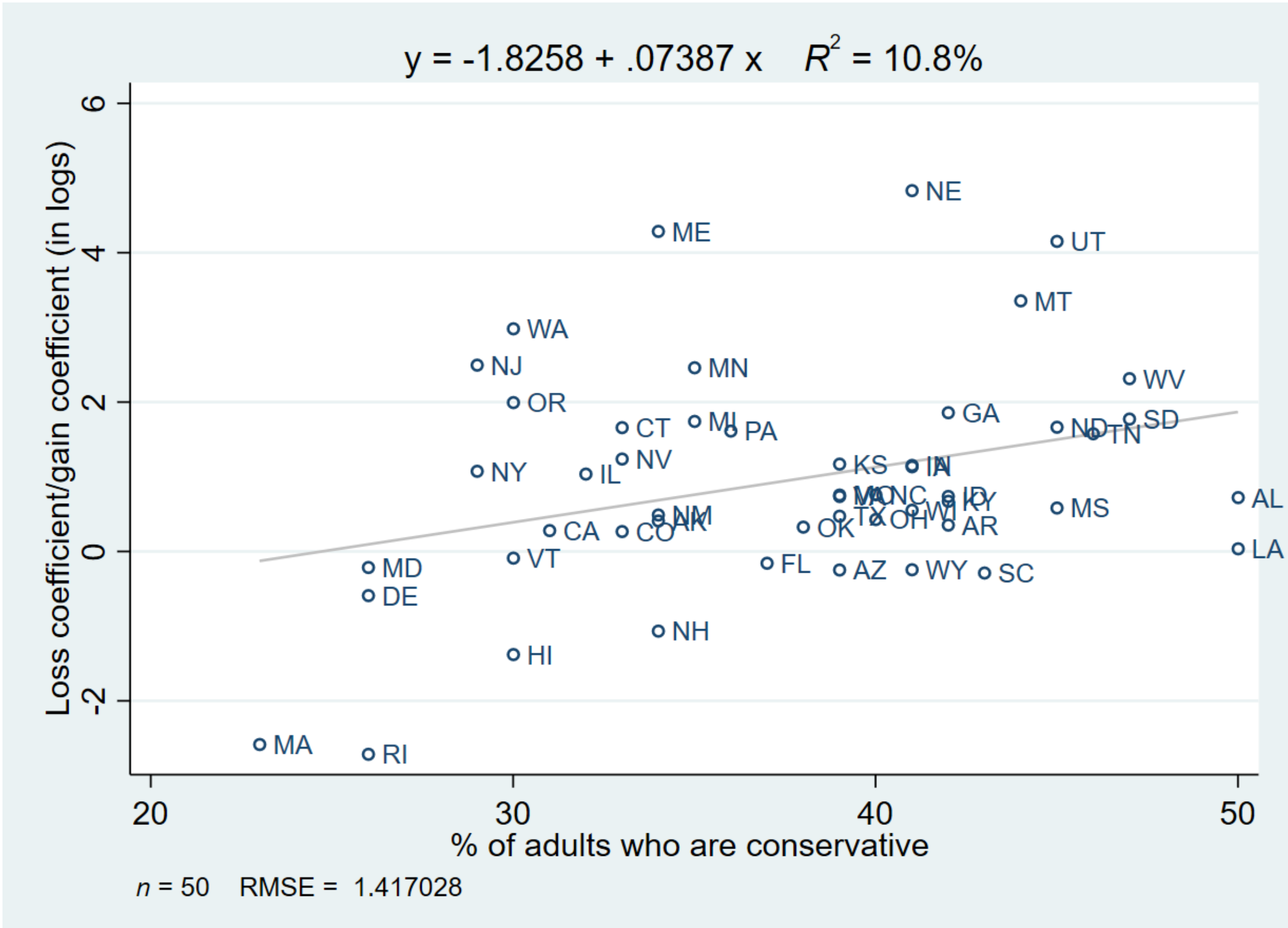




Notes:

1 Estimates of the effects of year-over-year increases (losses) and decreases (gains) in annual payroll on the number of small and large firms (in logs).
2 Number of small firms (< 20 employees) used in top figure. Bottom figure uses number of large firms.
3 Each dot represents a coefficient estimates based on the cross section of counties (and states) for the relevant year.
4 Solid blue line uses estimates of loss coefficients. Dashed red line uses estimates of gain coefficients.

Figure 4: Loss and gain coefficients across States.



Notes:

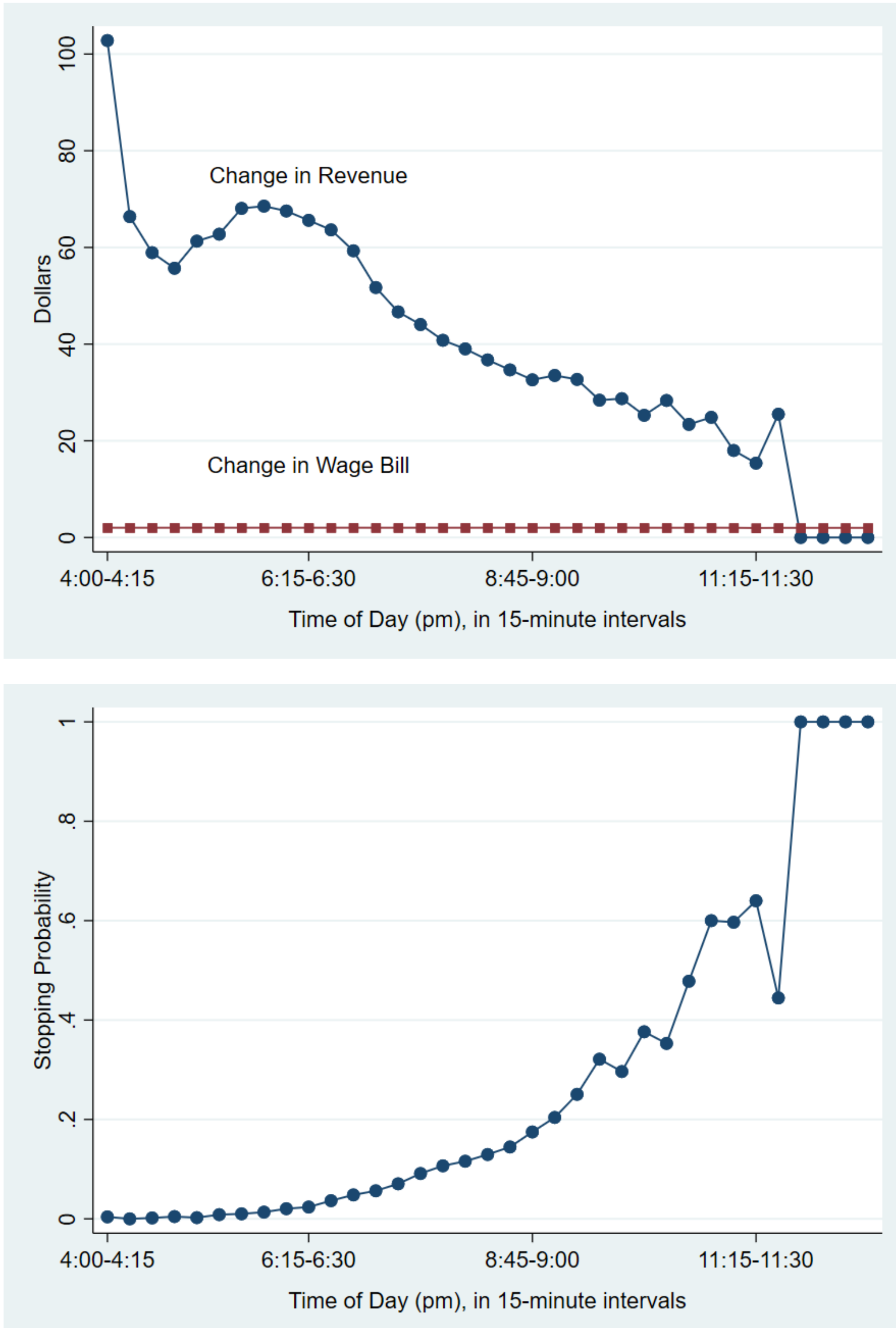
1 Vertical axis references estimates of the effects of year-over-year increases (losses) and decreases (gains) in annual payroll on the number of firms (in logs). Each loss/gain coefficient is computed using cross sectional and time series variation across counties within a State.

2 Horizontal axis references the percentage of adults in the state who are conservative. This information is taken from the 2014 PEW survey of political ideology by state.

3 State acronyms are attached to each loss/gain coefficient and involuntary bankruptcy share pair.

4 Slope coefficient is statistically significant at 5 percent level, with or without robust standard errors.

Figure 5: Revenue, wages, and stopping probability.



Notes:

1 Top figure plots 1 period ahead change in revenue against 1 period ahead change in cost. Each dot is the average over workers in a 15-minute interval.
2 Vertical axis in the bottom figure references the proportion of workers who stop taking customers.
3 Horizontal axes reference the time of day in 15-minute intervals.
4 Workers are paid in accordance with these 15-minute intervals.

Table 7: Loss coefficients for stopping decisions.

	Stop Worker (1=yes)		
	All	Slow days	Busy days
	(1)	(2)	(3)
Loss Coefficients			
$\overline{\lambda}_r$	0.588***	0.434***	0.849
$= (1-\eta+\eta\beta_{rl})/(1-\eta+\eta\beta_{rg})$	(0.051)	(0.066)	(0.082)
λ_F	2.548***	3.257***	1.361
$= \beta_{Fl}/\beta_{Fg}$	(0.233)	(0.400)	(0.280)
Reduced Form Coefficients			
$(1-\eta+\eta\beta_{rl})/\sigma$	0.002***	0.002***	0.004***
	(0.000)	(0.000)	(0.000)
$(1-\eta+\eta\beta_{rg})/\sigma$	0.004***	0.004***	0.004***
	(0.000)	(0.000)	(0.000)
$\eta\beta_{Fl}/\sigma$	-0.142***	-0.158***	-0.090***
	(0.009)	(0.011)	(0.017)
$\eta\beta_{Fg}/\sigma$	-0.056***	-0.048**	-0.066***
	(0.004)	(0.005)	(0.006)
c	-2.225***	-1.280***	-2.274***
	(0.103)	(0.080)	(0.103)
Observations	48816	21795	27021
Log-likelihood	-16459	-8995	-7441

Notes:

[1] Reference points based on coworker averages.

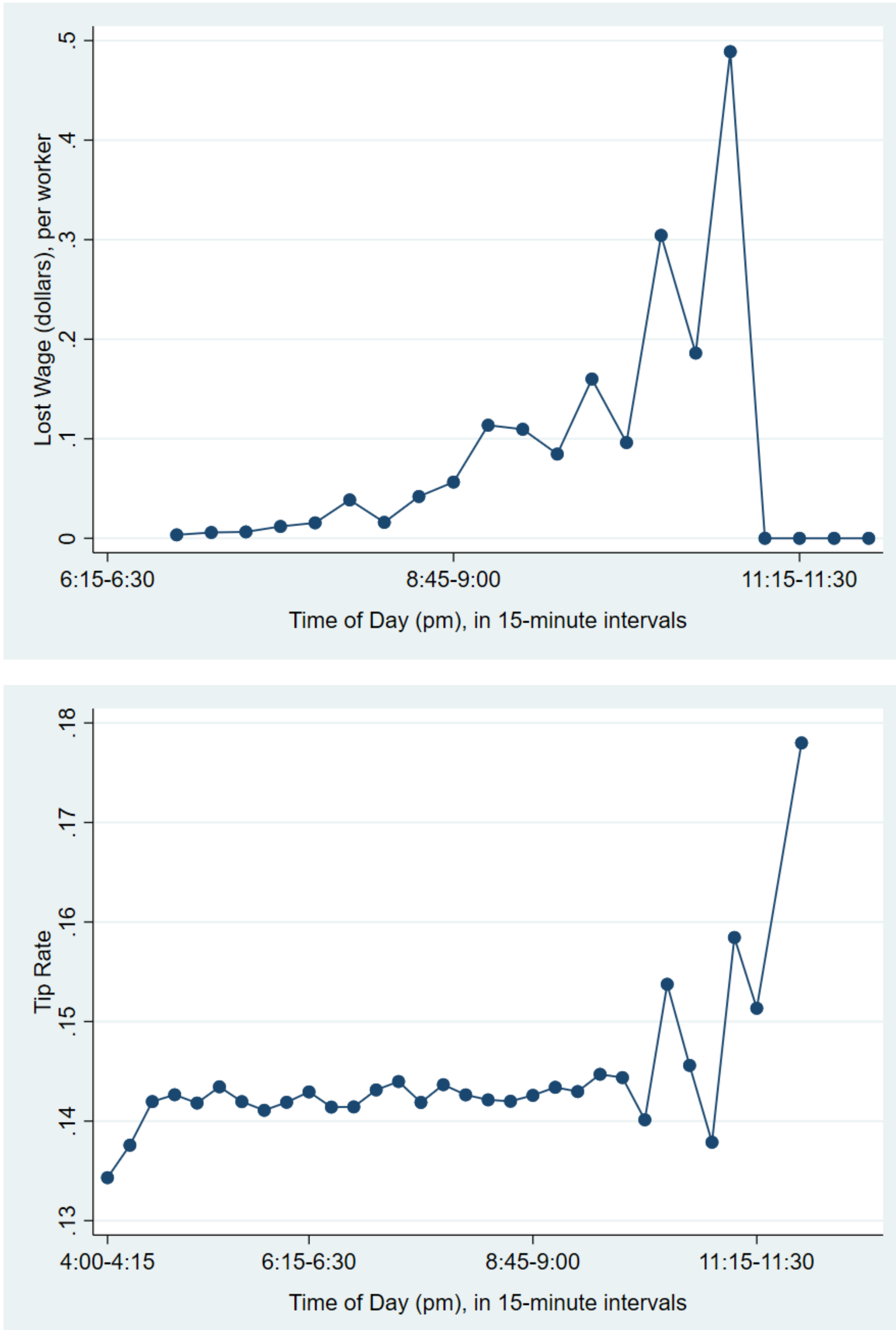
[2] Top panel reports structural estimates of the loss coefficients for revenue and the wage bill. Middle panel reports reduced form coefficient estimates for revenue gains and losses and for wage bill gains and losses, as well as a constant term. Null hypotheses in top panel are with reference to loss neutrality ($\overline{\lambda}_r = 1$ and $\lambda_F = 1$). Null hypotheses in middle panel are that the reduced form coefficients equal 0.

[3] Busy days are Fridays and Saturdays. 46 percent of consumer demand is generated on these days.

[4] Regressions condition on fixed effects for the restaurant-day of week-period combination. Periods are defined by 15-minute intervals.

[5] Standard errors in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5 percent levels.

Figure 6: Stopping decisions, wages, and tip rates.



Notes:

1 Top figure plots the lost wage per worker against the time of day. It uses slow (small scale) days because we observe loss averse behavior in shifts which take place on these days.

2 The lost wage is computed as follows. We estimated the stopping model and set gain-loss utility parameters equal to 0 and simulate the stopping decision. We assign the prorated hourly wage to the periods where workers were stopped early and compute the sum.

3 The mean lost wage is $1.73 (Canadian dollars) or 4.7 percent of daily earnings from hourly wages.

4 Bottom figure plots mean tip rates per period against the period.

Do the objectives of firms reflect the psychologies of owners?
Evidence of loss averse firms in a competitive industry

Online Appendix

Sacha Kapoor

March 1, 2023

A.1 Loss aversion measurement

1. Which business would you prefer to own? One where:

you are **GUARANTEED**	**COIN FLIP** determines whether you earn		
a profit of €0	a profit of €200000	**OR**	a loss of €200000
a profit of €0	a profit of €200000	**OR**	a loss of €100000
a profit of €0	a profit of €200000	**OR**	a loss of €50000

2. What loss would just make you willing to own the second business?

you are **GUARANTEED**	**COIN FLIP** determines whether you earn		
a profit of €0	a profit of €200000	**OR**	a loss (or profit) of €L=

3. Which business would you prefer to own? One where:

you are **GUARANTEED**	**COIN FLIP** determines whether you earn		
a profit of €175000	a profit of €200000	**OR**	a profit of €0
a profit of €150000	a profit of €200000	**OR**	a profit of €0
a profit of €125000	a profit of €200000	**OR**	a profit of €0

4. How small would the guarantee have to be for you to be willing to own the second business?

you are **GUARANTEED**	**COIN FLIP** determines whether you earn		
a profit of €G=	a profit of €200000	**OR**	a profit of €0

5. Which business would you prefer to own? One where:

you are **GUARANTEED**	**COIN FLIP** determines whether you earn		
a loss of €	a loss of € L=	**OR**	a profit of € 0
a loss of €	a loss of € L=	**OR**	a profit of € 0
a loss of €	a loss of € L=	**OR**	a profit of € 0

6. What would the guarantee have to be for you to be willing to own the second business?

you are **GUARANTEED**	**COIN FLIP** determines whether you earn	
a loss of € X=	a loss of € L=	**OR** a profit of € 0

A.2 Melitz model and loss aversion.

A.2.1. Demand. There is a continuum of varieties $\omega \in \Omega$. For each variety ω, consumers choose $q(\omega)$ to maximize

$$Q = \Big[\int_{\omega \in \Omega} q(\omega)^\rho d\omega \Big]^{\frac{1}{\rho}} \qquad \text{subject to} \qquad \int_{\omega \in \Omega} p(\omega) q(\omega) d\omega = R,$$

where $p(\omega)$ is price, R total expenditure, and $0 < \rho < 1$ reflects the preference for variety. Q is an aggregator of consumer demand for each variety. The bounds on ρ rule out complementarities across varieties and bound the elasticity of substitution $\sigma = 1/(1-\rho)$ from below $\sigma > 1$.

Differentiating the Lagrangian for the consumer's problem yields

$$\frac{q(\omega)^{\rho-1}}{p(\omega)} = \frac{q(\omega')^{\rho-1}}{p(\omega')}$$

for any pair of varieties ω and ω'. This expression can be used to derive an aggregate price index

$$P = \frac{R}{Q} = \Big[\int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega \Big]^{\frac{1}{1-\sigma}},$$

and the demand function

$$q(\omega') = \frac{R}{P} [\frac{P}{p(\omega')}]^\sigma = Q[\frac{P}{p(\omega')}]^\sigma.$$

and then firm revenue for an arbitrary ω:

$$r(\omega) = p(\omega) q(\omega) = R[\frac{P}{p(\omega)}]^{\sigma - 1}.$$

A.2.2. Production. There is a continuum of firms identified by the variety ω they produce. A producer of variety ω has productivity $\varphi(\omega)$ and fixed cost $F(\omega) = wf(\omega)$, where w is a wage. They use $\ell(\omega) = q(\omega)/\varphi(\omega) + f(\omega)$ labor units to produce quantity $q(\omega)$. They choose

$p(\omega)$ to maximize

$$V(\omega) = (1-\eta)\pi(\omega) + \eta v(F(\omega)|F^r)$$

where $\pi(\omega) = r(\omega) - w\ell(\omega)$ and

$$v(F(\omega)|F^r) = [F(\omega) - F^r]^- + \lambda[F(\omega) - F^r]^+.$$

$[F(\omega) - F^r]^- = \min\{F(\omega) - F^r, 0\}$ measures a fixed cost gain relative to the reference point F^r, $[F(\omega) - F^r]^- = \max\{F(\omega) - F^r, 0\}$ measures a fixed cost loss, and $\lambda > 1$. We assume

$$(1-\eta)F(\omega) + \eta v(F(\omega)|F^r) > 0.$$

$\eta = 0$ nests the firm's objective in Melitz [2003].

The setup assumes fixed labor costs, loss aversion in fixed costs, and loss neutrality in revenue. The assumptions are motivated by the insider evidence. Online Appendix Figure A.3.1 uses the insider data to plot the average wage bill per customer against the number of customers. The average wage bill decreases quickly at low customer volumes before flattening out at high customer volumes, consistent with a curve generated by fixed labor costs. Section 4 shows insider decision makers are loss averse in the (fixed) cost domain and gain seeking in the revenue domain, and that the weight placed on costs is more than 70 times the weight placed on revenue. By this token, loss aversion in costs and loss neutrality in revenue is a reasonable approximation to the objective function guiding firm decisions.

The optimal pricing rule, demand, and revenue equations for variety ω are the same as in Melitz [2003]:

- $p(\omega) = \frac{w}{\rho\varphi(\omega)} = \frac{\sigma}{\sigma-1}\frac{w}{\varphi(\omega)}$
- $q(\omega) = Q\left[\frac{\sigma}{\sigma-1}\varphi(\omega)P\right]^{\sigma}$
- $r(\omega) = R\left[\frac{\sigma}{\sigma-1}\varphi(\omega)P\right]^{\sigma-1}$

If a producer of ω is more productive than a producer of ω', they charge lower prices, sell more quantity, and generate more revenue. The per-period objective is then

$$V(\varphi, F) = (1-\eta)\Big\{(\frac{R}{\sigma})\Big[\frac{\sigma}{\sigma-1}\varphi P\Big]^{\sigma-1} - F\Big\} - \eta\Big\{[F - F^r]^- + \lambda[F - F^r]^+\Big\}.$$

where we have suppressed the ω in $\varphi(\omega)$ and $F(\omega)$ for notational convenience.

A.2.3. Aggregation. In Melitz [2003], equilibrium characterized by a mass of firms M and a univariate (marginal) productivity distribution $\mu_\varphi(\varphi)$ over a subset of the positive real numbers $\mathbb{R}_{>0} = (0, \infty)$. Here, equilibrium is characterized by the mass M and a bivariate productivity cost distribution $\mu(\varphi, F)$ defined over a subset Λ of $\mathbb{R}^2_{>0}$. The productivity and fixed cost of the average producing firm are then

$$\tilde{\varphi}(\Lambda) = \Big(\int\int_\Lambda \varphi^{\sigma-1}\mu(\varphi, F)d\varphi dF\Big)^{\frac{1}{\sigma-1}} \quad \text{and} \quad \tilde{F}(\Lambda) = \Big(\int\int_\Lambda F\mu(\varphi, F)d\varphi dF\Big).$$

where the weights reflect relative output shares of firms with differing levels of productivity [Melitz, 2003]. The fixed cost gain g and loss l for the average producing firm are

$$\tilde{g}(\Lambda) = \Big(\int\int_\Lambda [F - F^r]^- \mu(\varphi, F)d\varphi dF\Big) \quad \text{and} \quad \tilde{l}(\Lambda) = \Big(\int\int_\Lambda [F - F^r]^+ \mu(\varphi, F)d\varphi dF\Big).$$

Their price, quantity, revenue, profit, and utility are

$$\tilde{p}(\Lambda) = \frac{\sigma}{\sigma-1}\frac{w}{\tilde{\varphi}(\Lambda)}, \quad \tilde{q}(\Lambda) = Q(\frac{\tilde{p}(\Lambda)}{P})^{-\sigma}, \quad r(\tilde{\Lambda}) = p(\tilde{\Lambda})q(\tilde{\Lambda}),$$

and

$$\tilde{\pi}(\Lambda) = \frac{\tilde{r}(\Lambda)}{\sigma} - \tilde{F}(\Lambda), \quad \text{and} \quad \tilde{V}(\Lambda) = (1-\eta)\tilde{\pi}(\Lambda) - \eta(\tilde{g}(\Lambda) + \lambda\tilde{l}(\Lambda)).$$

With these objects we can compute aggregate price

$$P = \Big[\int_{\omega\in\Omega} p(\omega)^{1-\sigma}d\omega\Big]^{\frac{1}{1-\sigma}} = \Big[\int\int_\Lambda p(\varphi)^{1-\sigma}M\mu(\varphi, F)d\varphi dF\Big]^{\frac{1}{1-\sigma}} = M^{\frac{1}{1-\sigma}}\tilde{p}(\Lambda),$$

Since $q(\omega) = \Big(\frac{\varphi(\omega)}{\varphi(\omega')}\Big)^\sigma q(\omega')\ \forall\ \omega$ and ω', which implies $q(\varphi) = \Big(\frac{\varphi}{\tilde{\varphi}}\Big)^\sigma q(\tilde{\varphi})$, we have

$$Q = \Big[\int_{\omega\in\Omega} q(\omega)^\rho d\omega\Big]^{\frac{1}{\rho}} = \Big[\int\int_\Lambda q(\varphi)^\rho M\mu(\varphi, F)d\varphi dF\Big]^{\frac{1}{\rho}} = M^{\frac{\sigma}{\sigma-1}}\tilde{q}(\Lambda).$$

It follows that $R = PQ = M\tilde{r}(\Lambda)$. Unlike the price, quantity, revenue aggregates, the profit and utility aggregates depend on the fixed cost of the average producing firm. In particular, aggregate profit and utility are

$$\int\int_\Lambda \pi(\varphi, F)M\mu(\varphi, F)d\varphi dF = M\tilde{\pi}(\Lambda), \quad \text{and} \quad \int\int_\Lambda V(\varphi, F)M\mu(\varphi, F)d\varphi dF = M\tilde{V}(\Lambda)$$

which imply profit or utility of the average firm coincides with profit or utility per firm.

A.2.4. Firm entry and exit. Potential entrants are drawn from a large unbounded set of firms which are identical prior to entry. They must make an initial investment c_e in order to enter and learn their (φ, F), where (φ, F) are drawn from a continuous and common joint distribution with density $h(\varphi, F)$. c_e is sunk upon entry. Entrants then decide whether to exit immediately or to stay in. In the Melitz model and here exit takes place thereafter with exogeneous probability δ.

Entrants that exit immediately or to stay in do so on the basis of

$$\max\{\overline{u}, \sum_{t=0}^{\infty}(1-\delta)^t V(\varphi, F)\} = \max\{\overline{u}, \frac{(1-\eta)\pi(\varphi, F) + \eta v(F|F^r)}{\delta}\}.$$

where $\overline{u} > 0$ is the value the entrant derives from their outside option. Entrants stay in if $V(\varphi, F) \geq \overline{u}$. At the boundary φ is implicitly a function of F

$$\text{LB}\{\varphi(F)^{\sigma-1}\} = \begin{cases} \overline{u}, & \text{if } F < \eta F^r \\ \frac{1}{\theta}F + \frac{\eta}{\theta(1-\eta)}(F - F^r) + \overline{u}, & \text{if } \eta F^r < F \leq F^r \\ \frac{1}{\theta}F + \frac{\eta}{\theta(1-\eta)}\lambda(F - F^r) + \overline{u}, & \text{if } F > F^r. \end{cases}$$

where LB is an acronym for lower bound and $\theta = (\frac{R}{\sigma})\left[\frac{\sigma}{\sigma-1}P\right]^{\sigma-1}$. The set $\Lambda = \{(\varphi, F) : \varphi^{\sigma-1} \geq \text{LB}\{\varphi(F)^{\sigma-1}\}, F > 0\}$ defines who stays and who exits after learning (φ, F). Accordingly, the *ex post* productivity-cost distribution is

$$\mu(\varphi, F) = \begin{cases} \frac{h(\varphi, F)}{p_\Lambda}, & \text{if } (\varphi, F) \in \Lambda \\ 0, & \text{otherwise} \end{cases}$$

where $p_\Lambda = \mathbb{P}((\varphi, F) \in \Lambda) = \int\int_\Lambda h(\varphi, F) d\varphi dF < 1$.

An example of the set Λ for $\sigma = 2$, $\overline{u} = 0$, $w = \theta = wf^r = 1$, $\theta = 1/2$, and $\lambda = 2$ is depicted in Figure 1. The left figure identifies the set of entrants if producers are motivated purely by profit, *i.e.* if $\eta = 0$. The right figure identifies the set of entrants under loss aversion. Loss aversion increases entry by low productivity producers who would have not entered had they been motivated purely by profit. These producers earn negative operating profit but stay in because of the additional utility gain from being below the reference fixed cost. They can stay in with negative operating profit if $\overline{u} > 0$ and the owner makes a positive wage. Loss aversion decreases entry by high productivity producers who would have entered had they been motivated purely by profit. These producers stay out despite earning positive profit because of the utility loss from being below the reference fixed cost. The equilibrium number of firms will decrease if decreased entry by high productivity producers dominates increased entry by low productivity producers.

δM firms exit in every period. Exiters are replaced by $M_e p_\Lambda$ firms who stay in after drawing (φ, F). Since we focus on stationary equilibria, where aggregate variables are fixed through time, the fraction of successful entrants exactly replaces the fraction of firms who exited: $M_e p_\Lambda = \delta M$.

A.2.5. Equilibrium. A stationary equilibrium is defined by a Λ, a conditional joint productivity-cost distribution $\mu(\varphi, F)$, and a mass of firms M such that

$$V(\varphi(F), F) = \overline{u} \tag{ZPC}$$

$$p_\Lambda \tilde{V}(\Lambda) - \delta c_e = 0 \tag{FE}$$

$$wL = R \tag{LMC}$$

where ZPC, FE, and LMC are acronyms for the zero profit (in our case utility) curve, free entry, and labor market clearing conditions. The FE condition implies

$$\int \int_\Lambda V(\varphi, F) h(\varphi, F) d\varphi dF = \delta c_e.$$

The left hand side will be finite as long as $h(\varphi, F)$ is such that the unconditional expectation of $V(\varphi, F)$ is finite. It is well defined outside of measure 0 sets defined by the boundary and kinks. We are thus able to find values for δ and c_e which equate δc_e to the left hand side. For these values an equilibrium exists.

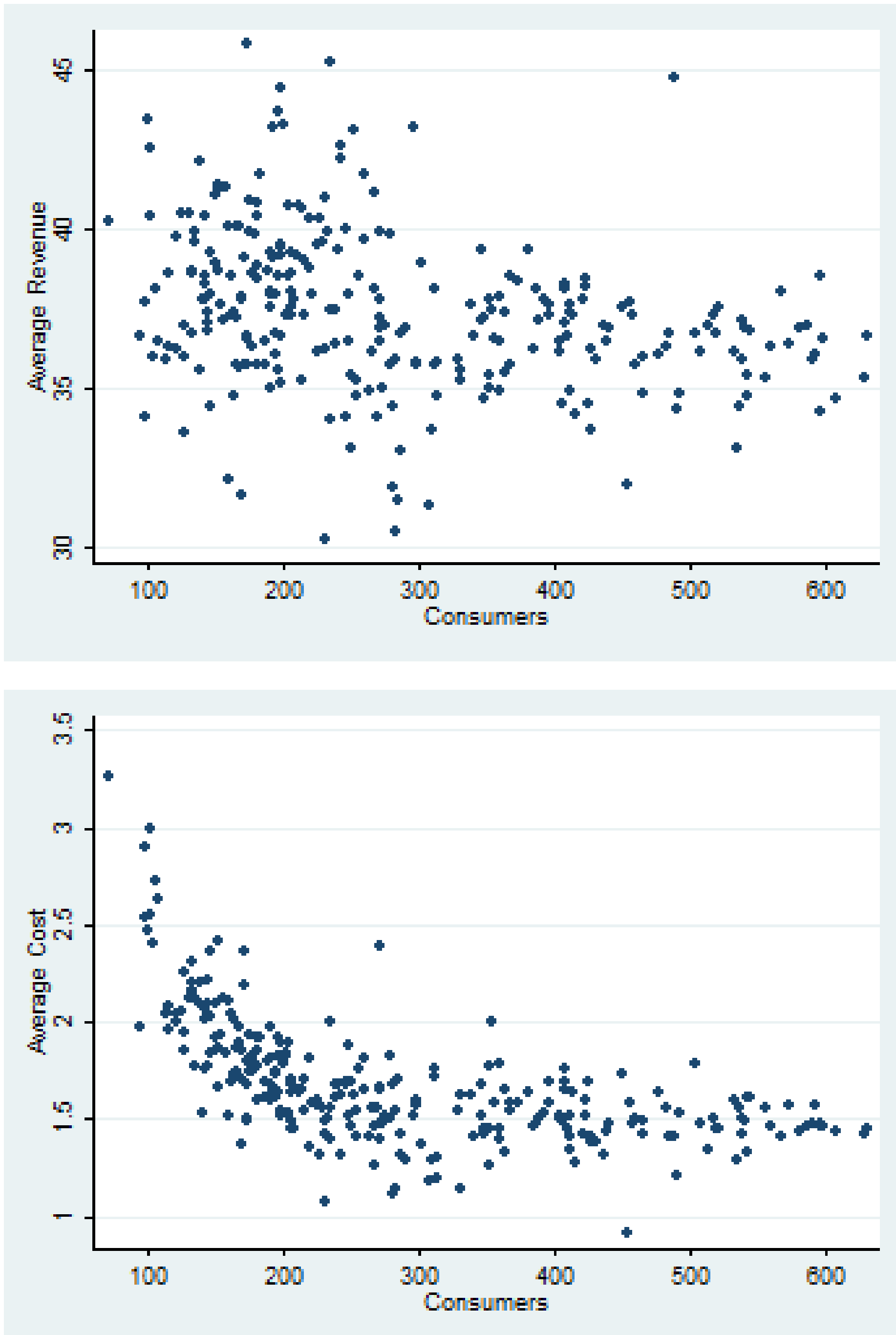
LMC implies $wL = M\tilde{r}$, then

$$M = \frac{wL}{\left(\frac{1}{1-\eta}\tilde{V}(\Lambda) + \tilde{F}(\Lambda) + \frac{\eta}{1-\eta}(\tilde{g}(\Lambda) + \lambda \tilde{l}(\Lambda))\right)},$$

which is the basis for the estimating equation in Section 3.

A.3 Additional figures and tables

Figure A.3.1: Average revenue and cost in 2006-2007



Notes:

1 Insider data from the 2006-2007. Each dot corresponds to a particular date and firm.
2 Average Revenue is the ratio of total revenue and total number of customers for that date and firm. Average cost is the ratio of hourly wages paid to waiters to total number of customers.
3 Bottom figure implies labor is a fixed cost for the firm at the shift level. Top figure implies convergence of revenue per customer around $37 when the production scale is large.
4 Source: [Kapoor, 2020].

Table A.3.1: Representativeness of owner sample.

Variable	Not Sampled	Sampled	Difference
	(1)	(2)	(2)-(1)
Price	20.59	20.87	-0.27
	(11.44)	(8.83)	[2.24]
Food Rating (/10)	7.77	7.60	0.17
	(0.60)	(0.67)	[0.11]
Service Rating (/10)	7.69	7.51	0.18
	(0.0.67)	(0.76)	[0.12]
Decor Rating (/10)	7.51	7.64	-0.13
	(0.61)	(0.55)	[0.11]
Observations	595	31	626

Notes:

[1] The table presents data from iens.nl, a website where consumers can evaluate restaurants based on their price, food, service, and decor.

[2] Column 1 presents information for restaurants not sampled in our survey, but were from the neighbourhoods of the sampled restaurants (Column 2). Note we could not locate ratings for all the restaurants we sampled in our survey.

[3] Estimates of the standard deviation are in round parentheses. Standard errors for the difference is in square parentheses, with *** for $p < 0.01$, ** for $0.01 < p < 0.05$, and * for $p < 0.1$.

Table A.3.2: Correlation with payroll changes in neighbouring counties

	Counties within					
	25 Miles		50 Miles		100 Miles	
	Below average payroll	Above average payroll	Below average payroll	Above average payroll	Below average payroll	Above average payroll
	(1)	(2)	(3)	(4)	(5)	(6)
Above average payroll	0.009	-0.004	0.027***	0.027	0.025	-0.070
(Neighbouring Counties)	(0.007)	(0.009)	(0.010)	(0.021)	(0.021)	(0.050)
Below average payroll	-0.013	0.016	-0.055***	0.015	-0.175***	0.038
(Neighbouring Counties)	(0.012)	(0.011)	(0.021)	(0.019)	(0.035)	(0.036)
Kleibergen-Paap F-statistic	0.395		1.902		0.878	
Observations	43364	43364	57049	57049	58634	58634
R^2	0.321	0.336	0.316	0.327	0.315	0.324

Notes:

[1] Table reports estimates of regressions of year-over-year payroll increases and decreases on the average year-over-year payroll increases and decreases in neighbouring counties.

[2] Unit of observation is the county and year. There are 3152 counties.

[3] Regressions condition on the number of employees (in logs), the housing price index (standardized), population density (standardized), annual payroll last year, fixed effects for the county, and fixed effects for the state-year combination.

[4] Standard errors clustered on the state and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5 percent levels.

Table A.3.3: Balancing tests

	Number of Returns (1)	Number of Exemptions (2)	Adjusted Gross Income (3)	Wages and Salaries (4)	Dividends Before Excl. (5)	Interest Received (6)
Employees (in logs)	0.022***	0.022***	0.023***	0.023***	0.026***	0.037***
	(0.005)	(0.006)	(0.006)	(0.005)	(0.009)	(0.007)
Housing price index	0.013	0.023**	0.019	0.030**	0.044***	0.089***
(standardized, base year = 100)	(0.010)	(0.010)	(0.015)	(0.014)	(0.013)	(0.019)
Population density	0.142	0.158	0.106	0.138	0.045	0.033
(standardized, per square mile)	(0.097)	(0.111)	(0.085)	(0.099)	(0.106)	(0.109)
Annual payroll	0.000**	0.000**	0.000***	0.000***	-0.000	0.000
(1 lag, in $ 1000s)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Above average payroll	0.000	-0.000	0.002	0.001	-0.001	-0.001
(standardized)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Below average payroll	0.001	0.001	0.001	0.001	-0.001	-0.001
(standardized)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	9.472***	10.251***	13.188***	12.871***	8.906***	9.614***
	(0.031)	(0.033)	(0.035)	(0.031)	(0.056)	(0.046)
Observations	31393	31395	31395	31395	31395	31395
R^2	0.998	0.998	0.997	0.997	0.991	0.992

Notes:

[1] Table reports estimates of regressions of county level tax information on average year-over-year payroll increases and decreases. Table shows the tax information is balanced relative to our measures of payroll gains and losses.

[2] Tax information is obtained from the internal revenue service (IRS) and covers 1998-2009.

[3] All dependent variables are in natural logarithms. Dividends before exclusion refers to dividends before the application of tax deductions. Interest received refers to taxable and non-taxable interest income.

[4] Regressions condition on fixed effects for the county and state-year combination.

[5] Standard errors clustered on the state and in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5 percent levels.

Table A.3.4: Scale and Demand Volatility. Customer arrivals includes customers who were served by the firm and ones who left upon learning the wait time for a seat. Standard deviations in parentheses.

	Customer Arrivals						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Minimum	82	108	169	126	211	271	207
Mean	218.59	246.47	282.87	335.30	538.83	747.75	412.06
	(75.41)	(52.99)	(61.10)	(80.23)	(93.04)	(131.85)	(147.33)
Maximum	619	417	560	602	716	1243	1220
Observations	95	100	94	94	110	110	94

Table A.3.5: Loss coefficients for stopping decisions (with alternative reference points).

	Stop Worker (1=yes)		
	All	Slow days	Busy days
	(1)	(2)	(3)
Loss Coefficients			
$\overline{\lambda}_r$	0.783***	0.698***	0.945
$= (1-\eta+\eta\beta_{rl})/(1-\eta+\eta\beta_{rg})$	(0.051)	(0.051)	(0.063)
λ_F	3.509***	5.939***	2.006***
$= \beta_{Fl}/\beta_{Fg}$	(0.422)	(1.609)	(0.264)
Reduced Form Coefficients			
$(1-\eta+\eta\beta_{rl})/\sigma$	0.004***	0.004***	0.006***
	(0.000)	(0.000)	(0.000)
$(1-\eta+\eta\beta_{rg})/\sigma$	0.006***	0.005***	0.006***
	(0.000)	(0.000)	(0.000)
$\eta\beta_{Fl}/\sigma$	-0.204***	-0.216***	-0.167***
	(0.011)	(0.013)	(0.018)
$\eta\beta_{Fg}/\sigma$	-0.058***	-0.036***	-0.083***
	(0.008)	(0.011)	(0.012)
c	-2.176***	-1.279***	-2.290***
	(0.105)	(0.083)	(0.108)
Observations	48816	21795	27021
Log-likelihood	-16190	-8833	-7332

Notes:

[1] Reference points are weighted averages of the coworker average, the average from the same day last year (if available), and the average from the same day last week.

[2] Top panel reports structural estimates of the loss coefficients for revenue and the wage bill. Middle panel reports reduced form coefficient estimates for revenue gains and losses and for wage bill gains and losses, as well as a constant term. Null hypotheses in top panel are with reference to loss neutrality ($\overline{\lambda}_r = 1$ and $\lambda_F = 1$). Null hypotheses in middle panel are that the reduced form coefficients equal 0.

[3] Busy days are Fridays and Saturdays. 46 percent of consumer demand is generated on these days.

[4] Regressions condition on fixed effects for the restaurant-day of week-period combination. Periods are defined by 15-minute intervals.

[5] Standard errors in parentheses. $***$ and $**$ denote statistical significance at the 1 and 5 percent levels.