Are markets loss averse?
Theory and evidence from a competitive industry

Julian Emami Namini and Sacha Kapoor*

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Abstract

Individual loss aversion is well-documented, with meta-analyses showing loss aversion coefficients between 1.8 and 2.1. We investigate how owners' loss aversion influences firm decisions and, in turn, market outcomes. We develop a model with monopolistic competition and loss averse firms to study implications for market structure, productivity, profits, and profit sharing. Our county-level analysis of U.S. data from 1998-2019 shows that market outcomes weigh losses more heavily than gains. Complementary survey evidence from 107 restaurant owners reveals substantial heterogeneity in loss aversion, with loss averse owners being 18-21 percentage points less likely to exit. Model simulations reveal that loss aversion reduces measured productivity by 30 percent relative to standard profit-maximizing firms. During the COVID-19 years, loss averse firms showed increased profits but reduced workers' profit shares, suggesting that employment subsidies targeting small businesses facilitate the survival of loss averse firms in general equilibrium. This helps explain why such programs had limited employment effects despite increasing firm profitability.

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*Emami Namini (emaminamini@ese.eur.nl), Kapoor (kapoor@ese.eur.nl): Erasmus University Rotterdam, Erasmus School of Economics, Burgemeester Oudlaan 50, 3062PA Rotterdam, The Netherlands. We thank Georgios Angelis, Suzanne Bijkerk, Han Bleichrodt, David Byrne, 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. All omissions and errors are our own.

1 Introduction

Loss aversion describes a phenomenon where individual payoffs are defined over losses and gains relative to a reference point, and where individuals experience more disutility from losses than from equivalent gains. This concept is foundational to prospect theory and more generally to a literature that develops descriptive models of decision making under uncertainty. Loss aversion has been used to rationalize behavior in a wide range of settings: among 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, Barberis, Huang, and Santos, 2001, Barberis, Mukherjee, and Wang, 2016, Barberis, Jin, and Wang, 2021], job search [DellaVigna et al., 2017], tax filers [Rees-Jones, 2018], among others [see Camerer, 2001, and O'Donoghue and Sprenger, 2018, for a more comprehensive list]. In a recent meta-analysis of 150 academic studies across a variety of domains, Brown et al. [2024] show mean loss aversion coefficients of between 1.8 and 2.1, where coefficients of 1 implies loss neutrality, and coefficients greater than 1 implies loss aversion.

While this evidence establishes the importance of loss aversion at the individual level, losses have also played a central role in the behavioral theory of the firm. 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 evolutionary paradigm has been used to explain the survival of large businesses that separate claims on 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. 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]. 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 prevalence of loss aversion among individuals and the importance of losses for firm success 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 with control, often within a single individual. If owners are active in business decisions and guided by their preferences, 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. By implication, not only may this affect the objective of the firm, but these preferences may survive aggregation and influence latent market outcomes. In this paper, we ask what are the implications, if any, for market aggregates such as market structure, productivity, profits, and the sharing of profits between owners and workers?

To investigate these implications for market aggregates, we develop a general equilibrium model that builds on the closed economy monopolistic competition model of Melitz [2003]. The main new feature of our model is the introduction of Kőszegi and Rabin [2006] loss averse firms. The entrepreneur is sophisticated in anticipating loss aversion before making the entry decision. Entrepreneurs enter the market, draw both a productivity parameter and a fixed cost parameter, and decide whether to become active. This decision depends on the economic profit for the average incumbent firm, the weights assigned to profit and gain-loss utility, and whether fixed costs fall above or below a reference level.

In equilibrium, this generates multiple channels through which loss aversion affects market outcomes. When entrepreneurs perceive fixed costs above their reference level as losses, they require higher productivity to justify market entry. This selection effect increases average productivity but reduces the mass of active firms. Conversely, when fixed costs fall below the reference level, firms perceive gains that encourage entry, potentially lowering the productivity threshold. The net effect of loss aversion on sector-wide productivity depends critically on the distribution of fixed costs, with empirically relevant parameters suggesting that increasing loss aversion leads to higher average productivity.

To study these mechanisms empirically, we focus on the restaurant industry, which offers several features that make it particularly suitable for examining loss aversion in firm decision-making. The ownership decision in this industry is strongly influenced by preferences, with owners often accepting lower wages relative to their outside options in exchange for non-pecuniary advantages such as menu development and autonomy.[1] Active participation by owners and management is commonplace, creating a direct channel through which individual preferences affect firm-level decisions. Additionally, local market structures serve as incubators for utility maximization, with rich arrays of horizontally and vertically differentiated products. This product differentiation can generate market power, enabling departures from profit maximization.

[1] Hamilton [2000] shows entrepreneurs tend to earn less than they would 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. Only 34 percent cite income generation as the primary motive.

The industry also provides a natural setting for loss aversion to emerge and influence firm selection through multiple channels. Characteristically high exit probabilities raise fear relating to failure, a fear that has been conceptualized as a form of loss aversion [Morgan and Sisak, 2016]. Loss aversion can also emerge in economies with rigid wages. When wages are inflexible—especially in a downward direction—firms cannot mitigate potential losses by reducing salaries and must instead resort to workforce reductions. In smaller firms, each employee plays a more critical role in operations, and the personal ties between decision-makers and employees tend to be stronger. Consequently, layoffs become psychologically more distressing for firm owners. Given that wage rigidity prevents firms from adjusting compensation downward in response to losses, and that workforce reductions are a less desirable alternative in smaller firms, owners of such firms may exhibit heightened loss aversion. Whatever the underlying reason for weighing losses more than equivalent gains, the prospect of loss can deter entry and promote exit.

Our paper provides descriptive evidence on the role of loss aversion in market outcomes. While the model generates clear predictions about how loss aversion influences market structure, firm selection, and profit sharing, directly testing these predictions is challenging as loss aversion is not directly observable at scale in firm-level data. We therefore take a descriptive approach using two complementary datasets. Our primary evidence draws on market-level data from U.S. counties over 1998-2019, using County Business Patterns data merged with housing prices and population estimates. Using year-over-year changes in average payroll as our measure of gains and losses relative to a reference point, we document that market-level outcomes weigh losses more heavily than gains. The observed number of establishments exhibits a loss-gain ratio of 8.9, with this pattern being particularly pronounced among small establishments.

We complement this descriptive analysis with survey evidence on loss aversion from 107 restaurant owners and managers, implementing the Abdellaoui et al. [2016] elicitation method with business-framed scenarios. The survey reveals substantial heterogeneity in loss aversion: while the median owner has a loss aversion coefficient of 1.6 (slightly below laboratory medians for university students), the mean is 10.1, indicating some very loss averse owners. Indeed, 74 percent of respondents exhibit loss aversion coefficients greater than 1, and 30 percent have coefficients exceeding 3. In the data, firms with loss averse owners are 18-21 percentage points less likely to exit after five years, against a mean exit rate of 0.28. This finding appears counterintuitive given that losses typically drive exit, but it aligns with our model's prediction: when loss averse owners receive sufficient support—

as our surveyed firms did through government assistance during COVID-19—their aversion to losses actually motivates them to persist in business. This dual descriptive approach, combining large-scale market evidence with direct measurement of individual loss attitudes, provides a comprehensive view of how loss aversion correlates with market outcomes.

Building on these descriptive patterns, our main empirical exercise calibrates and simulates our model using county-level data from the U.S. We treat each county as a separate market and use business applications and payroll data to measure entry costs and fixed costs. We identify gains and losses through year-over-year changes in average payroll per establishment, with variation stemming from changes in employment, wages, and developments in the payroll sector. Using loss aversion estimates from our survey and a meta-analysis to calibrate the model's behavioral parameters, we simulate productivity and profits under two scenarios: one where firms are standard von Neumann-Morgenstern (vNM) decision makers and another where they exhibit prospect theory (PT) preferences with loss aversion.

The simulations reveal two key findings. First, we document a substantial productivity bias: measured productivity at vNM firms exceeds that of PT firms by more than 30 percent on average, with this gap displaying countercyclical variation. Second, we find striking differences in profits and profit sharing between vNM and PT firms. While vNM firms maintain stable profits and worker profit shares, PT firms show greater variation, particularly during the COVID-19 period where they experienced a dramatic increase in profits while reducing workers' share of profits. These patterns during COVID-19, combined with evidence on the Paycheck Protection Program, suggest that employment subsidies targeting small businesses facilitate the survival of loss averse firms in equilibrium. This may help explain why such programs had limited impact on employment rates despite significantly increasing firm profitability.

Our study advances several distinct strands of literature. First, we contribute to a long-standing debate on whether behavioral biases influence aggregate outcomes. The traditional view holds that these biases are irrelevant because market forces drive biased agents from markets. While behavioral economics has brought renewed attention to this question [e.g., Russell and Thaler, 1985], empirical evidence remains scarce. A notable exception is Enke, Graeber, and Oprea [2023], who use laboratory experiments to study how confidence and its correlation with performance affects organizational and market outcomes. Our study complements this work by examining a different behavioral bias—loss aversion—using field data and a general equilibrium model to analyze its impact on firm and market-level outcomes.

Second, we contribute to a growing macroeconomic literature examining how behavioral biases affect economic aggregates. While much of this work focuses on consumer behavior—such as Krusell and Smith Jr [2003]'s analysis of temptation and self-control in consumption decisions and Gabaix and Laibson [2001]'s work on consumer inattention—relatively little research examines how behavioral factors influence firm decisions and subsequent market outcomes. This gap is particularly notable for small businesses, where individual preferences may have outsized effects on firm behavior. Our work connects to research on small business dynamics [e.g., Hurst and Pugsley, 2011] by showing how loss aversion among entrepreneurs influences market structure and productivity.

Finally, our analysis extends research on firm entry and exit dynamics. The seminal work of Hopenhayn [1992] develops a framework for industry dynamics with heterogeneous firms, while Hopenhayn and Rogerson [1993] extends this to analyze labor market frictions. Arkolakis [2016] builds on these foundations to analyze firm lifecycle dynamics, highlighting the role of entry costs and market structure in determining patterns of entry and exit. While this literature has traditionally focused on rational expectations and profit maximization, our findings suggest that behavioral factors—particularly loss aversion—play a crucial role in entry and exit decisions. This is especially relevant for understanding the dynamics of small businesses, where the integration of ownership and control makes individual preferences particularly salient for firm decisions.

2 Conceptual Background

2.1. Profit maximization. Our null hypothesis is a neoclassical objective function for the firm:

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

where $\pi(y)$ is profit, $p(y)$ is the maximum price consumers are willing to pay for y units of output. $p(y)$ is decreasing in y by the law of demand. $c(y)$ is total variable cost, and 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 (e.g., at the daily level) 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. Costs of equipment and commercial space are fixed in the short and variable in the long run. In the very short run, at the daily level, labor costs are fixed.[2] In the long run labor costs are variable. In the very short run uncertainty in $p(y)$ and $c(y)$ can be due to the number of consumer arrivals or bottlenecks in production. In the long 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]. Since profit increases income, and utility is increasing in consumption, the owners will try to maximize profit themselves or instruct managers to do so. 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 to reflect violations of the axioms of choice under uncertainty among owners and employees at the firm.

2.2. Loss aversion. Our alternative hypothesis to profit maximization is the objective of loss aversion:

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

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 reference profit. We assume $0 \leq \eta < 1$.

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

[2] Online Appendix Figure A.4.2, bottom panel, confirms this with historical data from the restaurants we study.

any incidental mental or physical strain on owners and employees. Thus, the steeper slope can reflect a heuristic towards survival. The existence of a compensatory analog on the side of gains is not obvious.

Assume v is differentiable at π^r, with derivatives $v'_{\uparrow}(\pi^r|\pi^r)$ as π approaches π^r from below, and $v'_{\downarrow}(\pi^r|\pi^r)$ as π approaches π^r from above. Following Kobberling and Wakker [2005], the loss aversion coefficient is defined as:

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

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. Equation 2 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.

2.3. Economic versus accounting profit. The theoretical part of our analysis assumes decisions are guided by economic profit π. In practice, decisions may be guided by accounting profit. To understand the implications of our assumption, consider the identity $\pi = \pi_{ac} + oc$, where π_{ac} is accounting profit, and oc opportunity cost. If decision makers are guided by accounting profit exclusively, then their utility function is

$$V_{ac} = (1-\eta)\pi_{ac} + \eta v(\pi_{ac}|\pi^r_{ac}).$$

If they are guided by economic profit, their utility function becomes

$$V_{\pi} = V_{ac} + (1-\eta)oc + \eta v(oc|oc^r) = V_{ac} + V_{oc},$$

where a separate gain-loss utility for opportunity cost, $v(oc|oc^r)$, exists if decision makers have a separate reference point for their opportunity cost, i.e. $\pi^r = \pi^r_{ac} + oc^r$.

The term for V_{π} shows accounting profit and opportunity cost are additively separable, which follows from the definition of profit (revenue minus cost) and the functional form for loss aversion in equation 3. The additive separability implies that the "economic" decision maker can maximize V_{π} by maximizing V_{ac} and minimizing V_{oc} separately. Thus, in our theoretical model in section 3 we normalize $oc = 0$ without affecting our comparative statics with respect to η and λ.

3 Model

We build a model with monopolistically competitive firms and loss averse firm owners. While we use some facts to defend model assumptions, the model can reconcile all key facts.

3.1. Technologies and preferences. The production side is characterized by a mass of firms, each one producing a unique variety. A firm produces its variety with productivity ϕ and fixed costs $F = wf$, where w is the wage and f a fixed labor input. We choose labor as numéraire, set w equal to 1 and, thus, $F = f$. To produce q units of output, a firm uses $l = \frac{q}{\phi} + f$ units of labor. Each unique variety will be indexed by its productivity parameter ϕ, and the set of available varieties is Φ.

The utility function of a representative consumer is $Q = \left[\int_{\phi\in\Phi} q(\phi)^{\rho} d\phi\right]^{1/\rho}$, $0 < \rho < 1$, and demand for a single variety ϕ results as: $q(\phi) = RP^{\sigma-1}\left[\frac{1}{p(\phi)}\right]^{\sigma}$, where R denotes aggregate spending on the sector's output and P the price per unit of the aggregate consumption good Q. Revenues of a single firm producing with ϕ are given by: $r(\phi) = R\left[\frac{P}{p(\phi)}\right]^{\sigma-1}$.

Firms choose their price $p(\phi)$ to maximize the owner's utility, which is given by:

$$V(\phi) \;=\; (1-\eta)\pi(\phi) - \eta v\left(F|F^r\right), \tag{4}$$

where $\pi(\phi) = r(\phi) - l(\phi)$ and $v\left(F|F^r\right) = \left(F - F^r\right)^{-} + \lambda\left(F - F^r\right)^{+}$, $\lambda > 1$. $\left(F - F^r\right)^{-} = \min\left\{F - F^r; 0\right\}$ measures a perceived fixed costs gain, while $\left(F - F^r\right)^{+} = \max\left\{F - F^r; 0\right\}$ measures a perceived fixed costs loss relative to a reference point F^r. We assume $(1-\eta)F + \eta v\left(F|F^r\right) > 0$, i.e. a perceived fixed costs gain can never compensate for the actual fixed costs. The profit maximizing price results as $p(\phi) = \frac{\sigma}{\sigma-1}\frac{1}{\phi}$.

3.2. Market entry and exit. Prior to market entry, firms do not know their productivity level ϕ, nor their fixed costs F. Only after paying sunk market entry costs F^e, firms simultaneously draw ϕ and F from exogenously given and independent distributions, characterized by densities $g(\phi)$ and $h(F)$ and cumulative densities $G(\phi)$ and $H(F)$, respectively. Each period a firm may be hit by a negative shock with probability θ, which forces the firm to exit the market.

3.3. General equilibrium. First, a zero cutoff profit condition has to be defined for each potential F an entrant might draw after market entry. Given F, the zero cutoff profit condition determines the threshold productivity parameter ϕ^*, at which an entrant realizes zero profits, net of sunk market entry costs—notice that $\pi(\phi) = \frac{r(\phi)}{\sigma} - F$ since $p(\phi) = \frac{\sigma}{\sigma-1}\frac{1}{\phi}$:

$$(1-\eta)\left[\frac{r(\phi^*)}{\sigma} - F\right] - \eta\nu\left(F|F^r\right) \;=\; 0. \tag{5}$$

Assuming a Pareto–distribution for ϕ with shape parameter k and defining an average productivity parameter $\widetilde{\phi}$ as $\widetilde{\phi} = \left(\int_{\phi^*}^{\infty} \phi^{\sigma-1} \frac{g(\phi)}{1-G(\phi^*)} d\phi\right)^{\frac{1}{\sigma-1}}$ implies $\frac{\phi^*}{\widetilde{\phi}} = \left(\frac{k-\sigma+1}{k}\right)^{\frac{1}{\sigma-1}}$. Considering $r(\phi^*) = r(\widetilde{\phi})\left(\frac{\phi^*}{\widetilde{\phi}}\right)^{\sigma-1}$ leads to:

$$r\left(\widetilde{\phi}\right)\frac{k-\sigma+1}{\sigma k}(1-\eta) \;=\; \eta\nu\left(F|F^r\right) + (1-\eta)F. \tag{6}$$

Second, a free entry condition has to hold in general equilibrium:

$$\int_{\underline{F}}^{F^r} \left[1 - G(\phi_G^*(F))\right] V\left(\widetilde{\phi}_G(F)\right) h(F)dF + \int_{F^r}^{\overline{F}} \left[1 - G(\phi_L^*(F))\right] V\left(\widetilde{\phi}_L(F)\right) h(F)dF \;=\; F^e, \tag{7}$$

where the subscripts G and L in equation 7 indicate the relationship between the productivity parameters and F in the case of a perceived fixed costs gain or loss, respectively. ϕ^* and $\widetilde{\phi}$ are functions of F, following from equation 6. The term $1 - G(\phi_x^*(F))$, $x = G, L$ denotes the probability of being active after market entry for a drawn F.

The price index for the aggregate consumption good results as:

$$\begin{aligned} P \;=\; \Bigg\{ M_e \Bigg[&\int_{\underline{F}}^{F^r} \left[1 - G(\phi_G^*(F))\right] p(\widetilde{\phi}_G(F))^{1-\sigma} h(F)dF \\ &+ \int_{F^r}^{\overline{F}} \left[1 - G(\phi_L^*(F))\right] p(\widetilde{\phi}_L(F))^{1-\sigma} h(F)dF \Bigg] \Bigg\}^{\frac{1}{1-\sigma}}, \end{aligned} \tag{8}$$

with M_e denoting the mass of entrants into the market. Considering the definition of V (equation 4) and the zero cutoff profit condition (equation 6), the free entry condition (equation 7) results as:

$$\int_{\underline{F}}^{F^r} \left[1 - G(\phi_G^*(F))\right] r(\widetilde{\phi}_G(F))h(F)dF + \int_{F^r}^{\overline{F}} \left[1 - G(\phi_L^*(F))\right] r(\widetilde{\phi}_L(F))h(F)dF \;=\; \frac{\sigma k}{\sigma-1}\frac{F^e}{1-\eta}.$$

Using $r(\widetilde{\phi}_x(F)) = RP^{\sigma-1}p(\widetilde{\phi}_x(F))^{1-\sigma}$, $x = G, L$, and P from equation 8 then allows us to solve for the mass of entrants: $M_e = \frac{(\sigma-1)R}{\sigma k}\frac{1-\eta}{F^e}$.

To fully characterize general equilibrium, the function $\phi^*_x = \phi^*_x(F)$, $x = G, L$, still needs to be derived. For that purpose we rewrite equation 6 by using (i) the terms for $r(\widetilde{\phi}_x(F))$, P and M_e, and (ii) the assumption of a Pareto–distribution for ϕ, which implies $1-G(\phi^*_x(F)) = \left(\frac{\underline{\phi}}{\phi^*_x(F)}\right)^k$ and $\phi^*_x = \widetilde{\phi}_x\left(\frac{k}{k-\sigma+1}\right)^{-\frac{1}{\sigma-1}}$, $x = G, L$:

$$\widetilde{\phi}_x(F) = \Theta\left\{\left[\int_{\underline{F}}^{F^r} h(F)\left(\widetilde{\phi}_G(F)\right)^{\sigma-k-1} dF + \int_{F^r}^{\overline{F}} h(F)\left(\widetilde{\phi}_L(F)\right)^{\sigma-k-1} dF\right]\right\}^{\frac{1}{\sigma-1}} \Phi(F)^{\frac{1}{\sigma-1}}, \quad (9)$$

with $\Theta \equiv \left(\frac{(\sigma-1)(1-\eta)}{(k-\sigma+1)f_e}\underline{\phi}^k\left(\frac{k}{k-\sigma+1}\right)^{\frac{k}{\sigma-1}}\right)^{\frac{1}{\sigma-1}}$ and $\Phi(F) \equiv F + \frac{\eta}{1-\eta}\nu\left(F|F^r\right)$. Considering $\widetilde{\phi}_x(F) = \widetilde{\phi}_G(\underline{F})\left[\frac{\Phi(F)}{\Phi(\underline{F})}\right]^{\frac{1}{\sigma-1}}$, which follows from equation 9, leads to:

$$\widetilde{\phi}_G(\underline{F}) \;=\; \Theta\left[\widetilde{\phi}_G(\underline{F})\right]^b\left\{\int_{\underline{F}}^{F^r}\left[\frac{\Phi(F)}{\Phi(\underline{F})}\right]^b h(F)dF + \int_{F^r}^{\overline{F}}\left[\frac{\Phi(F)}{\Phi(\underline{F})}\right]^b h(F)dF\right\}^{\frac{1}{\sigma-1}}\Phi(\underline{F})^{\frac{1}{\sigma-1}}, \quad (10)$$

with $b \equiv \frac{\sigma-1-k}{\sigma-1} < 0$. Solving equation 10 for $\widetilde{\phi}_G(\underline{F})$ results in:

$$\widetilde{\phi}_G(\underline{F}) \;=\; \Theta^{\frac{\sigma-1}{k}}\Phi(\underline{F})^{\frac{1}{\sigma-1}}\left\{\mathbb{E}(\Phi)\right\}^{\frac{1}{k}}, \quad (11)$$

with $\mathbb{E}(\Phi) = \int_{\underline{F}}^{F^r} h(F)\Phi(F)^b dF + \int_{F^r}^{\overline{F}} h(F)\Phi(F)^b dF$. In order to derive the relationship between $\widetilde{\phi}_x$, $x = G, L$, and *any* F, we substitute $\widetilde{\phi}_G(\underline{F}) = \Theta^{\frac{\sigma-1}{k}}\Phi(\underline{F})^{\frac{1}{\sigma-1}}E(\Phi)^{\frac{1}{k}}$ into equation 10 and consider the definition of $\mathbb{E}(\Phi)$ to get:

$$\widetilde{\phi}_x(F) \;=\; \Theta^{\frac{\sigma-1}{k}}\mathbb{E}(\Phi)^{\frac{1}{k}}\Phi(F)^{\frac{1}{\sigma-1}}, \quad x \;=\; G, L. \quad (12)$$

3.4. Labor market clearing condition. Due to loss preferences firm owners might realize monetary profits beyond their wage, or losses which they pay out of their wage income. As firm owners are part of L, they also receive wage w. These monetary profits or losses impact demand for goods and, thus, for labor, which impacts the labor market clearing condition.

To quantify the monetary profits or losses firm owners might realize due to loss preferences, we rewrite the free entry condition (equation 7):

$$\int_{\underline{F}}^{F^r} [1 - G(\phi_G^*(F))] \, \pi \left(\widetilde{\phi}_G(F)\right) h(F) dF + \int_{F^r}^{\overline{F}} [1 - G(\phi_L^*(F))] \, \pi \left(\widetilde{\phi}_L(F)\right) h(F) dF - F^e =$$
$$\frac{\eta}{1-\eta} \left\{ F^e + \int_{\underline{F}}^{F^r} [1 - G(\phi_G^*(F))] \, h(F) \left(F - F^r\right) dF + \int_{F^r}^{\overline{F}} [1 - G(\phi_L^*(F))] \, h(F) \lambda \left(F - F^r\right) dF \right\}. \tag{13}$$

If $\eta = 0$, i.e. without loss aversion, the average firm owner only receives wage w as part of L. If $\eta > 0$ the average firm owner realizes profits or losses beyond w.

If realized fixed costs are on average substantially larger than the reference level F^r, or if the parameter of loss aversion λ is large, the positive term $\int_{F^r}^{\overline{F}} [1 - G(\phi_L^*(F))] \, h(F) \lambda \left(F - F^r\right) dF$ dominates the right hand side of equation 13. This discourages market entry, compared to the case of $\eta = 0$. Thus, the left hand side of equation 13 is positive, and the average firm owner realizes positive profit which we denote by χ. χ leads to additional demand for the average variety equal to $\frac{\chi}{\widetilde{\widetilde{\phi}}}$. Notice that the markup $\frac{\sigma}{\sigma-1}$ is left out from this term, as firm owners not only pay the markup, but also collect it. The corresponding additional labor demand is $\widetilde{\widetilde{\phi}} \frac{\chi}{\widetilde{\widetilde{\phi}}}$, which reduces to χ. This additional labor demand is balanced by a reduction in the mass of active firms, maintaining the labor market clearing condition.

Conversely, if realized fixed costs are on average substantially smaller than the reference level F^r, or if the parameter of loss aversion λ is small, the negative term $\int_{\underline{F}}^{F^r} [1 - G(\phi_G^*(F))] \, h(F) \left(F - F^r\right) dF$ dominates the right hand side of equation 13. This encourages market entry, compared to the case of $\eta = 0$ and the left hand side of equation 13 is negative. The average firm owner thus realizes losses, and χ is negative. The corresponding reduction in labor demand equals χ, and is balanced by an increase in the mass of active firms, maintaining again the labor market clearing condition.

Thus, the labor market clearing condition results as:

$$\begin{aligned} L \;=\; M_e \Bigg\{ & F^e + \int_{\underline{F}}^{F^r} h(F) \left[1 - G\left(\phi_G^*(F)\right)\right] \left[F + \frac{q\left(\widetilde{\phi}_G(F)\right)}{\widetilde{\phi}_G(F)}\right] dF \\ & + \int_{F^r}^{\overline{F}} h(F) \left[1 - G\left(\phi_L^*(F)\right)\right] \left[F + \frac{q\left(\widetilde{\phi}_L(F)\right)}{\widetilde{\phi}_L(F)}\right] dF + \chi \Bigg\}, \end{aligned} \tag{14}$$

with χ being equal to the left hand side of equation 13. Considering (i) $\frac{q(\phi)}{\phi} = r(\phi)\frac{\sigma-1}{\sigma}$, (ii)

$r(\phi) = \frac{Rp(\phi)^{1-\sigma}}{P^{1-\sigma}}$ and (iii) the price index (equation 8), equation 14 can be rewritten:

$$L = M_e \left[F^e + \int_{\underline{F}}^{F^r} \left[1 - G\left(\phi_G^*(F)\right)\right] Fh(F)dF + \int_{F^r}^{\overline{F}} \left[1 - G\left(\phi_L^*(F)\right)\right] Fh(F)dF + \frac{\sigma - 1}{\sigma} \frac{R}{M_e} + \chi \right]. \tag{15}$$

Substituting $\frac{r(\widetilde{\phi}_x(F))}{\sigma}$ from the zero cutoff profit condition (equation 6) into the free entry condition (equation 7) and simplification leads to:

$$\int_{\underline{F}}^{F^r} h(F) \left[1 - G(\phi_G^*(F))\right] FdF + \int_{F^r}^{\overline{F}} h(F) \left[1 - G(\phi_L^*(F))\right] FdF \; = \; F^e \frac{k - (\sigma - 1)(1 - \eta)}{(1 - \eta)(\sigma - 1)} - \chi. \tag{16}$$

Combining equations 15 and 16 leads to:

$$L \;\; = \;\; M_e \left[F^e + f_e \frac{k - (\sigma - 1)(1 - \eta)}{(\sigma - 1)(1 - \eta)} - \chi + \frac{\sigma - 1}{\sigma} \frac{R}{M_e} + \chi \right]. \tag{17}$$

Finally, considering $M_e = \frac{(\sigma-1)R}{\sigma k} \frac{1-\eta}{f_e}$, equation 17 simplifies to: $1 = \frac{1}{\sigma k} \frac{\sigma k}{1}$.

3.5. Key variables and equations. The key variables are: (i) the average productivity parameter for any drawn F: $\widetilde{\phi}_x(F)$, $x = G, F$; (ii) the mass of entrants into the market: M_e; (iii) the mass of active firms: M; (iv) profits of the average entrepreneur: χ. The corresponding 4 equations are:

$$\widetilde{\phi}_x(F) \;\; = \;\; \Theta^{\frac{\sigma-1}{k}} \mathbb{E}(\Phi)^{\frac{1}{k}} \Phi(F)^{\frac{1}{\sigma-1}} \tag{18}$$

$$M_e \;\; = \;\; \frac{(\sigma - 1)R}{\sigma k} \frac{1 - \eta}{f_e} \tag{19}$$

$$M \;\; = \;\; M_e \left\{ \int_{\underline{F}}^{F^r} \left[1 - G(\phi_G^*(F))\right] h(F)dF + \int_{F^r}^{\overline{F}} \left[1 - G(\phi_L^*(F))\right] h(F)dF \right\} \tag{20}$$

$$\chi \;\; = \;\; \int_{\underline{F}}^{F^r} \left[1 - G(\phi_G^*(F))\right] \pi\left(\widetilde{\phi}_G(F)\right) h(F)dF + \int_{F^r}^{\overline{F}} \left[1 - G(\phi_L^*(F))\right] \pi\left(\widetilde{\phi}_L(F)\right) h(F)dF - F^e, \tag{21}$$

where Θ, $\Phi(F)$ and $\mathbb{E}(\Phi)$ have been defined in subsection 3.3.

Finally, we can define a sector-wide average productivity parameter $\widetilde{\widetilde{\phi}}$ as a weighted average over all possible $\widetilde{\phi}(F)$:

$$\widetilde{\widetilde{\phi}} = \left\{ \frac{\int_{\underline{F}}^{F^r} [1 - G(\phi_G^*(F))] \left(\widetilde{\phi}_G(F)\right)^{\sigma-1} h(F)dF + \int_{F^r}^{\overline{F}} [1 - G(\phi_L^*(F))] \left(\widetilde{\phi}_L(F)\right)^{\sigma-1} h(F)dF}{\int_{\underline{F}}^{F^r} [1 - G(\phi_G^*(F))] h(F)dF + \int_{F^r}^{\overline{F}} [1 - G(\phi_L^*(F))] h(F)dF} \right\}^{\frac{1}{\sigma-1}}. \tag{22}$$

Notice that the price index in equation 8 is identical to a price index $P = \left[Mp \left(\widetilde{\widetilde{\phi}} \right)^{1-\sigma} \right]^{\frac{1}{1-\sigma}}$, with M being the mass of active firms (equation 20) and $\widetilde{\widetilde{\phi}}$ as defined by equation 22. To understand the impact of loss aversion on $\widetilde{\widetilde{\phi}}$, two counteracting effects of λ on $\widetilde{\widetilde{\phi}}$ need to be considered. First, with an increase in λ the perceived losses for the case of $F > F^r$ increase, ceteris paribus leading to less firm entries. Less firm entries imply less competition in goods markets, decreasing $\phi_x^*(F)$ and $\widetilde{\phi}_x(F)$, $x = G, L$, and, thus, $\widetilde{\widetilde{\phi}}$. Second, with an increase in λ the perceived losses for the case of $F > F^r$ increase, ceteris paribus increasing $\phi_L^*(F)$ and $\widetilde{\phi}_L(F)$ and, thus, $\widetilde{\widetilde{\phi}}$. Which of these two effects dominates crucially depends on the magnitude of F^r and on the distributional assumption for F.

We first show in online appendix A.1 that, if F follows a uniform distribution on a certain interval, $\widetilde{\widetilde{\phi}}$ may increase or decrease with λ, depending on the magnitudes of σ and k. Second, we show in online appendix A.1 that, if F follows a Pareto distribution with an empirically relevant shape parameter of $\kappa = 0.3$, $\widetilde{\widetilde{\phi}}$ increases with λ.

4 Data

Our evidence draws on market level data from U.S. counties over many years.

4.1. Primary sources. Our primary source is County Business Pattern (CBP) data for 1998-2019. 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 compensation costs are fixed from the employer's perspective, particularly the costs of front line restaurant employees (kitchen workers, servers), whose compensation 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 (FHFA) and county population estimates by the US Census Bureau.

Our market analysis also draws on Business Dynamics Statistics (BDS) from the US Census Bureau, as that dataset distinguishes between entry and exit rates directly. We estimate 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.

Our sample is restricted to 1998-2019 because the Census Bureau changed the industry classification in 1998 from the Standard Industry Classification (SIC) system to the 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 1998-2011 and NAICS code 7225 for 2012-2019. 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 1.

4.2. Supplementary survey of owners and managers in the industry. We implemented a small-scale survey to obtain direct measures of loss aversion among owners and managers in the restaurant industry, and to relate loss aversion to the propensity to exit the industry 5 years later. We did the survey in the Netherlands out of convenience, but our estimates lie within the supports described in the broad-based meta-study by Brown et al. [2024].

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

Overall, we interviewed the owners of 107 restaurants during the summer of 2016. The restaurants make up 15 percent of the population covered by `iens.nl`, and basically all restaurants in the targeted cities. These restaurants employ 1,870 people.

We explore the representativeness of the sample in Online Appendix Table A.4.1. We compare the subset of restaurants with ratings in our sample with non-sampled restaurants on `iens.nl`. We show that sampled and non-sampled ones are similar in terms of average price food, service, and decor ratings. 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.

The measurement procedure follows the method of Abdellaoui et al. [2016], which allows us 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 increased interview times substantially. We instead asked owners about their propensity to take on risk in a separate question. We describe the method in detail in the next section.

We tracked down the firms of surveyed owners in October 2021, more than 5 years after the original survey. We looked for evidence of closures using various sources including Google, Facebook, local newspapers, and the firms' websites. Some firms announced their closures on Facebook. For others Google indicates if the firm has been closed permanently. Local newspapers reported closures of several long-standing firms, often blaming the government for their demise during COVID-19. For survivors, we looked for recent posts on Facebook, opening hours information on Google, as well as whether reservations were still possible.

5 Descriptive facts from US counties

5.1. Specification. We estimate

$$ln(M_{it}) = \beta_1 ln(R_{it}) + \beta_2 ln(f_{it}^e) + \beta_g \boldsymbol{g}_{it}(F_{it} - F_{it}^r) + \beta_l \boldsymbol{l}_{it}(F_{it} - F_{it}^r) + \alpha_i + \gamma_{s(i)t} + \varepsilon_{it} \quad (23)$$

where M_{it} is the number of establishments in county i during year t, R_{it} is market size, f_{it}^e are entry costs, F_{it} is average annual payroll (per establishment), $\boldsymbol{g}_{it}$ indicates whether $F_{it} - F_{it}^r < 0$, $\boldsymbol{l}_{it}$ indicates the opposite $F_{it} - F_{it}^r > 0$, α_i is a county fixed effect, $\gamma_{s(i)t}$ is a state-year fixed effect, and ε_{it} is an idiosyncratic error term. We take absolute values of gains and losses to simplify the interpretation of the regression coefficients.

The estimating equation is ultimately a log-linearization of the equilibrium number of firms in the general equilibrium model we develop later. We proxy for market size using annual county GDP. We proxy for entry costs using the number of business applications. We use α_i and $\gamma_{s(i)t}$ to proxy for the level of F_{it} as well as variation in the outside options or opportunity costs of owners and managers. $\gamma_{s(i)t}$ is especially useful because it tracks state specific changes to minimum wages.

Our proxy for the reference point is lagged average payroll, $F_{it}^r = F_{it-1}$. Given this reference point, $\beta_g \boldsymbol{g}_{it}(F_{it} - F_{it}^r)$ and $\beta_l \boldsymbol{l}_{it}(F_{it} - F_{it}^r)$ measure year-over-year decreases and increases in average payroll respectively. Variation in $\beta_g \boldsymbol{g}_{it}(F_{it} - F_{it}^r)$ and $\beta_l \boldsymbol{l}_{it}(F_{it} - F_{it}^r)$ is generated therefore by a host of factors including employment, wages, or developments in the payroll sector. In the model this variation is generated by decreases and increases in fixed costs. In reality they can be generated by decreases and increases in variable costs, which in turn can reflect contractions and expansions in county output. Some of this will be reflected in GDP as well as the state-year fixed effects.[3]

Note that the factors generating payroll decreases can differ from factors generating payroll increases. Paying the minimum wage is common practice in this sector. Minimum wages are almost always increasing over time. By this token, changes to minimum wage legislation always generate losses, never gains. Alternatively, technological developments in the payroll sector have been exploited to decrease payroll costs over time.

β_g and β_l are identified if there is no residual variation tracking year-over-year 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 the diffusion of outsourced or automated payrolls.

5.2. Results. Estimates are found in Table 2. Moving left to right in Table 2 shows estimates for three dependent variables: the number of establishments (in logs), the entry rate, and the exit rate. Note that below average payroll is interpreted as a gain. Above average payroll as a loss. Estimates of the loss-gain ratio β_l/β_g are in the bottom panel.

Column 1 shows a one standard deviation loss increase is associated with 1% fewer establishments ($p < 0.01$). We see no statistical or substantive effect for gains. The corresponding loss-gain ratio is 8.9. It is not statistically different from 1 because the gain coefficient is small and imprecisely estimated.

Column 2 shows gains attract entry. A one standard deviation gain increase increases the percentage change in births by 0.4 points ($p < 0.01$). An equivalent loss has no statistical effect on entry rates. The loss-gain ratio is 0.1.

Column 3 shows losses bring about exit. A one standard deviation loss increase increases the percentage change in deaths by 0.47 points ($p < 0.01$). There is no statistical effect of gains on exit rates. Here the loss-gain ratio is 4.7.

We replicate Table 2 in Appendix Table A.4.2 but with a broader set of controls than is specified by our equilibrium model. More specifically, we show that the results are robust

[3]We use our administrative data to provide evidence that payroll has a strong fixed cost component. See Online Appendix Figure A.4.2 for details.

to the number of employees in the sector (in logs), a standardized housing price index, population density (in logs), average year-over-year payroll losses (gains) in neighbouring counties within 25 miles. Our estimate of the loss-gain ratio for the number of establishments is smaller (2.3) but estimated more precisely ($p < 0.01$).

The loss-gain ratios in Columns 1 and 3 of Tables 2 and A.4.2 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].

We study variation in the loss-gain ratios over time. We estimate Equation 23 for every year from 2005-2021 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 partitioned by firm size and plotted in Figure 2.

The figure suggests our baseline patterns 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.

6 Facts from the survey

The first row of Table 3 summarizes the loss aversion estimates.[4] 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 to the full sample. Both applications led to rejection of gain seeking and loss neutrality ($p < 0.01$).

The remaining rows of Table 3 summarize 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?

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

how many would you lose if (current) prices went up by 5 percent? 10 percent? 20 percent? The questions yield perceived elasticities at current prices, at 105 percent of current prices, and 110 percent of current prices. The lower panel of Table 3 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.

To evaluate the implications for exit, we constructed an indicator for whether a firm exited by October 2021. 30 firms exited. The implied exit share was 0.28. The share 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.

We further estimate

$$Exit_i = \beta_0 + \beta_1 \mathbf{1}(\lambda_i > 1) + \mathbf{X}_i \Gamma + \varepsilon_i$$

where $\mathbf{1}(\lambda_i > 1)$ indicates whether i is loss averse, $\mathbf{X}_i$ are controls, and ε_i is a random variable. The identifying assumption is $\mathbb{E}[\varepsilon_i | \lambda_i, \mathbf{X}_i] = \mathbb{E}[\varepsilon_i | \mathbf{X}_i] = 0$. The timing of events facilitates identification, as λ_i is measured 5 years prior to the exit decision. While the timing facilitates identification, it is insufficient for a causal interpretation because λ_i likely correlates with other relevant but unobserved traits.[5]

Regression estimates are found in Table 4. 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.

There is a stark contrast between the survey results and Table 2. The surveys shows loss aversion decreases the probability of exit. Table 2 shows losses increase the probability of exit. One simple explanation for the contrast relates to the fact that while loss averse management 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

[5]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]. 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.

probability of exit, regardless of management preferences, as is the case in Table 2. Indeed, this is why we made the assumption $\eta < 1$. However, the owners and general managers we surveyed in 2016 were supported financially by the Dutch government during COVID-19 and the associated lockdowns. The financial support enabled them to survive. This explains why market aggregates can reflect loss aversion in general equilibrium.

7 Simulated productivity and profit

In this section, we conduct a simulation analysis to examine productivity, profit and profit sharing between owners and workers, with and without loss aversion. We investigate the cyclicality of the bias due to loss aversion, with emphasis on how the bias evolved during the COVID-19 years. Rather than calibrating the model to replicate realized values, we select model parameters based on existing literature and our own analysis. This approach ensures that the chosen parameters are empirically plausible while allowing us to explore the implications of different firm decision-making behaviors.

We assume that each US county m is in general equilibrium in each year t. General equilibrium is defined by:

$$\widetilde{\phi}_G(F_{mt}) = \Theta^{\frac{\sigma-1}{k}} \mathbb{E}(\Phi)^{\frac{1}{k}} \Phi_G(F_{mt})^{\frac{1}{\sigma-1}} \quad (24)$$

$$\widetilde{\phi}_L(F_{mt}) = \Theta^{\frac{\sigma-1}{k}} \mathbb{E}(\Phi)^{\frac{1}{k}} \Phi_L(F_{mt})^{\frac{1}{\sigma-1}} \quad (25)$$

$$M^e_{mt} = \frac{(\sigma-1)R_{mt}}{\sigma k} \frac{1-\eta}{F^e_{mt}} \quad (26)$$

$$M_{mt} = M^e_{mt} Pr(A_{mt} = 1 | F_{mt}, F^r_{mt}, F^e_{mt}) \quad (27)$$

where $A_{mt} = 1$ indicates whether an entrant becomes active, $Pr(.)$ denotes their subjective probability:

$$Pr(A_{mt} = 1 | F_{mt}, F^r_{mt}, F^e_{mt}) = \left\{ \int_{\underline{F}}^{F^r_{mt}} \left[1 - G(\phi^*_G(F))\right] h(F) dF + \int_{F^r_{mt}}^{\overline{F}} \left[1 - G(\phi^*_L(F))\right] h(F) dF \right\}.$$

With these objects in hand, we can compute implied profits for the average entrepreneur:

$$\chi_{mt} = \frac{\eta}{1-\eta} \cdot \left\{ F^e_{mt} + \int_0^{F^r_{mt}} [1 - G(\phi^*_G(F))]\, h(F)\,(F - F^r_{mt})\, dF + \int_{F^r_{mt}}^{\infty} [1 - G(\phi^*_L(F))]\, h(F)\lambda\,(F - F^r_{mt})\, dF \right\}. \tag{28}$$

To simulate productivity and profit, we first impute values for key parameters: σ, k, $\underline{\phi}$, η, and λ. Using our proxies for F^e_{mt}, F_{mt} and F^r_{mt}, we then generate $\widetilde{\phi}_G(F_{mt})$, $\widetilde{\phi}_L(F_{mt})$, and χ_{mt} for every m and t in our sample. We simulate two distinct scenarios:

1. vNM decision-making Firms: in this scenario, we set $\sigma = 4$, $k = 3.4$, $\underline{\phi} = 1$, $\eta = 0$, and $\lambda = 1$.

2. PT decision-making Firms: here, we modify η and λ, setting $\eta = 0.3$, and $\lambda = 7$, while keeping $\sigma = 4$, $k = 3.4$ and $\underline{\phi} = 1$ unchanged.

Our choices for σ and k are based on established estimates from previous studies, including Bernard et al. [2007], Melitz and Redding [2015], and Farrokhi and Soderbery [2024]. The parameters η and λ are selected based on our own analysis, while $\underline{\phi} = 1$ is a normalization.

The results of our simulations are presented in Figure 3 and subsequently in Figure 4, highlighting the differences in productivity and profit outcomes between the two firm decision-making scenarios.

The top panel of Figure 3 plots the ratio of average productivities under vNM and PT firms. Measured productivity at vNM firms is approximately 35 percent higher than productivity at PT firms on average. The productivity of vNM firms is more sensitive to the business cycle, and is in fact countercyclical. The bottom panel of Figure 3 plots implied profits for the average entrepreneur. Profits are always 0 at vNM firms. Profits at PT firms are almost always fluctuating around 0 except during the COVID-19 period. Here we observe an enormous spike in profit at PT firms.

We use the expression for χ to study the differences in profit and profit sharing between vNM and PT firms. The top panel of Figure 4 plots average total county-level firm profit by year. The bottom panel does the same but for the total payroll to total profit ratio. Both figures include county GDP per capita detrended as a point of comparison.

8 Conclusion

We develop an equilibrium model with loss averse firms that lets us study the implications of loss aversion for productivity, profit, and profit-sharing.

Our study may have implications for a literature that tries to understand the positive correlation between firm productivity and size. Previous research has focused on factors such as learning by doing, vertical integration for facilitating intangible input transfers within the firm, market competition, or regulatory influences.[6] By contrast, we underscore the pivotal role of ownership or management team size in prioritizing profit-related objectives, ultimately enhancing measured firm productivity.

Our study sheds light on why loans to small firms under the Paycheck Protection Program, initiated during the COVID-19 period, had a limited impact on employment rates in the United States.[7] Our results suggest employment subsidies that target small businesses facilitate the survival of nonpecuniary preferences and, ultimately, the existence of loss averse firms in equilibrium.

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[6] An extensive summary of this previous research is provided by Syverson [2011].

[7] The limited impact, in particular for small firms, has been documented by, e.g., Autor et al. [2022], Granja et al. [2022], and Chetty et al. [2020].

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Figures and Tables

Table 1: 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	68279
GDP (thousands of 2021 dollars)	4,963,405	21,505,450	4,418	785361615	59131
Business applications	880.25	3,635.64	0.00	128,114	47138
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

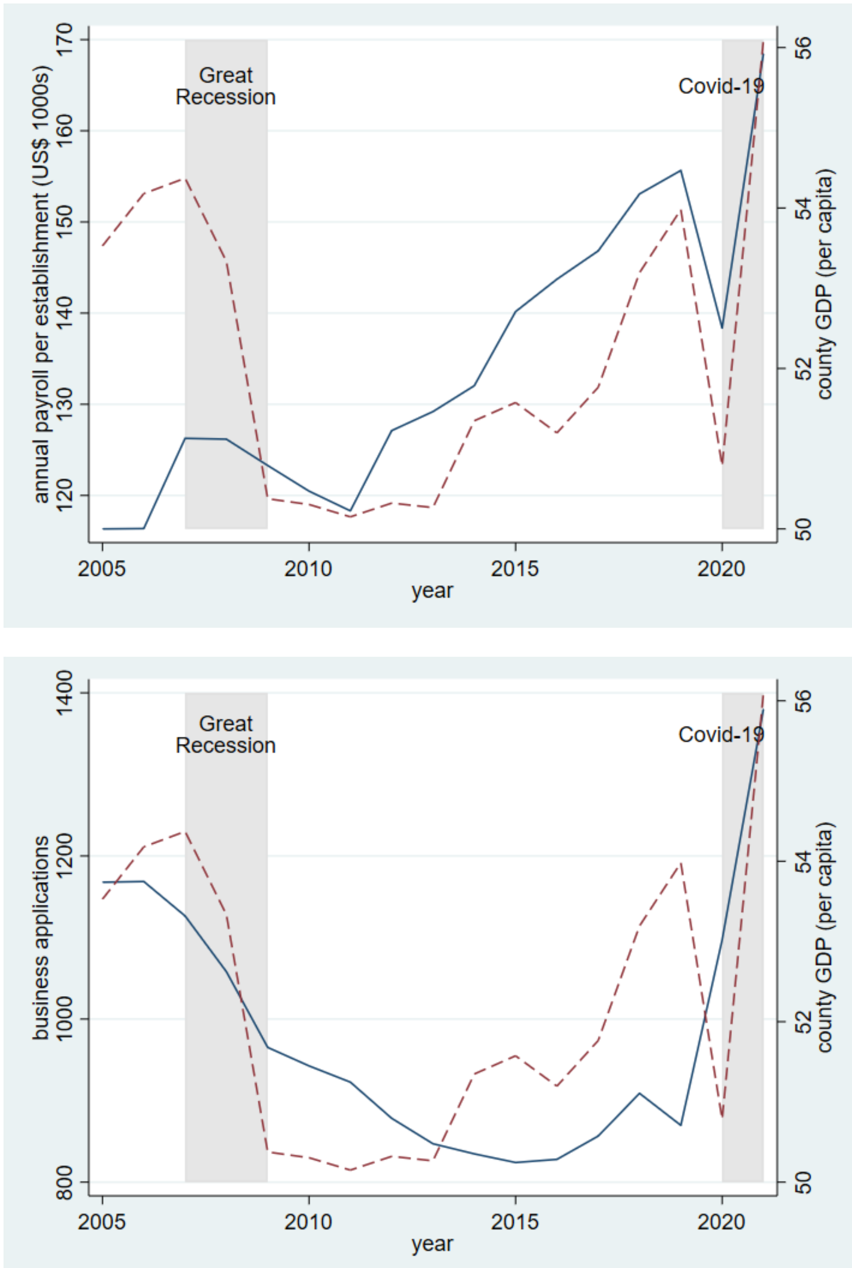
Notes:

[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] 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.

Figure 1: Annual payroll per establishment (US$ 1000s) and business applications over time.



Notes:

1 Figures depict the two key variables that we input into our model in order to generate measures of profit and productivity.

2 Annual payroll per establishment and business applications are in blue. Both are the sum of their mean and the detrended variable.

3 Dashed red line is county GDP. GDP is the sum of mean GDP and detrended GDP.

Table 2: Loss-gain ratios in equilibrium

	Establishments (in logs) (1)	Entry Rate (2)	Exit Rate (3)
GDP (in logs)	0.114***	-0.210	0.345
	(0.018)	(0.499)	(0.556)
Business applications (in logs)	0.050***	2.495***	0.057
	(0.008)	(0.388)	(0.353)
β_l: Above average payroll (standardized, absolute value)	-0.010***	0.039	0.471***
	(0.002)	(0.067)	(0.092)
β_g: Below average payroll (standardized, absolute value)	0.001	0.407***	0.100
	(0.002)	(0.071)	(0.101)
Constant	1.899***	0.200	5.132
	(0.253)	(6.711)	(7.528)
H_0: $\beta_l/\beta_g = 1$	8.900	0.095***	4.689
	(13.426)	(0.173)	(5.109)
County fixed effects	Y	Y	Y
State-Year fixed effects	Y	Y	Y
Observations	45431	32250	34389
R^2	0.992	0.337	0.311

Notes:

[1] Table reports estimates of the effect of year-over-year payroll increases and decreases on the number of establishments, entry rates, and exit rates. Unit of observation is the county and year. There are 3152 counties.

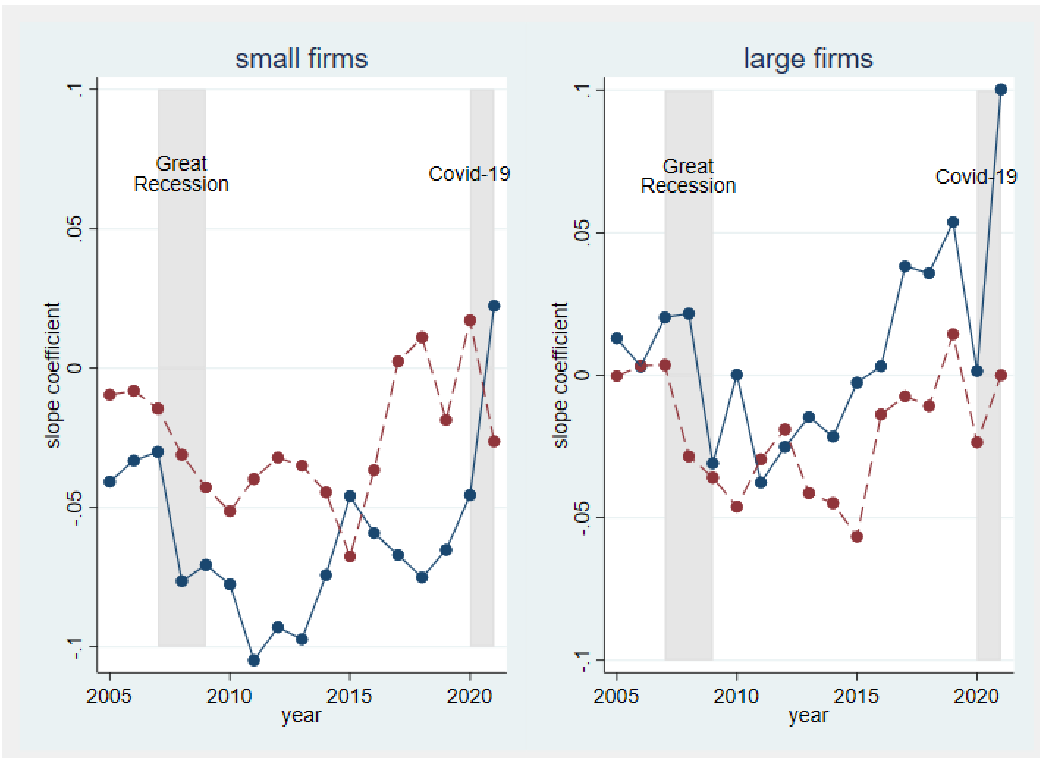
[2] Entry and exit rates come from the Business Dynamics Statistics (BDS), produced and distributed by the U.S. Census Bureau. Entry rates are 100 multiplied the count of establishments born within the last 12 months divided by the average count for the last two years. Exit rates are constructed similarly.

[3] 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.

[4] Entry rate regressions use lagged controls. Exit rate regressions use contemporaneous controls. These specifications better reflect the nature and timing of entry and exit rate decisions.

[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 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 left figure. Right 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.

Table 3: 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 4: 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:

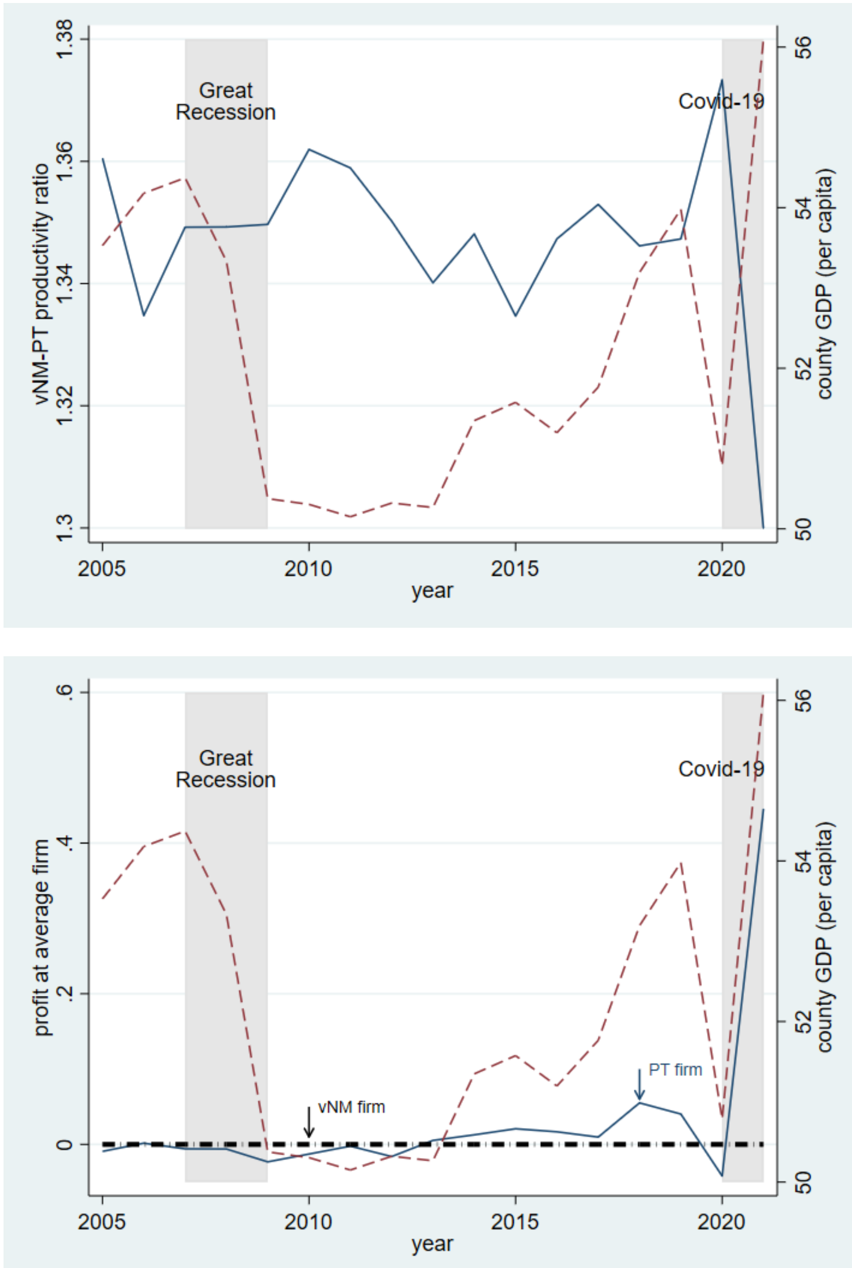
[1] Table reports regression estimates of the effects of owner loss aversion on exit decision of firm.

[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 3: Productivity and profits of vNM and PT decision makers.



Notes:

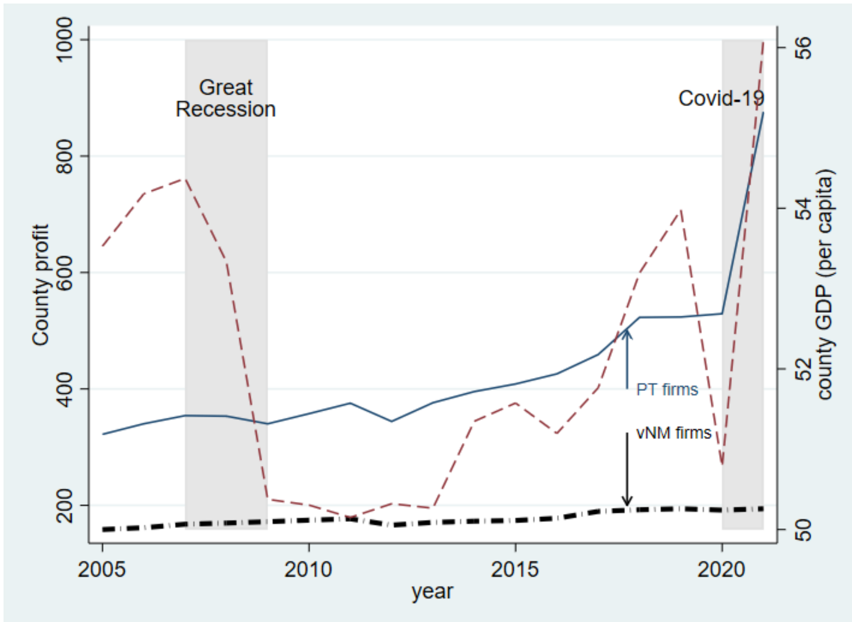
1 vNM decision makers maximize expected utility. PT decision makers maximize a linear combination of expected utility and gain-loss utility.

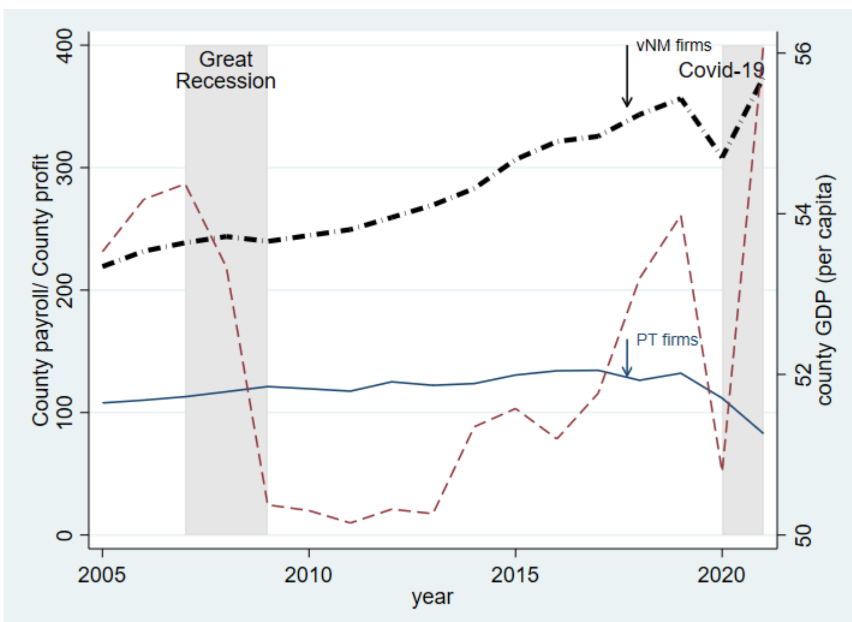
2 The top figure plots $\frac{\tilde{\tilde{\phi}}_{vNM}}{\tilde{\tilde{\phi}}_{PT}}$ against the year, where $\tilde{\tilde{\phi}}$ is the productivity of the average firm, $\tilde{\tilde{\phi}}_{vNM}$ is our estimate if the firm is run by expected utility maximizers, and $\tilde{\tilde{\phi}}_{PT}$ is our estimate if the firm is run by reference dependent utility maximizers.

3 Bottom figure plots our estimates of profit at the average firm against the year. Profit of a vNM firm is always 0 and in black. Profit of a PT firm is in solid blue.

4 Dashed red line is county GDP. GDP is the sum of mean GDP and detrended GDP.

Figure 4: County profit and payroll under vNM and PT decision makers.





Notes:

1. County profit is average profit (as in Equation **??**) multiplied by the number of firms.
2. Average profit is computed under two scenarios. First, firms are VNM decisions makers who maximize expected utility. Second, firms are PT decision makers who maximize expected utility and gain-loss utility.
3. Dashed red line is county GDP per capita. GDP is the sum of mean GDP and detrended GDP.

Are markets loss averse?

Online Appendix

Julian Emami Namini and Sacha Kapoor

February 18, 2025

A.1 Comparative statics of $\tilde{\tilde{\phi}}$ with respect to λ.

We study how the parameter of loss aversion λ affects sector-wide average productivity, which is given by:

$$\tilde{\tilde{\phi}} = \left\{ \frac{\int_{\underline{F}}^{F^r} [1 - G(\phi_G^*(F))] \left(\tilde{\phi}_G(F)\right)^{\sigma-1} h(F)dF + \int_{F^r}^{\overline{F}} [1 - G(\phi_L^*(F))] \left(\tilde{\phi}_L(F)\right)^{\sigma-1} h(F)dF}{\int_{\underline{F}}^{F^r} [1 - G(\phi_G^*(F))] h(F)dF + \int_{F^r}^{\overline{F}} [1 - G(\phi_L^*(F))] h(F)dF} \right\}^{\frac{1}{\sigma-1}}. \tag{29}$$

We use a Pareto–distribution for each $\phi(F)$ on $[\underline{\phi}, \infty)$. Using equation 12 for $\tilde{\phi}_x(F)$, $x = G, L$, and the definition of $\mathbb{E}(\Phi)$, equation 29 simplifies to:

$$\tilde{\tilde{\phi}}^{\sigma-1} = \Theta^{\frac{(\sigma-1)^2}{k}} \frac{\left[\int_{\underline{F}}^{F^r} \Phi(F)^b h(F)dF + \int_{F^r}^{\overline{F}} \Phi(F)^b h(F)dF\right]^{\frac{b-2}{b-1}}}{\int_{\underline{F}}^{F^r} \Phi(F)^{b-1} h(F)dF + \int_{F^r}^{\overline{F}} \Phi(F)^{b-1} h(F)dF}. \tag{30}$$

Notice that the comparative statics of $\tilde{\tilde{\phi}}^{\sigma-1}$ with respect to λ are qualitatively identical to those of $\tilde{\tilde{\phi}}$ with respect to λ, as $\sigma - 1 > 0$. Linearizing the terms $\Phi(F)^b$ and $\Phi(F)^{b-1}$ around a point F^0 according to a first order Taylor approximation leads to:

$$\begin{aligned}
\Phi(F)^b\Big|_{F<F^r} &\approx \left(F^0\alpha_1 - (\alpha_1 - 1)F^r\right)^b + b\left(F^0\alpha_1 - (\alpha_1 - 1)F^r\right)^{b-1} \alpha_1(F - F^0) \\
\Phi(F)^b\Big|_{F\geq F^r} &\approx \left(F^0\alpha_\lambda - (\alpha_\lambda - 1)F^r\right)^b + b\left(F^0\alpha_\lambda - (\alpha_\lambda - 1)F^r\right)^{b-1} \alpha_\lambda(F - F^0) \\
\Phi(F)^{b-1}\Big|_{F<F^r} &\approx \left(F^0\alpha_1 - (\alpha_1 - 1)F^r\right)^{b-1} + (b-1)\left(F^0\alpha_1 - (\alpha_1 - 1)F^r\right)^{b-2} \alpha_1(F - F^0) \\
\Phi(F)^{b-1}\Big|_{F\geq F^r} &\approx \left(F^0\alpha_\lambda - (\alpha_\lambda - 1)F^r\right)^{b-1} + (b-1)\left(F^0\alpha_\lambda - (\alpha_\lambda - 1)F^r\right)^{b-2} \alpha_\lambda(F - F^0),
\end{aligned}$$

with $\alpha_1 \equiv \frac{1}{1-\eta}$, and $\alpha_\lambda \equiv \frac{1-\eta+\eta\lambda}{1-\eta}$. $\tilde{\tilde{\phi}}^{\sigma-1}$ increases (decreases) with λ if the elasticity of the numerator with respect to λ is larger (smaller) than the elasticity of the denominator with respect to λ in equation 30, i.e. if the following holds:

$$\frac{\frac{b-2}{b-1}\frac{\partial\left(\int_{F^r}^{\overline{F}} \Phi(F)^b h(F)dF\right)}{\partial\lambda}}{\int_{\underline{F}}^{F^r} \Phi(F)^b h(F)dF + \int_{F^r}^{\overline{F}} \Phi(F)^b h(F)dF} > (<) \frac{\frac{\partial\left(\int_{F^r}^{\overline{F}} \Phi(F)^{b-1} h(F)dF\right)}{\partial\lambda}}{\int_{\underline{F}}^{F^r} \Phi(F)^{b-1} h(F)dF + \int_{F^r}^{\overline{F}} \Phi(F)^{b-1} h(F)dF}. \tag{31}$$

First, we will show with an example that ">" and "<" are possible. In this example we assume (i) a uniform distribution for F on $[0;1]$, i.e. the densities $h(F)$ in inequality 31 cancel out, and (ii) $F^0 = F^r$. Solving the integrals in inequality 31 with $F^0 = F^r$ and afterwards taking the corresponding partial derivatives with respect to λ allows us to express inequality 31 as:

$$\frac{\frac{b-2}{b-1}b\left[(F^r)^2\frac{1}{2} - F^r + \frac{1}{2}\right]}{(F^r)^2 b\frac{\alpha_\lambda-\alpha_1}{2} + F^r(1-b\alpha_\lambda) + \frac{b\alpha_\lambda}{2}} \lesseqgtr \frac{(b-1)\left[(F^r)^2\frac{1}{2} - F^r + \frac{1}{2}\right]}{(F^r)^2(b-1)\frac{\alpha_\lambda-\alpha_1}{2} + F^r(1-(b-1)\alpha_\lambda) + \frac{(b-1)\alpha_\lambda}{2}}.$$

Further simplification leads to: $(F^r)^2\frac{\alpha_\lambda-\alpha_1}{2} - F^r\left[\alpha_\lambda + \frac{1}{b(1-b)}\right] + \frac{\alpha_\lambda}{2} \lesseqgtr 0$. If $F^r = 0$, we get: $\frac{\alpha_\lambda}{2} > 0$. However, if $F^r = 1$, and after plugging in the terms for α_1 and b we get:

$$-\frac{1}{2(1-\eta)} - \frac{(\sigma-1)^2}{(\sigma-1-k)k} \lesseqgtr 0.$$

If $\eta \to 1$, or if $\eta \to 0$ and, e.g., $\sigma = 2$ and $k > 2$, the left hand side is *negative*. Thus, both ">" and "<" are possible in inequality 31.

Second, we will show that the left hand side is *always* larger than the right hand side in inequality 31, implying that $\tilde{\tilde{\phi}}$ increases with λ, if F follows a Pareto distribution on the interval $[\underline{F}, \infty)$ with density $h(F) = \frac{\kappa \underline{F}^\kappa}{F^{\kappa+1}}$ and $\kappa = 0.3$. Notice that inequality 31 leads to an ∞/∞ indeterminate form on both sides as the terms with $F^{1-\kappa}$ approach infinity at $\overline{F} \to \infty$. This becomes evident when solving the two integrals with upper bound $\overline{F} \to \infty$:

$$\int_{F^r}^{\infty} \Phi(F)^b h(F)dF = \kappa\underline{F}^\kappa \frac{\left[\frac{F^0\alpha_\lambda(1-b)-(\alpha_\lambda-1)F^r}{-\kappa}F^{-\kappa} + \frac{b\alpha_\lambda}{1-\kappa}F^{1-\kappa}\right]_{F^r}^{\infty}}{\left[F^0\alpha_\lambda - (\alpha_\lambda-1)F^r\right]^{1-b}} \tag{32}$$

$$\int_{F^r}^{\infty} \Phi(F)^{b-1} h(F)dF = \kappa\underline{F}^\kappa \frac{\left[\frac{\left[F^0\alpha_\lambda(2-b)-(\alpha_\lambda-1)F^r\right]}{-\kappa}F^{-\kappa} + \frac{(b-1)\alpha_\lambda}{1-\kappa}F^{1-\kappa}\right]_{F^r}^{\infty}}{\left[F^0\alpha_\lambda - (\alpha_\lambda-1)F^r\right]^{2-b}}. \tag{33}$$

Thus, we apply L'Hopital's rule with respect to $\overline{F}^{1-\kappa}$ to both sides of inequality 31. Simplification then allows us to express inequality 31 as follows:

$$\frac{b-2}{b-1}\frac{\partial\alpha_\lambda}{\partial\lambda}b\frac{(F^0-F^r)b\alpha_\lambda + F^r}{b\alpha_\lambda(F^0\alpha_\lambda - (\alpha_\lambda-1)F^r)} > \frac{\partial\alpha_\lambda}{\partial\lambda}(b-1)\frac{(F^0-F^r)(b-1)\alpha_\lambda + F^r}{(b-1)\alpha_\lambda(F^0\alpha_\lambda - (\alpha_\lambda-1)F^r)}. \tag{34}$$

Notice that the ">" sign implies that $\tilde{\tilde{\phi}}$ increases with λ. We can divide both sides by $\frac{\partial\alpha_\lambda}{\partial\lambda}$

and multiply both sides by α_λ without changing the inequality sign:

$$\frac{b-2}{b-1}\frac{b\alpha_\lambda\left(F^0-F^r\right)+F^r}{F^0\alpha_\lambda-(\alpha_\lambda-1)F^r} \quad > \quad \frac{(b-1)\alpha_\lambda\left(F^0-F^r\right)+F^r}{F^0\alpha_\lambda-(\alpha_\lambda-1)F^r}. \tag{35}$$

Multiplying both sides with $b-1$ changes the unequal sign:

$$(b-2)\frac{b\alpha_\lambda\left(F^0-F^r\right)+F^r}{F^0\alpha_\lambda-(\alpha_\lambda-1)F^r} \quad < \quad (b-1)\frac{(b-1)\alpha_\lambda\left(F^0-F^r\right)+F^r}{F^0\alpha_\lambda-(\alpha_\lambda-1)F^r}. \tag{36}$$

If the denominator in inequality 36 is positive, i.e. if $F^0 > \frac{\eta\lambda}{1-\eta+\eta\lambda}F^r$, we can simplify inequality 36 to:

$$F^0 \quad > \quad \frac{\eta\lambda}{1-\eta+\eta\lambda}F^r. \tag{37}$$

If the denominator in inequality 36 is negative, i.e. if $F^0 < \frac{\eta\lambda}{1-\eta+\eta\lambda}F^r$, we can simplify inequality 36 to:

$$F^0 \quad < \quad \frac{\eta\lambda}{1-\eta+\eta\lambda}F^r. \tag{38}$$

Thus, regardless of the magnitude of the linearization point F^0, the left hand side of inequality 31 is *always* larger than the right hand side. This implies that $\tilde{\tilde{\phi}}$ increases with λ in the case of a Pareto distribution for F on the interval $[\underline{F},\infty)$ and with shape parameter $\kappa = 0.3$.

A.2 Survey Methodology

A.2.1. Survey Design and Implementation Our sampling approach began with the website `iens.nl`, a platform allowing customers to evaluate restaurants based on multiple dimensions including price, food quality, service, and decor. The website provided a comprehensive list of restaurants and addresses, primarily focusing on the Dutch cities of Rotterdam and Utrecht. Research assistants employed a multi-step approach to recruit participants, including initial website scraping to identify potential restaurant participants, telephone outreach to schedule interviews, and on-site visits for in-person interviews. The final sample comprised 107 restaurants, representing 15% of the `iens.nl` population and essentially all restaurants in the targeted cities. These sampled restaurants employed a total of 1,870 people. We conducted a detailed analysis of sample representativeness, comparing our sampled restaurants with non-sampled restaurants on iens.nl. This comparison demonstrated similarity across key dimensions such as average food price ratings, service ratings, and decor ratings. However, it is important to acknowledge that the sample is inherently selected based on owners' willingness and ability to participate in the survey.

A.2.2. Measurement Procedure Our measurement procedure follows the method developed by Abdellaoui et al. [2016]. 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:

$$w^+(p)u(g) + w^-(1-p)u(l) = 0, \tag{39}$$

   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 $(g, p; 0, 1-p)$:

$$w^+(p)u(g) = u(ce_g). \tag{40}$$

4. Solicit the certainty equivalent ce_l for the loss prospect $(0, p; l, 1-p)$:

$$w^-(1-p)u(l) = u(ce_l). \tag{41}$$

In each case the subject works through several examples to help identify their indifference point. Equations 39-41 imply

$$u(ce_g) = -u(ce_l). \tag{42}$$

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

$$\frac{u(ce_l)/ce_l}{u(ce_g)/ce_g} = \frac{ce_g}{ce_l}, \tag{43}$$

where the equality follows from Equation 42. Owners are classified as loss averse if $\frac{ce_g}{ce_l} > 1$.

To make the problem less abstract, we frame the decision as a choice between businesses. For example, to solicit the loss l from step 2, we asked respondents: "Which business would you prefer to own? One where:..."

...you are **GUARANTEED**	...a **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.

We also asked: "What loss would just make you willing to own the second business?"

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

We made the stakes sufficiently high to make the amounts meaningful for business persons. The remaining questions used in the procedure can be found in the Section A.3.

We deliberately did not distinguish between accounting and economic profit, recognizing that owners and managers may not be familiar with technical distinctions. Our sample consisted of a relatively even split between owners and managers, with economic profit being more relevant for owners. We investigated whether interpretation differences track the owner-manager distinction by examining potential variations in loss aversion, and notably, no significant differences were observed.

The decision problem was explained as a coin flip with a 50-50 chance ($p = 0.5$), focusing on measuring loss aversion under risk with known, objective probabilities. This approach is distinct from ambiguity-based decision measurements, providing a clear and structured method of understanding risk perception.

A.2.3. Follow-up Investigation In October 2021, more than 5 years after the original survey, we conducted a comprehensive follow-up to track the status of surveyed restaurants. This investigation utilized multiple data sources including Google, Facebook, local newspapers, and firms' websites. Our tracking approach focused on identifying permanent closures, examining survivor businesses, and understanding closure reasons, with particular attention to potential COVID-19 impacts.

The methodology builds upon Abdellaoui et al. [2016]'s insights, which suggest that measurements under risk and ambiguity yield similar loss aversion coefficients.

A.3 Loss aversion survey questions

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:

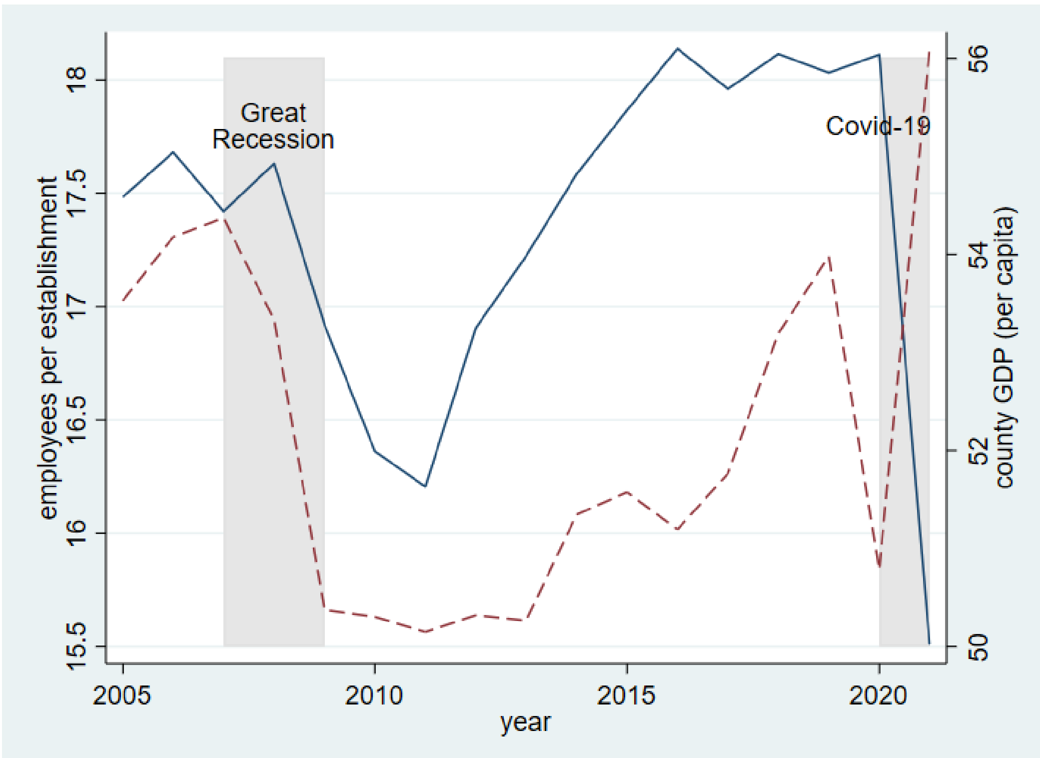
you are **GUARANTEED**	**COIN FLIP** determines whether you earn		
a loss of €	a loss of € L=	**OR**	a profit of € 0
a loss of €	a loss of € L=	**OR**	a profit of € 0
a loss of €	a loss of € L=	**OR**	a profit of € 0

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.4 Additional figures and tables

Figure A.4.1: Employees per establishment over time.

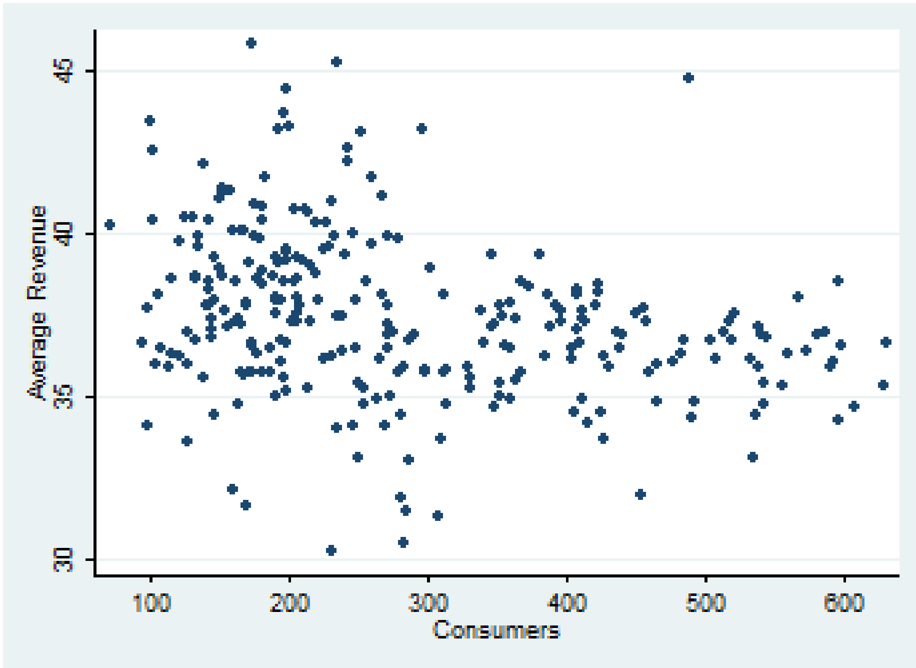


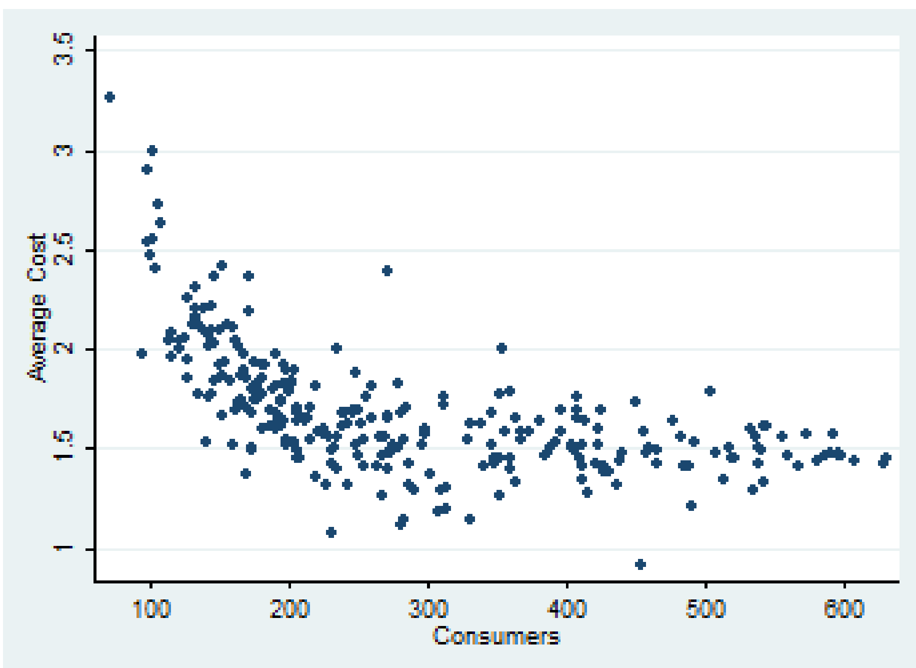
Notes:

1 This graph uses data that is not captured by our model. It shows that employmet per establishment decreases. This could be for deleterious reasons or simply because the advent of online delivery made it easier to have fewer employees on staff.

2 Solid blue line is employment per establishment. Dashed red line is county GDP per capita.

Figure A.4.2: Average revenue and cost in 2006-2007





Notes:

1 Administrative data from a restaurant for the 2006-2007 season. Each dot corresponds to a particular date and firm.

2 Average Revenue is the ratio of total revenue to 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 Top panel implies convergence of revenue per customer around $37 when the production scale is large. Bottom panel implies labor is a fixed cost for the firm at the shift level.

4 Source: Kapoor [2020].

Table A.4.1: Representativeness of owner sample.

Variable	Not Sampled (1)	Sampled (2)	Difference (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.4.2: Loss-gain ratios in equilibrium with additional controls.

	Establishments (in logs) (1)	Entry Rate (2)	Exit Rate (3)
GDP (in logs)	-0.003	0.083	1.081
	(0.020)	(0.823)	(1.128)
Business applications (in logs)	0.033***	0.430	0.079
	(0.009)	(0.613)	(0.370)
β_l: Above average payroll (standardized, absolute value)	-0.017***	-0.046	0.534***
	(0.002)	(0.079)	(0.108)
β_g: Below average payroll (standardized, absolute value)	0.007***	0.524***	0.030
	(0.002)	(0.083)	(0.155)
Constant	-0.148	20.621**	25.932
	(0.307)	(9.862)	(16.675)
H_0: $\beta_l/\beta_g = 1$	2.336***	0.099***	17.075
	(0.496)	(0.143)	(97.006)
County fixed effects	Y	Y	Y
State-Year fixed effects	Y	Y	Y
Additional control variables	Y	Y	Y
Observations	29303	23221	23052
R^2	0.995	0.352	0.339

Notes:

[1] Table replicates Table 2 but with a broader set of county-time control variables relative to the estimating equation from general equilibrium model.

[2] Control variables include the number of employees in the sector (in logs), a standardized housing price index, population density (in logs), average year-over-year payroll losses and gains in neighbouring counties within 25 miles.

[3] Housing price index constructed by the Federal Housing Finance Agency (FHSA). County population estimates constructed by the US Census Bureau.

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