Asset Pricing with Entry and Imperfect Competition[†]

Job Market Paper

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Abstract

I study the implications of fluctuations in new firm creation across industries for asset prices and macroeconomic quantities. I write a general equilibrium model with heterogeneous industries, allowing for firm entry and time variation in markups. Firms entering an industry increase competition and displace incumbents' monopoly rents. This mechanism is strongest in industries that exhibit high profit margins and high elasticity of innovation to the cost of entry. A positive shock to the aggregate cost of entry increases the marginal utility of consumption —the price of entry risk is negative. Therefore, firms with more exposure to rents' displacement have higher expected excess returns. Using micro-level data on entry rates, I trace out the impact of firm creation on incumbent firms' profitability and stock returns. The effect is strongest for the types of industries the model predicts. I confirm aggregate entry risk is priced: differential exposure to the aggregate entry shock explains a large fraction of the cross-industry variation in expected returns.

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1 Introduction

Innovation by new firms is an important driver of economic growth.[1] However, all firms do not share these benefits equally. Innovation by new entrants increases competition and can lead to displacement of incumbent firms.[2] Not all incumbent firms are equally sensitive to this displacement. Sometimes, incumbents have a strong brand that makes competing with it hard for new entrants.[3] In other cases, firms derive monopoly rents that are fragile.[4] In this paper, I build a general equilibrium model with heterogeneous industries to explore that incumbent firms incur due to the entry of new firms.

I start with the observation that a large *systematic* component is present in firm entry rates across industries that is not related to contemporaneous output growth.[5] I interpret this aggregate component as evidence that the cost of new firm creation—or alternatively the benefit of creating new firms—varies independently from the productivity of existing firms. This time-varying cost improves the term of business creation and can be interpreted either as an embodied technical change—a higher productivity of new firm creation—or as a metaphor for the time-varying ability of new firms to obtain financing. Further, an important feature of the data is that cross-sectional dispersion is present in the time-series volatility of industry entry rates. A large part of this volatility can be attributed to the heterogeneous sensitivities of industry entry rates to this common shock.[6]

Firm creation is costly; resources need to be substituted away from consumption goods towards creating new firms. As a result of the equilibrium reallocation of resources away from consumption to innovation, a reduction in the price of new firm creation is associated with temporarily lower household consumption. Under some general conditions on house-

[1] This idea goes back to Schumpeter (1942). See Aghion and Howitt (1992) for a modern theory of creative destruction.

[2] Bresnahan and Reiss (1991) identify the causal effect of firm entry on competition. They show competition increases more after entry for the more concentrated industries. Syverson (2004) shows consumers substitute more easily in a more densely populated market.

[3] Warren Buffett mentioned examples such as *Coca-Cola* and *Gillette*.

[4] Finance practitioners have long identified this phenomenon. Warren Buffett, in his 2007 Chairman's letter to the board of Berkshire Hathaway, writes, "A truly great business must have an enduring "moat" that protects excellent returns on invested capital. The dynamics of capitalism guarantee that competitors will repeatedly assault any business "castle" that is earning high returns. (...). Our criterion of "enduring" causes us to rule out companies in industries prone to rapid and continuous change."

[5] Contemporaneous correlation with output growth of this component is -0.4.

[6] The sensitivity of concentrated industries' entry rates to aggregate entry shocks is twice as large as for low concentration industries. At the same time, the time-series volatility of concentrated industries is twice as large as for the low concentration industries. See table 1 for more summary statistics of entry rates by quintiles of industry concentration.

holds' preferences, their marginal utility of consumption increases after a positive shock to aggregate entry—lower cost of innovation—, and as a consequence, the price of entry risk is negative.

My model features multiple industries. Within each industry, firms compete by producing differentiated goods—product varieties. Consumers have preferences for variety, implied by the translog expenditure function.[7] The degree of industry concentration—the number of incumbent firms—determines profit margins. The number of firms, and therefore incumbent profits, varies as a result of fluctuations in the cost of entry.

The sensitivity of industry profits to fluctuations in aggregate entry depends on (a) the degree of industry concentration and (b) the elasticity of industry entry to changes in aggregate entry.As a result of this differential cash-flow exposure, industry stock returns have heterogeneous exposure to the cost of new firm creation, depending on these two characteristics. Industries with large profit margins and industries with high elasticity of firm entry are most vulnerable to fluctuations in aggregate entry. From the perspective of the representative investor, incumbent firms in these industries are excessively risky, leading to lower prices and therefore higher risk premia.

Further, my model has implications about the interaction between concentration and elasticity of firm entry. In competitive industries, profit margins are slim; hence new firm entry has a small effect on profits. As a result, for competitive industries, the relation between elasticity of new entry and risk premia is weak. By contrast, firms in concentrated industries enjoy higher monopoly rents. When the elasticity of industry entry is small—high barriers to entry—incumbent firms are protected from aggregate fluctuations to new entry. However, concentrated industries with high entry elasticity—low barriers to entry—are riskier and have higher returns in equilibrium.

I test the predictions of my model using micro-level data on firm creation at the three-digit SIC code level from the Bureau of Labor Statistics. First, I show the profitability of incumbent firms is more sensitive to shocks to aggregate entry in more concentrated industries. A one-standard-deviation unexpected increase in industry entry rates is related to a 5% average decline in profitability and a 3% decline in contemporaneous annual returns for the more concentrated industries. By contrast, this effect disappears in less concentrated

[7] The translog expenditure function specifies consumers' preferences over a continuum of varieties. A key feature of translog preferences is the elasticity of substitution across goods that increases with the number of varieties available. See appendix A.1 for a detailed discussion of the translog demand system.

industries. This systematic shock to aggregate firm entry is an important determinant of profitability and stock returns even across longer horizons. Using a vector autoregressive analysis to decompose variations in returns, I find that at a five-year-horizon aggregate entry rates explain 25% of the variance of stock returns in the most concentrated firms but only 10% in industries with low concentration.

Second, the model predicts industries with higher entry rates are more exposed to the displacement risk. I document that firms in industries with high entry rates tend to have higher average returns than firms in low-entry-rates industries; a high-minus-low portfolio formed on these characteristics has an annual Sharpe ratio of 47%. Ranking industries by their level of concentration, this spread in returns disappears for the least concentrated industries and is more pronounced for the most concentrated industries.

Third, the model implies that in concentrated industries, entry elasticity is strongly related to risk premia. I measure elasticity as the sensitivity of unexpected industry entry rates to shocks to the first principal component of industry entry rates.[8] I consider double-sorted portfolios of firms sorted on industry concentration and sensitivity of industry entry to the systematic component of industry entry rates. I find industries that react more to those shocks have higher average returns, albeit only in the more concentrated industries; here the high-minus-low portfolio has a Sharpe ratio of 24%.

Related Literature

A vast literature in asset pricing investigates how firm characteristics and aggregate fluctuations explain the cross section of firms' risk premia theoretically and empirically (see Cochrane (2008) for a survey). I contribute to the empirical asset-pricing literature that links industries' economic characteristics to stock returns. Fama and French (1997) explain "uncertainty about true factor risk premiums" prevents a clear understanding of industries' cost of equity. More specifically, I complement the work of Hou and Robinson (2006) who show that concentrated industries earn on average lower expected returns than more competitive industries. I show concentrated industries are not *a priori* safer, because they have larger barriers to entry. Specifically, I show concentrated industries can be riskier, because their monopoly rents are good incentives for sectoral innovation.

I contribute to a literature that explores features of the macroeconomic real business

[8] As a robustness test, I also use the price of new equipment goods, commonly found to measure shocks to productivity of the intensive margin of capital accumulation.

cycle model (RBC) for asset prices. Jermann (1998), Tallarini (2000), and Boldrin, Christiano, and Fisher (2001) focus on the time-series properties of asset prices in macroeconomic models. My paper is closest to a branch of this literature investigating the effect of heterogenous firm characteristics for the cross section of risk premia (see, e.g., Berk, Green, and Naik (1999), Gomes, Kogan, and Zhang (2003), and Kogan and Papanikolaou (2012) for a survey).

Numerous studies (Kogan (2001), Gomes, Kogan, and Zhang (2003), Papanikolaou (2011), Gârleanu, Kogan, and Panageas (2012), Gârleanu, Panageas, and Yu (2012), Kogan, Papanikolaou, and Stoffman (2012)) analyze a general equilibrium production-based model to draw predictions about the time series and the cross section of returns. Their framework uses the intensive margin of innovation (firms' investment) to draw such predictions. My paper is closest to Papanikolaou (2011) and Kogan, Papanikolaou, and Stoffman (2012) who argue that firms' *assets in place* are subject to capital-embodied technical change, which makes them risky. I share a similar mechanism with this literature: in my model, the entry shock commands a negative price of risk in equilibrium and firms' differential exposures to this shock generate the cross section of risk premia. This mechanism is present in Papanikolaou (2011) and in Kogan, Papanikolaou, and Stoffman (2012)): a shock to the marginal productivity of investment affects different firms differently. Investment shocks favor growth opportunities relative to assets in place. As investment shocks command a negative price of risk, they can generate a value premium. In contrast to these works studying displacement effects of assets within the firm, I study how the extensive margin of innovation affects incumbent rents in industries. Hence I am able to draw implications about the cross section of industries' expected returns.[9]

The asset-pricing implications of my model supplement studies linking heterogeneity across industries on the demand side to the cross section of asset prices. Ait-Sahalia, Parker, and Yogo (2004) argue households have different risk aversion for luxury goods than for essential goods. Binsbergen (2007) extends this work and considers good specific preferences (deep habit), where the price elasticity of demand differs across goods, generating cross-sectional variation in expected returns. Yogo (2006) and Gomes, Kogan, and Yogo (2009) argue for a distinction between durable and non-durable goods; they find that durable-goods producers earn higher expected returns as the demand for those goods is pro-cyclical. My work stands in contrast with these studies, because I include richer

[9]Cohen, Polk, and Vuolteenaho (2003) show the value-premium puzzle is mainly a within- rather than between-industry phenomenon.

supply-side features of industries: the role of industry-entry-rate dynamics and concentration for the cross section of industry risk premia. In this paper, industries have different risk premia because the innovation sector displaces monopoly rents and those rents are differentially exposed to aggregate conditions for different industries.

My analysis is non-standard for asset-pricing, and I rely on a body of literature linking aggregate fluctuations and innovations. The idea of a connection between macroeconomic aggregates and the extensive margin of adjustment goes back to Schumpeter (1942) or, more recently, Aghion and Howitt (1992).[10] My framework builds on a recent line of papers by Bilbiie, Ghironi, and Melitz (2007, 2008, 2012) that integrate the extensive margin of investment into the RBC framework to understand the effect of firm creation on the dynamics of real quantities. I rely for my model of innovation on models of endogenous growth based on consumers' taste for variety (Romer (1990) and Grossman and Helpman (1992)) and more recent advances in the trade literature formalizing the role of the extensive margin of adjustment (Melitz (2003) and Chaney (2008)). I extend these previous works to study heterogeneous industries with multiple firms. My work focuses on the patterns of new firms' entry, and I bring empirical analysis from asset-pricing to shed light on the cross-section of industry entry.

I contribute to the literature that studies the impact of resource misallocation on aggregate productivity: I find markup variation across time and industries generates distortions in the allocations of resources to innovation. Hence the dynamics of markups in the cross section affect aggregate productivity. My work complements Jaimovich and Floetotto (2008), Bilbiie, Ghironi, and Melitz (2008) and Opp, Parlour, and Walden (2012) by considering two sources of distortions: time-varying markups and markup dispersion across industries.

The structure of the paper is as follows: in section 2, I present the model and I derive its main implications for asset prices. In section 3, I present the data, summary statistics, and preliminary evidence of the role of entry rates for stock returns. In section 4, I test the model implications for expected excess returns. All proofs along with some ancillary results are in the appendix.

[10] Shleifer (1986) is another example of such work tying innovation and firm creation to the business cycle. Kung and Schmid (2012) use the idea of growth driven by innovation to generate low-frequency movements in growth rates, and long-run risk for asset prices.

2 Model

In this section, I write a general equilibrium model with a consumption-goods-sector and an innovation sector to analyze the link between entry rates in an industry, its level of concentration, and firms' expected returns. The setup builds on recent macroeconomic models with firm creation (Melitz (2003), Bilbiie, Ghironi, and Melitz (2012)) and on the real business cycle (RBC) model with adjustment cost of investment (see Jermann (1998)). I cast the model in discrete time to make it more explicit and I solve it using perturbation methods.

2.1 Households

2.1.1 Intertemporal Consumption Choice

The representative household has recursive preferences of the Epstein and Zin (1989) type. She maximizes her continuation utility J_t over sequences of the consumption index C_t:

$$J_t = \left[(1-\beta)C_t^{1-\nu} + \beta\left(\mathsf{R}_t(J_{t+1})\right)^{1-\nu}\right]^{\frac{1}{1-\nu}},$$

where β is the time-preference parameter and ν is the inverse of the elasticity of intertemporal substitution (EIS). $\mathsf{R}_t(J_{t+1}) = [\mathbf{E}_t\{J_{t+1}^{1-\gamma}\}]^{1/(1-\gamma)}$ is the risk-adjusted continuation utility, where γ is the coefficient of relative risk aversion. I use Epstein and Zin (1989) preferences to disentangle the risk characteristics of households across states, and across time. She supplies L units of labor inelastically each period in a competitive labor market, at wage w_t. Units of labor are freely allocated between the production in the consumption-good-sectors, (L_i^p), and the innovation sectors, (L_i^e), in each industry i:

$$\sum_i L_{i,t}^p + L_{i,t}^e = L.$$

2.1.2 Intratemporal Consumption Choice

At each time period t, the representative household consumes a composite good C_t from her own consumption $C_{i,t}$ in each industry i of the economy. C_t is defined using the following

constant elasticity of substitution (CES) aggregator:

$$C_t = \left[\sum_i C_{i,t}^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}, \tag{2.1}$$

where θ is an elasticity of substitution across industries. A larger value of θ means a higher degree of substitution across industries (θ lies in $[1, +\infty[$). I assume a CES function to aggregate the industry-level baskets of consumption-goods for simplicity, because my main focus is on the aggregation of consumption-goods within each industry. Hereafter I detail how consumers form choices within a particular industry i of the economy.

In each industry, a set of available differentiated varieties, $\Omega_{i,t}$, is available to consumers. The industry-specific consumption basket $C_{i,t}$ is aggregated over these varieties. As new products enter and old products exit the industry over time, the composition of industry-level consumption varies over time.[11] I assume that in each industry, consumers have preferences of the transcendental logarithmic (translog) form over the set $\Omega_{i,t}$ of differentiated varieties.[12] Translog preferences define the consumer demand system $(c_{i,t}(\cdot))$ over the set of varieties $\Omega_{i,t}$ in industry i. I define the mass of available variety in industry i, $M_{i,t} = m(\Omega_{i,t})$. The industry consumption basket can be written as a weighted sum over available varieties:

$$C_{i,t} = \int_{\Omega_{i,t}} \rho_{i,t}(\omega) c_{i,t}(\omega) d\omega, \tag{2.2}$$

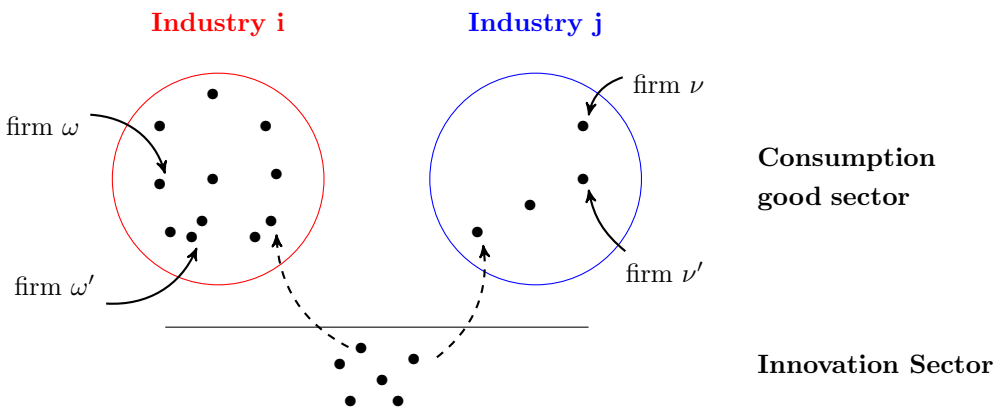
where $\rho_{i,t}$ is a preference weight determined in equilibrium.

Translog preferences introduce two realistic features in consumer choice. First, the price elasticity of demand increases with the mass of available variety $M_{i,t}$. As variety increases in the industry, consumers can more easily substitute away from individual demand and they become more sensitive to prices. Second, increasing the set of available variety provides diminishing returns. The marginal benefit for consumers of an extra product in an industry with hundreds of different varieties is smaller than an industry that would increase varieties from one sold to two. The demand curve is described by two sufficient statistics summarizing these key features, the price elasticity of demand $\chi_{i,t}$ and the marginal benefit

[11] In the empirical section, industries are defined as firms sharing the same three-digit SIC code.

[12] This assumption follows a specification used in Feenstra (2003) and Bilbiie, Ghironi, and Melitz (2012).

Figure 1
CONSUMPTION-GOODS PRODUCTION AND FIRM CREATION IN THE ECONOMY



of variety $\epsilon_{i,t}$:

$$\frac{\partial \chi_{i,t}}{\partial M_{i,t}} > 0, \quad \frac{\partial \epsilon_{i,t}}{\partial M_{i,t}} < 0.$$

In equilibrium, I show below that the translog preferences can be expressed under a simple functional form and that $M_{i,t}$ is a sufficient statistic to describe the demand system. Below I use the benefit of variety $\rho_{i,t}$ defined from the marginal benefit of variety by integrating $\partial \log \rho_{i,t} / \partial \log M_{i,t} = \epsilon_{i,t}$.[13]

2.2 Firms

In the economy, production takes place in two separate sectors: the consumption-goods producing sectors, and an innovation sector that fosters the creation of new firms. I show a simple schematic representation of the supply side of the model in figure 1. The consumption-goods sector is composed of n industries, each composed of different varieties to give industry consumption $C_{i,t}$. I detail below the production process of the differentiated varieties within industry i.

[13] $\chi_{i,t}$ and $\rho_{i,t}$ are also a set of sufficient statistics to describe the translog demand system.

2.2.1 Consumption-goods Producers

I describe the production process for industry i, because other consumption-goods industries have a symmetric structure. Each firm within industry i produces a unique differentiated variety. In my model, a firm is identified by its single production output, variety ω.[14] Within their industries, firms operate in a monopolistically competitive market structure. Labor is the unique factor of production; it enters linearly in their technology:

$$y_{i,t}(\omega) = A_t l_{i,t}(\omega),$$

where $y_{i,t}(\omega)$ is firm production of variety ω in industry i at time t. Labor is subject to an exogenous productivity process that evolves according to an autoregressive process in logarithms:

$$\log A_{t+1} = \rho_A \log A_t + \sigma_A \, \varepsilon^A_{t+1},$$

were $\sigma_A \, \varepsilon^A_t$ is an i.i.d. process with standard deviation σ_A, and $\rho_A < 1$, such that the process $\log A_t$ is stationary. Firms hire labor at market wage w_t and maximize their static profit, $\pi_{i,t}(\omega) = p_{i,t}(\omega) y_{i,t}(\omega) - w_t l_{i,t}(\omega)$. In a monopolistically competitive market structure, firms take consumers' demand curve $c_{i,t}(\omega)$ as given. They produce $y_{i,t}(\omega) = c_{i,t}(\omega)$ and set their price $p_{i,t}(\omega)$ at a markup $\mu_{i,t}(\omega)$ over marginal cost:

$$p_{i,t}(\omega) = \mu_{i,t}(\omega) \frac{w_t}{A_t}.$$

Markups are determined by consumers' demand curve, precisely their price elasticity of substitution. If the elasticity of substitution between products in the industry is high, consumers are price sensitive. A high elasticity of substitution makes extracting consumer surplus difficult for firms and translates into lower markups. The relation between net markups $\mu_{i,t}(\omega) - 1$ and the price elasticity of demand $\chi_{i,t}(\omega)$ for the good ω is

$$\mu_{i,t}(\omega) - 1 = \frac{1}{\chi_{i,t}(\omega) - 1}.$$

[14] I come back to the empirical implication of this assumption in the measurement section 3.1. I do not consider the case of multi-product firms. Units of productions are infinitesimal in the model and no strategic interaction occurs between them. Formally considering multi-unit firms as the linear aggregate of a countable set of varieties is possible, but they will only be the formal sum of their different parts.

Within an industry, firms are symmetric. They face an identical demand curve and share the same production technology. In equilibrium, they set identical prices and produce the same quantity. For any varieties produced in the industry, $(\omega, \omega') \in \Omega_{i,t}$, $y_{i,t}(\omega) = y_{i,t}(\omega')$. The price elasticity of demand $\chi_{i,t}$ and the markup have a simple expression in equilibrium. They only depend on the mass $M_{i,t}$ of products/firms in the industry. I provide detail of the derivation of the static industry equilibrium in appendix A.1:

$$\chi_{i,t}(\omega) = \chi_i(M_{i,t}) = 1 + \tau_i \left(M_{i,t} - 1\right), \tag{2.3}$$

$$\mu_{i,t}(\omega) - 1 = \mu_i(M_{i,t}) - 1 = \frac{1}{\tau_i M_{i,t}}. \tag{2.4}$$

Translog preferences imply markups are a simple function (see equation 2.3) of the mass of variety in the consumer consumption set and their elasticity of substitution. As the mass of variety increases, goods become closer substitutes and the elasticity of substitution is high. Markups are inversely proportional to the elasticity of substitution. In industries with many varieties, consumers can substitute away more easily and markups are low (equation 2.4). The parameter τ_i characterizes the absolute level of monopoly rent firms can extract from consumers in industry i for a given level of concentration. In the subsequent analysis, I keep τ_i constant across industries ($\tau_i = \tau$). Therefore, any heterogeneity in markup and profit across industries comes from heterogeneity in levels of concentration (different $M_{i,t}$).

2.2.2 Innovation Sector: Firm Entry and Exit

Entry: There are n different innovation sectors. Each one is specialized in a single industry i. In each industry, a representative entrepreneur is endowed with a special technology and create new firms in her area of expertise. Her production function is concave and uses labor supplied by the households as her sole input. To parametrize the production function I specify the cost function as in Jermann (1998); the labor requirement $L^e_{i,t}$ to introduce a mass of new firm $M^e_{i,t}$ in industry i is

$$L^e_{i,t} = \frac{1}{X_t}\Phi_i(M^e_{i,t}, M_{i,t}) = \frac{1}{X_t}\frac{a_i}{1+\zeta_i^{-1}}\left(\frac{M^e_{i,t}}{M_{i,t}}\right)^{1+\zeta_i^{-1}} M^e_{i,t}. \tag{2.5}$$

The process X_t is the aggregate productivity of the innovation sector. It is common to entrepreneurs in all industries and follows an autoregressive process in logarithm:

$$\log X_{t+1} = \rho_X \log X_t + \sigma_X \varepsilon^X_{t+1},$$

where $\sigma_X \, \varepsilon^X_t$ is an i.i.d. process with standard deviation σ_X, and $\rho_X < 1$, such that the process $\log X_t$ is stationary.. A positive shock $\varepsilon^X_t > 0$ to X_t increases the productivity of new firm creation in the whole economy.[15]

I make two assumptions for the specification of the cost of entry in equation (2.5): (a) The cost of creating new firms is convex in the entry rate, M^e_i/M_i, and ζ_i governs the level of convexity. Differences in entry-rate convexity captures the idea that it is easier to enter a large market than a niche. ζ_i controls the intensity of this effect; below, I detail the implications of industries' heterogeneity in ζ_i. (b) For a given level of entry-rate, the cost of entry is increasing in the absolute level of entry, M^e_i; the parameter a_i controls the size of this effect. Differences in a_i across industries correspond to changes in the cost to the absolute level of entry in an industry.[16] I represent heterogeneity in both parameters, ζ_i and a_i, in figure 2.

Entrepreneurs are in fixed supply, normalized to one, and they earn rents due to the adjustment technology. The value of an entrepreneur $v^e_{i,t}$ represents a claim to rents to the fixed supply technology of firm creation.[17] Entrepreneurs hire labor and sell the newly created firms at market price $v_{i,t}$ to the households. They are perfectly competitive; hence they take the wage w_t and the consumption-goods firms value $v_{i,t}$ as given. Their opti-

[15]The functional form for the entry costs is smooth from the point of view of the representative entrepreneur. Although smoothness is attractive for analytical tractability, it is not a realistic feature for the extensive margin of investment. Some of the literature on the extensive margin of investment also argues that at a disaggregated level, most of the costs are fixed; see, for example, Khan and Thomas (2008) and Bloom (2009). However, smoothness of entry costs at the industry level does not preclude one from having a fixed cost at the disaggregated entrepreneur level. Following this interpretation, each of the infinitesimal entrepreneurs face fixed costs of firm creation that are distributed like the aggregate marginal cost curve.

[16]The diminishing returns to scale of entrepreneurs' efficiency with respect to the absolute level of entry can also be interpreted as Venture Capitalists (VCs) monitoring start-ups before selling them on capital markets. Sahlman (1990) and Lerner (1995) show most of VCs' activity is spent monitoring startup projects. In a world with a fixed supply of VCs' monitoring has to be shared between all the firm-creation projects in the industry.

[17]Alternatively, I could consider entrepreneurs need industry-specific land for firm creation. If this industry-specific land is in fixed supply, normalized to one, the value of entrepreneurs is a claim to the land used to create new firms.

mization program is

$$v_{i,t}^e = \max_{(M_{i,t+u}^e)} \mathbf{E}_t \sum_{u=0}^{\infty} \frac{S_{t+u}}{S_t} \left(v_{i,t+u} M_{i,t+u}^e - w_{t+u} L_{i,t+u}^e \right),$$

where S_t is the stochastic discount factor (SDF) determined in equilibrium. Entrepreneurs are infinitisemal, and they do not internalize the effect of their actions on the value of the firm in the industry. Hence they maximize their static profit each period: $\max_{M_{i,t}^e} v_{i,t} M_{i,t}^e - w_t L_{i,t}^e$, and their first-order condition reads

$$v_{i,t} = \frac{w_t}{X_t} \partial_1 \Phi_i(M_{i,t}^e, M_{i,t}). \tag{2.6}$$

By contrast with standard models of the extensive margin of innovation, in which the supply of entry is perfectly elastic, I introduce an inelastic supply curve.[18] Monopoly rents are shared between insiders—the incumbent firms— and the outsiders—the entrepreneurs. The sharing rule depends on the convexity of the cost of entrepreneurs, that is, the coefficient ζ_i.

Exit and Timing: In each industry, consumption-goods firms are subject to an exogenous death shock at a rate δ. The shock hits firms at the end of the period. Firms do not face fixed costs to operate, and exit is entirely driven by this exogenous shock.

Entrants produced at time t face the same death shock as incumbents. Hence the dynamics for the mass of firms in industry i is given by the following accumulation equation:

$$M_{i,t+1} = (1 - \delta) \left(M_{i,t} + M_{i,t}^e \right).$$

The dynamics for the mass of firms in an industry resembles that of capital in the neoclassical growth model. Nevertheless I describe formally in section A.4 of the appendix, how my framework departs from the neoclassical models of investment.

2.3 Equilibrium

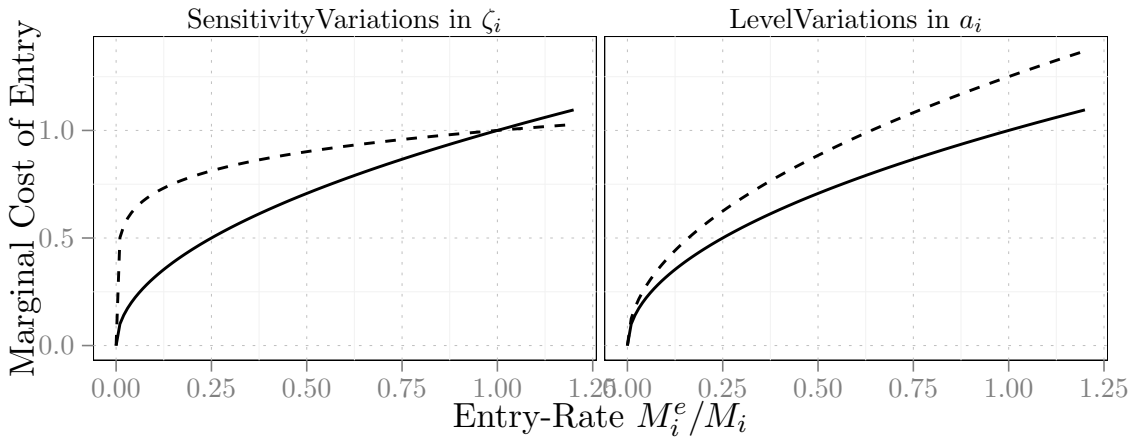
I solve for the competitive equilibrium of the economy. In appendix A.4, I derive the planner problem. I show the economy is subject to three distortions due to markup heterogeneity

[18] In classic models of firm entry dynamics (see, e.g., Hopenhayn (1992), Melitz (2003)) costs of entry are fixed and the supply is perfectly elastic whenever incumbents' value is above the fixed costs.

Figure 2

Marginal cost of new firm creation

I represent different specifications for the cost of entry. In the left panel, I present differences in convexity of the entry-rate, through ζ_i. In the right panel, I present differences in the level of the cost of entry a_i.



across industries and across states, and a wedge between private and social motives for innovation. I discuss the implications of the distortions in section 2.3.4 below. Details of the derivation of the competitive equilibrium are in appendix A.2.

2.3.1 Firm Equilibrium

Within industry i, the firm equilibrium is symmetric as shown in section 2.2.1. The translog characteristics take a simple form. They only depend on the mass of firms in the industry $M_{i,t}$.[19] Then firm-level profit can be expressed as a function of aggregate quantities and one sufficient industry state variable $M_{i,t}$:

$$\pi_{i,t}(\omega) = \pi_{i,t} = \left(1 - \frac{1}{\mu_{i,t}}\right)\left(\frac{A_t}{w_t}\frac{\rho_{i,t}}{\mu_{i,t}}\right)^{\theta-1}\frac{C_t}{M_{i,t}}.$$

[19] To simplify notations, I write $\mu_{i,t} = \mu_i(M_{i,t})$, $\rho_{i,t} = \rho_i(M_{i,t})$ and $\epsilon_i(M_{i,t}) = \epsilon_{i,t}$. The markup parametrization is not time-varying; however, as the mass of firms $M_{i,t}$ changes over time, markups are time-varying.

Profit is increasing in the level of markups $\mu_{i,t}$, consumer demand by unit of capital $C_t/M_{i,t}$, and it is decreasing in the effective cost of labor w_t/A_t.

2.3.2 Household Optimization Conditions

I compute the composite consumption good C_t from the demand for each of the individual varieties $c_{i,t}(\omega)$. The link between the aggregate consumption and the industry consumption baskets $(C_{i,t})_i$ is given by the CES aggregator in equation 2.1. I derive the industry consumption basket from the demand for individual variety $c_{i,t}(\omega)$.[20] In a symmetric equilibrium using equation (2.2), I show $C_{i,t} = \rho_{i,t} M_{i,t} c_{i,t}$. $\rho_{i,t}$ is increasing in $M_{i,t}$: as more varieties become available in industry i to the consumer, the industry consumption index $C_{i,t}$ increases. Hence $\rho_{i,t}$ represent consumer taste for variety for goods in industry i. For a given level of expenditure, consumers receive a higher utility when they spread their expenses among a larger set of products.

There are n mutual funds specializing in the consumption-goods sector, and n mutual funds in the innovation sector. For each sector, a mutual fund owns all firms of an industry. Funds collect profits from firms—either entrepreneurs or consumption-goods producers depending on their specialization—and redistribute them to their shareholders. Households can invest in $x_{i,t}$ shares of a mutual fund specializing in industry i for a price $x_{i,t}(M_{i,t} + M^e_{i,t})v_{i,t}$. Proceeds from the fund flow back to the shareholders and are equal to the profits made by all firms within an industry: $x_{i,t} M_{i,t} v_{i,t}$. Households also invest $x^e_{i,t}$ shares in mutual funds specializing in entrepreneurs of industry i. The price of $x^e_{i,t}$ shares is $x^e_{i,t} v^e_{i,t}$ (the supply of entrepreneurs is fixed at one). Proceeds from this investment are $x^e_{i,t} \pi^e_{i,t}$.

Hence the dynamic program the representative household faces is the maximization of their continuation utility J_t subject to the following sequential budget constraint:

$$\sum_j \left[\int_0^{M_{j,t}} p_{j,t}(\omega)\ c_{j,t}(\omega) d\omega + x_{j,t+1} v_{j,t} \frac{M_{j,t+1}}{1-\delta} + x^e_{j,t+1} v^e_{j,t} \right] \\ \leq w_t L + \sum_j \left[x_{j,t} M_{j,t} (v_{j,t} + \pi_{j,t}) + x^e_{j,t} (v^e_{j,t} + \pi^e_{j,t}) \right]. \tag{2.7}$$

I derive the one-period-ahead stochastic discount factor (SDF) from the household

[20] For simplicity of notation, I write $c_{i,t}$ for $c_{i,t}(\omega)$ when unambiguous.

intertemporal Euler equation:

$$\frac{S_{t+1}}{S_t} = \beta \left(\frac{C_{t+1}}{C_t} \right)^{-\nu} \left(\frac{J_{t+1}}{\mathsf{R}_t(J_{t+1})} \right)^{\nu-\gamma}.$$

I give details of the derivation of the household optimization condition in appendix A.2.2. The Bellman equation for pricing the consumption-goods firms in industry i is

$$v_{i,t} = (1-\delta)\mathbf{E}_t \left\{ \frac{S_{t+1}}{S_t} \left(v_{i,t+1} + \pi_{i,t+1} \right) \right\}. \tag{2.8}$$

2.3.3 Definition of the Competitive Equilibrium

Now I can formally define the competitive equilibrium of the economy. The competitive equilibrium is a sequence of prices, $(p_{i,t}(\omega), w_t, v_{i,t}, v^e_{i,t})$, and allocations, $(c_{i,t}(\omega), C_{i,t}, C_t, L^e_{i,t}, L^p_{i,t}, M^e_{i,t}, M_{i,t}, x_{i,t}, x^e_{i,t})$; such that given the sequence of shocks $(\varepsilon^A_t, \varepsilon^X_t)$, (a) allocations maximize the households program (b) consumption-goods firms maximize profits (c) entrepreneurs maximize their value, (d) the labor, good, and asset markets clear, and (e) resources constraints are satisfied.

2.3.4 Markup Distortions

My model has implications for the dynamics of resource misallocation. In appendix A.5, I derive the efficient allocations for the Pareto equilibrium. I show there is a time-varying wedge between consumption in the competitive equilibrium and in the Pareto equilibrium: $C^{\text{CE}}_t = \Lambda_t C^{\text{PE}}_t$. Λ_t is the wedge, it is smaller than one, varies over time and depends on the dispersion of markups across industries. To understand variations in this consumption wedge, I find the sources of distortions in the competitive equilibrium. (a) Static distortions due to the heterogeneity of markups across industries. The production factor is primarily allocated to industries with low market power. (b) Within industries, dynamic distortions appear due to time variation in markups. (c) In the translog preference specification, private and social motives for entry are disentangled. Private motives are provided through industry profits. Social motives originate from consumers' taste for variety. In this framework, entry is only efficient if the benefit for social surplus exceeds the cost of allocating resources to innovation rather than consumption.

2.4 Asset Prices

In this section, I detail the mechanisms at work in the model. First, I discuss heterogeneity in entry dynamics across industries. Then I show how concentration and entry rates are tied in the model. Finally I relate sources of aggregate risk in the model to heterogeneity in cash-flow variation, and I draw implications for the cross section of industry returns.

2.4.1 Entry Dynamics Mechanism

As firms enter and exit industries, markups and firms' profits vary over time. I explain the sources of variations in firms' profits across industries by focusing on two characteristics of industries: the level of concentration in equilibrium and the variation in new firm creation after an aggregate entry shock. To understand how those two dimensions affect the valuation of firms in equilibrium, I analyze the supply and the demand curve of new firms' creation.

The entrepreneurs' decision to create new firms determines the supply of new firms. From their optimization condition, I showed the value of incumbents equates to the cost of the marginal entrant to the representative entrepreneur:

$$v_{i,t} = a_i \frac{w_t}{X_t} \left(\frac{M^e_{i,t}}{M_{i,t}} \right)^{\zeta_i^{-1}}.$$

The value of incumbents provides incentives for the innovation sector. A higher value $v_{i,t}$ increases the level of entry rates. The elasticity of the supply is governed by ζ_i as

$$\frac{\partial \log(M^e_{i,t}/M_{i,t})}{\partial \log(X_t v_{i,t})} = \zeta_i.$$

A lower ζ_i translates into a low elasticity of entry rates to the firm value $v_{i,t}$ or to a change in productivity for the innovation sector, in which case the innovation sector has a slow response and entry rates do not respond to changes in valuations.

Households' demand for shares, $x_{i,t}$, in the mutual fund that owns the consumption-goods firms in industry i, determines the demand curve for firm creation. It is best summarized by the Bellman pricing equation 2.8:

$$v_{i,t} = (1-\delta)\mathbf{E}_t \left\{ \frac{S_{t+1}}{S_t} \left(v_{i,t+1} + \pi_{i,t+1} \right) \right\}.$$

Demand ties the current value of the firm to aggregate discount rates and profit levels. After a decline in profits (or a rise in discount rates), household demand for shares in the mutual fund drops and so does the value of the firm $v_{i,t}$.

The equilibrium firm value $v_{i,t}$ and entry rate $M^e_{i,t}/M_{i,t}$ for an industry are determined jointly by these two equilibrium conditions. After a temporary and exogenous shock to the cost of entry X_t, entry rates increase. As new firms enter the industry, they increase competition and displace incumbents' monopoly rents. This causes profits and subsequently firm value to drop back to their long-run equilibrium values.

I now examine heterogeneity in the supply and in the demand curve to analyze the role of industries' organization on the dynamics of prices. Heterogeneity in the supply curve of firm entry generates cross-sectional variation in firm value. Let me consider two industries with different convexity of entry; industry one has a greater elasticity than industry two ($\zeta_1 > \zeta_2$). After a positive shock to X_t, meaning a lower aggregate cost of entry, entry rates increase in both industries. However, they will be higher in industry one, because a larger elasticity corresponds to a higher response of entry rates to cost of entry. With the flow of new entrants, competition increases, although more in industry one than two. The drop in profit for industry one, will be starker. Hence, in industry one where the elasticity of the supply is higher, firm value decreases more after a positive shock to the cost of entry than for the lower-elasticity industry two.

To further understand how much entry rates affect firm value, I analyze the demand curve linking the level of concentration with profits and firm value. The question here is: what is the percentage decline in a firm's profit caused by a percentage increase in industry entry. I decompose the elasticity of profits to entry into an aggregate component common to all industries and an industry-specific component (see appendix A.3 for details of the derivation). Differences in the industry specific component drive heterogeneity in the response of firm's value to changes in entry rates, that is, ultimately to changes to the aggregate process X_t. However, concentrated industries have a smaller elasticity (in absolute value) than more competitive industries. Because of the taste for variety, an increase in new products increases consumers' demand for the industry ($C_{i,t}$). This effect compensates the drop in the demand for each single variety and dampens the effect of competition for incumbents. This compensating demand is stronger in more concentrated industries where the marginal benefit of variety is high. In the simulation exercise below I show this dampening has a small effect on prices compared to differences in entry-rate elasticity.

2.4.2 Concentration and Entry Rates

As emphasized, I focus on two main characteristics of an industry: their level of concentration and the convexity of the supply of new firms. These two quantities are not exogenously specified, but they are endogenous equilibrium objects, outcomes of an industry's structure and organization. This approach is consistent with the new empirical industrial organization literature directing studies toward a structural analysis of markets (see, e.g., Berry and Reiss (2007) and Bresnahan (1989)). Equilibrium outcomes such as concentration or entry rates are the result of market parameters or technologies rather than being exogenously specified. In my model, concentration and entry rates are tied together. Profits provide the incentives for the innovation sector, whereas entry in equilibrium determines the level of concentration in the industry. I examine hereafter how those two outcomes—concentration and entry rates—are intertwined.

As I show in figure 2, industries with a small convexity/high elasticity of entry rates (ζ_i) also have a higher marginal cost of entry. Hence, paradoxically, industries with higher costs of entry will have a higher sensitivity of entry rates to aggregate entry shocks. From the first-order condition for the innovation sector, a higher cost of entry translates into higher firm value or smaller entry rates. In the non-stochastic steady state of the economy, the entry rate is equivalent to the replacement rate of firms exiting the industry: it is constant across industries.[21] A higher entry cost will then translate into a higher value for firms in the industry, that is, a higher level of concentration.

This link between the elasticity of the supply and concentration depends crucially on my assumptions for the functional form of entry. The specification is validated by the data as I show in my empirical analysis below. High-concentration industries tend to have higher entry rates, and those entry rates are more volatile and respond more to an aggregate shock to entry.

The fact that entry rates are more volatile for concentrated industries is better understood once the distinction between the absolute level of entry $M_{i,t}$ and entry rates $M^e_{i,t}/M_{i,t}$ is emphasized. Entry rates are typically higher in concentrated industries, even though barriers to entry are higher. In a duopoly, a 50% entry rate that the absolute level of entry is one. In the case of a competitive industry composed of, say, 50 firms, the same 50% increases will account for an absolute number of entrants of 25. In my model,

[21] In an extension, I add an other layer of heterogeneity across industries in the model by considering heterogeneous exit rates. I find that firms with higher entry rates also have higher variation and higher sensitivity in entry rates.

entry rates are the relevant quantity to study: a change in absolute entry of one firm has a different effect for a concentrated and a competitive industry. However a 1% change in entry rates will have similar effects on both industries.[22]

To disentangle the link between elasticity and concentration, the parameter a_i only affects the cost with respect to the absolute entry size (see 2.5). Hence after matching the convexity of the cost function with ζ_i, I use the a_i parameter to match levels of entry and levels of concentration.

2.4.3 Aggregate Risk

Shocks to aggregate entry affect firms of different industries differently. To capture the cross section of risk premia, I show shocks to X_t are priced, meaning they affect the stochastic discount factor (SDF). The SDF is the multiplier on the representative household budget constraint (2.7); it gives the state price of consumption weighted by the probability of that state. Assets with high payoffs in states in which the price of consumption is high are attractive. They have a higher price and command a higher risk premium in equilibrium.

The two shocks in the economy are shocks to the aggregate productivity of consumption (ε_t^A) and shocks to the cost of entry (ε_t^X). They affect firm profits (and by extension the payoff of shares in the industry mutual funds) and the SDF. To understand whether a firm has higher risk premium because it covaries negatively, or positively with ε_t^X or ε_t^A. I need to find the sign of the price of each risk in the model. By analogy with continuous time models, I define the price of risk for both shocks as[23]

$$\mathrm{rp}_t^A = \mathrm{Cov}_t\left(\frac{S_{t+1}}{S_t}, \varepsilon_{t+1}^A\right), \quad \mathrm{rp}_t^X = \mathrm{Cov}_t\left(\frac{S_{t+1}}{S_t}, \varepsilon_{t+1}^X\right).$$

In the model, the price of risk for ε_t^A, shocks to aggregate productivity of the consumption-goods sectors, is positive. After a good shock to A_t, consumption increases and the marginal utility of consumption decreases. The state price of consumption is low, and assets that pay off when A_t is high have low prices and high expected returns.

The sign of the price of risk for the shock ε_t^X to the marginal productivity of the innovation sector is equivocal. Two effects concur on the SDF. A shock to the cost of

[22] This result is only approximately true as industries react asymmetrically to changes in entry rates, as I showed when considering the elasticity of profits to entry.

[23] In an appendix available upon request, I derive the exact formulas for the price of risk in the continuous time version of the model.

entry does not affect the aggregate contemporaneous production of consumption goods. The only contemporaneous effect of a shock to X_t is the shift of productive resources away from consumption and toward the innovation sector. This reallocation effect generates a drop in current consumption and a concurrent rise in the marginal utility of consumption. However, changes in the cost of entry have long-run effects, because they affect the level of innovation and the continuation utility of households. Firm creation increases future aggregate output and consumption, lifting their continuation utility and decreasing the state price of consumption.[24]

The relative size of both effects depends on the coefficient of relative risk aversion, γ, and the elasticity of intertemporal substitution, ν^{-1}. I find that for consumers with preferences for early resolution of uncertainty ($\nu^{-1}\gamma > 1$), the effect of a higher future consumption through the continuation utility dominates.[25] Households can diversify the risk over time and they have less precautionary savings. The risk incurred by shocks to the productivity of entrepreneurs is smoothed out over time and the effect on future aggregate consumption dominates; hence the marginal utility of wealth increases and the price of risk is positive ($\text{rp}^X > 0$). When consumers have preferences for late resolution of uncertainty ($\nu^{-1}\gamma < 1$), the effect on contemporaneous consumption dominates. Households do not diversify risk over time, and a positive shock to X_t increases the marginal utility of wealth: the price of risk is negative ($\text{rp}^X < 0$). I find the price of entry risk is negative in the data (see Section 4). Hence, I assume consumers have preferences with late resolution of uncertainty.[26]

2.4.4 The Cross Section of Industry Risk Premia

Next I characterize firms' risk premia across industries. My model features a rich equilibrium cross section of industries. Differences in firms' exposures to shocks to A_t or X_t arise

[24] This mechanism is akin to the response of the stochastic discount factor to capital-embodied schocks (investment-specific technological change) in general equilibrium with an intensive margin of adjustment for investment. Papanikolaou (2011) shows that under some preference assumption, the price of investment shocks is negative. This mechanism generates cross-sectional implications for firms, as it favors future "growth" opportunities and is detrimental to assets in place. See also Kogan, Papanikolaou, and Stoffman (2012) for an amplification of the mechanism.

[25] Epstein and Zin (1989) show this condition is equivalent to early resolution of uncertainty for Kreps-Porteus utility functions.

[26] There is little consensus about *early* versus *late* resolution of uncertainty in non-time-separable utility functions. The long-run-risk literature shows early resolution of uncertainty helps solve some asset-pricing puzzles (see Bansal and Yaron (2004)). Eisfeldt and Papanikolaou (2013), for example, show risk created by the reallocation of organization capital has a negative price.

endogenously as a consequence of differences in the entry technology of their innovation sector. Because the risk of both shocks is priced in equilibrium (i.e. rp^X and rp^A are different from zero), differences in exposures will generate heterogeneous risk premia across industries. I linearize the SDF around the non stochastic steady state of the economy; then for firms in industry i, I decompose expected excess returns into two components:

$$\mathbf{E}_t\left\{R^e_{i,t}\right\} \simeq \text{rp}^A_t \underbrace{\text{Cov}_t\left(\frac{v_{i,t+1}+\pi_{i,t+1}}{v_{i,t}}, \varepsilon^A_{t+1}\right)}_{\text{Exposure to TFP shock}} + \text{rp}^X_t \underbrace{\text{Cov}_t\left(\frac{v_{i,t+1}+\pi_{i,t+1}}{v_{i,t}}, \varepsilon^X_{t+1}\right)}_{\text{Exposure to aggregate entry shock}}.$$

Heterogeneity in risk premia across industries come from the latter term, of exposures to ε^X_t.

Shocks to the aggregate productivity of consumption play a small role in the cross-sectional dispersion of expected returns in the model. On impact, profits react identically for all industries because the elasticity of profits to A_t is common across industries. Differences in exposures to ε^A_t work through the mean reversion of profits to their steady-state value. In industries with high elasticity of the supply of entrants, after an increase in profits due to higher aggregate productivity, entry rates increase rapidly and drive down profits. Industries with high elasticity see a lower effect of aggregate productivity on their valuations as the innovation sector captures their profits. However, heterogeneity in the mean reversion of profit only generates a small dispersion in returns in the calibration.

In this paper, I focus on the effect of the second shock, ε^X_t, to the marginal productivity of innovators. Shocks to aggregate entry affect the level of profit through industry concentration. Heterogeneity of the response of profits (and firms' value) works through differences in the elasticity of the supply curve for entrants. Industries with high elasticity (ζ_i) have low profits after the aggregate entry shock due to a strong increase in competition. In the data I find the price of risk of this shock is negative ($\text{rp}^X < 0$), and a positive shock to X_t denotes a bad state of the world (high marginal utility of wealth). Hence firms in industries that have a high response from their innovation sector will have a low payoff in those bad states of the world. They earn higher expected returns in equilibrium.

2.5 Simulation and Calibration

I calibrate an economy with four different industries. Industries differ along two dimensions: their level of concentration and their dynamics of entry rates. First, I separate industries

into two groups by their concentration level. I choose the shift parameter a_i that governs the entry cost for the less concentrated group such that the average level of net markups for that group is 10%. For the group of concentrated industries, I choose a_i such that their average net markup level is 30%. I choose these values based on an extended body of literature on markups that finds a range going from 5% to 40%.[27]

Using the first-order condition on the supply of firms at the steady-state, I showed changes in a_i have no effect on entry rates. If the parameter ζ_i stays constant across industries, entry rates are unchanged for different levels of concentration. The elasticity of the supply curve of new firms, governed by ζ_i, determines the dynamics of entry rates. To calibrate the value of ζ_i across the four industries of the economy, I rely on a robust stylized fact from the empirical analysis: concentrated industries have higher entry rates, and those rates are more volatile. The intuition follows from this fact comes from the distinction between entry rates and the absolute level of entry. In concentrated industries, because the number of firms M_i is generally low, entry rates M_i^e/M_i tend to be high compared to competitive industries. Increasing the number of firms by one does not translate the same way for a duopoly as for a competitive industry of 100 producers. Any absolute variation in the number of entrants M_i^e will generate larger fluctuations in the rate of entry in the most concentrated industries. Hence I match values of ζ_i to the volatility of entry rates in the data from the Bureau of Labor Statistics. Within the highest-concentration quintile of industries, the 20th and 80th percentiles of standard deviation in entry rates are 0.1% and 0.9% respectively, whereas for the least concentrated industries, the 20th and 80th percentiles are 0.2% and 0.4%, respectively. For each concentration group of industries, I choose ζ_i to match these levels of standard deviation.

To calibrate household preferences, I choose a value of the elasticity of intertemporal substitution $\nu^{-1} = 0.3$, in line with the estimates of Vissing-Jorgensen (2002). I choose a low value for risk aversion $\gamma = 1.2$ that is consistent with the real business cycle literature (see King and Rebelo (1999)). I report values of the parameters in table 6.

I simulate 10,000 observations of the model at quarterly frequency using second-order perturbation methods. I compute impulse responses of the main statistics of the model from the simulations in figure 3. The economy includes four different industries. I represent the impulse response functions to a productivity shock in the innovation sector for the

[27] See, e.g., Hall (1988), Basu and Fernald (1997), and Nekarda and Ramey (2010).

mass of firms $M_{i,t}$, firms profits $\pi_{i,t}$, and valuations $v_{i,t}$. In the left panels, I represent two competitive industries. In the right panels, I represent two concentrated industries. In each panel, the dashed line represents industries with lower fluctuations in entry rates (low elasticity of the supply of entry rates) and the solid line represents industries with high fluctuations in entry rates (high elasticity) in their concentration class. I show the aggregate response of consumption and the stochastic discount factor in figure 4.

After an increase in X_t (a decrease in the effective cost of entry in aggregate), entry goes up in all industries, albeit not with the same intensity.

(a) There is little heterogeneity in entry among the competitive industries, because the spread in the elasticity of supply is small. Within concentrated industries, industries with high elasticity peak at a 2% increase in entry, while the less elastic top at 0.5%.

(b) Profits are the symmetric counterpart to the dynamic of entry (and concentration). The elasticity of profits to entry rates is almost constant across industries to a first-order approximation. However, demand effects compensate the crowding out of market power in the more concentrated industries. If the set of products increases by 100% from one to two in the more concentrated industries, consumers will not scale back their consumption for each good by half. They have a taste for variety and they will consume more of the two goods than they were consuming of the single good. This demand effect compensates for the negative effect of a competitor on markups. In the case of the less concentrated industries, consumers are already satiated by varieties: the marginal benefit of variety diminishes as the number of goods increases. Hence the elasticity of profits to entry rates will be more negative in the less concentrated industries.

(c) In the bottom panels in figure 3, I represent the response of the valuations $v_{i,t}$ for the industries. Valuations are the expected sum of future profits. Hence, after a shock to entry, valuations fall as future profits fall. Little difference exists in the fall of firm value in the competitive-industry group: the drop is 2.1% for the more elastic industry whereas it is 2% for the less elastic. Hence, in the more competitive industries, entry rates do not generate a significant dispersion in risk premia across industries. For the more concentrated industries, the difference is much larger. Even though the compensating demand for variety effect dampens the effect of entry rates on profits, the dispersion of elasticity generates a large dispersion in the response of firms' valuations to entry rates. In the more elastic industries, firms' valuations drop

by 2.5%, whereas in the least elastic ones, the drop is only 2%.

(d) In figure 4, I represent the response of aggregate quantities to the X_t shock. As predicted, consumption falls on impact before reverting to the steady state. The overshooting of consumption before it reverts to its steady-state is due to slow adjustment of the supply side after the shock hits. The state-price-density increases, on impact before reverting to its steady-state; this is due to the calibration of Epstein-Zin where I assume that consumers have preferences for late resolution of uncertainty. The calibrated model predicts small variations in returns, due to a shock to the marginal productivity of entry. I find my model generates a 0.5% annual spread in returns between firms in *concentrated* industries with high or low elasticity of entry. The spread falls to 0.1% between the more *competitive* industries.[28]

The calibration confirms the main mechanism of the model and their relative importance for a calibration that matches second moments of entry rates and concentration levels.

3 Measurement and Preliminary Evidence

3.1 Measurement

In this section, I discuss the empirical counterparts of the model. I describe entry data, the aggregate entry factor and concentration measures for industries.

3.1.1 Sample Selection

My sample includes all firms with listed securities on the AMEX, NASDAQ, or NYSE that have both a match in the CRSP monthly file and in the COMPUSTAT annual file from 1980 to 2012. I exclude regulated industries and financials from the sample.[29] To be included in my sample, firms must have a stock price, shares outstanding and a three-digit SIC code. Moreover, firms in CRSP/COMPUSTAT must have their three-digit SIC code in the entry dataset from the BLS (eighty-seven industries). Earnings are measured before interest, taxes, depreciation and amortization (item ebitda); I scale earnings by

[28] Kogan, Papanikolaou, and Stoffman (2012) introduce limited risk sharing to increase the price of the risk associated with a shock to innovation.

[29] My results are robust to including regulated and financials. However, their price-setting decision might be regulated, and linking concentration to markups in such industries is difficult.

Figure 3

Impulse response to a one-standard-deviation shock to X_t.

I plot impulse responses to a one-standard-deviation shock to X_t of industry size ($M_{i,t}$), firm profits ($\pi_{i,t}$), and valuation ($v_{i,t}$). The simulated economy includes four different industries. In the left panel are impulse-response functions for competitive industries (high $M_{i,t}$), in the right panels for concentrated industries (high $M_{i,t}$). In each panel, the dashed line represents industries with lower fluctuations in entry rates (low elasticity of the supply of entry rates) and the solid line represents industries with high fluctuations in entry rates (high elasticity).

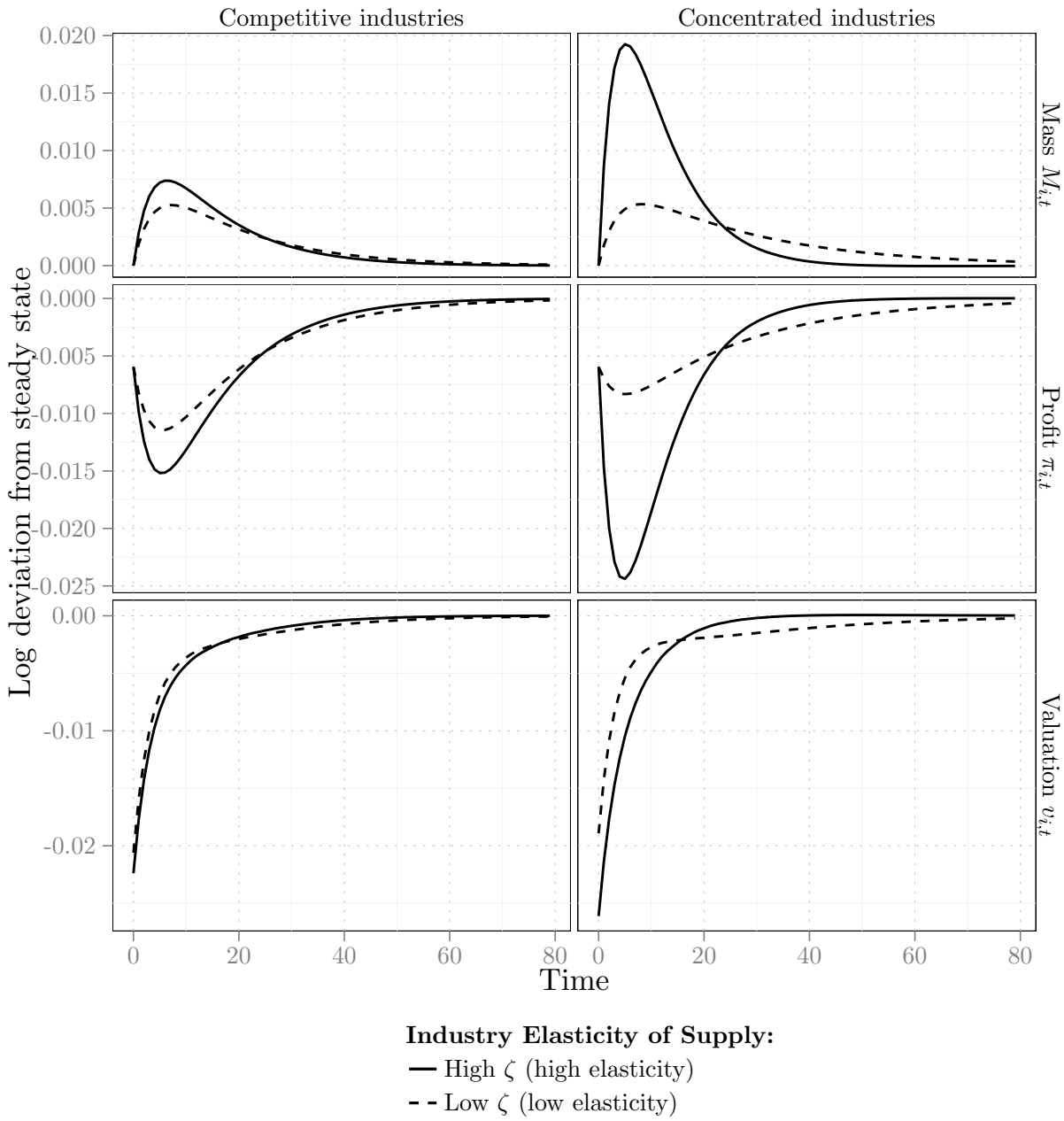
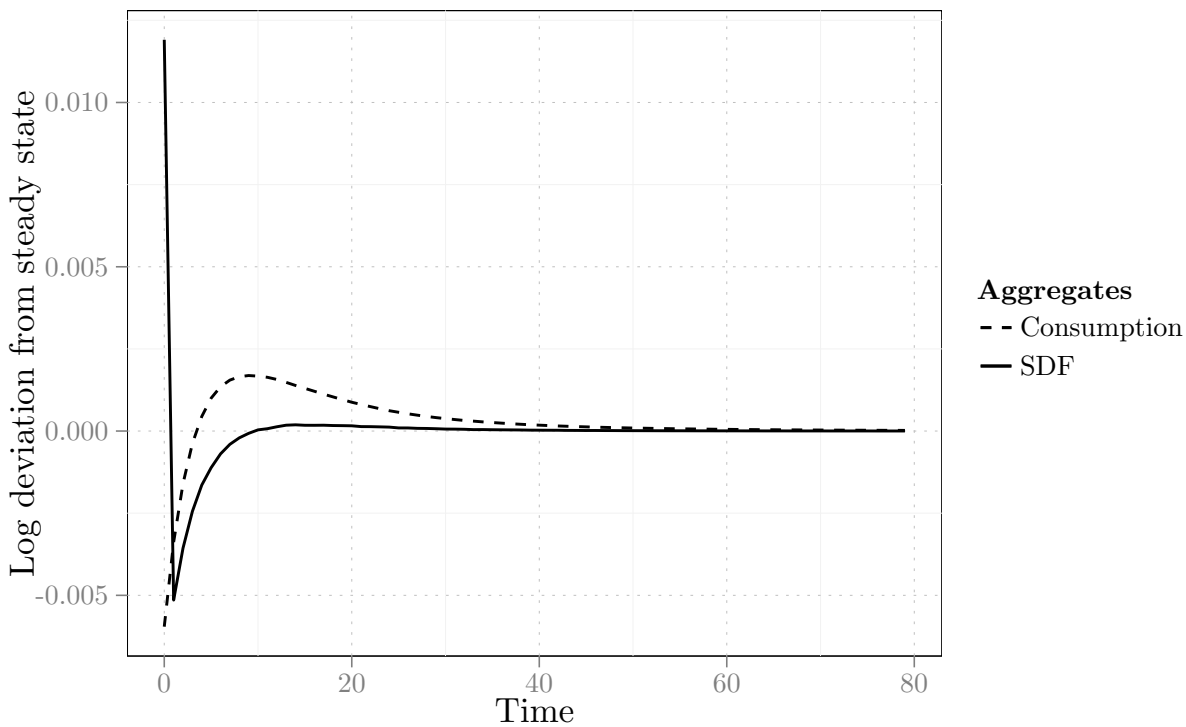


Figure 4

Impulse response of aggregate quantities to a one-standard-deviation shock to X_t.

I plot impulse responses to a one-standard-deviation shock to X_t of the aggregate consumption index C_t (dashed line) and the stochastic discount factor (solid line).



assets, hence I exclude firms with assets below \$10 million to alleviate concerns when assets become close to zero as in Fama and French (2000). I define industries using the three-digit SIC classification. [30] Moreover, the data on entry rates is aggregated at the three-digit SIC code level, which allows for a match at the industry level of the Bureau of Labor Statistics (BLS) data with the CRSP/COMPUSTAT sample.

3.1.2 Measuring Industry Concentration

To capture the size of monopoly rents arising in the model, I use industry concentration to capture the differences in M_j across industries in the model. My main measure of concentration is the Herfindahl index (HH)[31], computed as the sum of squared sales market shares within an industry:[32]

$$\mathsf{HH}_J = \sum_{i \in J} (s_{i,t}^J)^2,$$

where $s_{i,t}^J$ is the market share of firm i in industry J in year t. For robustness, I average the Herfindahl index over the past three years to avoid drastic changes in industry concentration due to potential measurement errors. The empirical industrial organization literature commonly uses the Herfindahl index, and it is well anchored in theory (see Schmalensee (1989)). For robustness, I consider the four firm concentration ratio (CR4), the sum of market shares of the four largest firms in an industry.[33] In appendix B.1.3, I show both measures have a direct mapping to the mass of firms in the model. The Herfindahl index and concentration ratio are inversely proportional to the mass of firmss M_J of industry J in the model. Hence a small mass M_J in industry J in the model maps onto a high index of concentration toward one. Results are robust to the use of the four firm concentration ratio.

[30] Hou and Robinson (2006) and Giroud and Mueller (2010, 2011) choose such partitioning, because it mitigates concern between having a partition that is too coarse to be relevant with regard to competition. On the other hand, too fine a partition would be subject to potential misclassification. As an example, the two-digit SIC code 26 is *paper and allied products*. It includes groups, such as *pulp mills* (261) and *paperboard containers and boxes* (265), that are not in direct competition. However, at the four-digit level, the 265 industry code includes *sanitary food containers, except folding* (2656) and *folding paperboard boxes, including sanitary* (2657), products that are potentially in direct competition.

[31] The Herfindahl index is also commonly referred to as the Hirschman-Herfindahl index.

[32] Item sale in COMPUSTAT.

[33] The U.S. Department of Justice and the Federal Trade Commission recommend the use of the Herfindahl index for concentration measures in their Horizontal Merger Guidelines, §5.2 (available at http://www.justice.gov/atr/public/guidelines/hmg-2010.pdf).

3.1.3 Measuring Entry

To distinguish between industries with different entry elasticity parameters ζ_J, I use micro-level data on entry. I extract entry rates for industries from the Survey of Business Dynamics from the Bureau of Labor Statistics (BLS). This dataset reports entry and exit rates of all private business firms at the three-digit SIC code level; the sample covers the period from 1992 to 2012 at a quarterly frequency and includes 87 three-digit industries.

Entry rates measured in the BLS survey are in line with alternative datasets that have been used in the literature on firm dynamics. Dunne, Roberts, and Samuelson (1988) established the first measures of entry rates using the Census of Manufacturers from 1963 to 1982 and estimated entry rates ranging from 30% to 42% over a five-year period, that is, 6% to 8% annually. Lee and Mukoyama (2011) use the Longitudinal Research Database, a yearly dataset from the U.S. Census Bureau from 1972 to 1997, and find annual entry rates for plants between 3.4% in recessions and 8% in expansions. I report summary of statistics of entry rates from the BLS in table 9. Quarterly entry rates weighted by employment are 1.5%, or 6% annually, in the range of estimates of previous studies that use census data.

Firm entry is a conservative measure of the impact of new products on an industry market structure. Recent work with disaggregated data shows product creation is substantial within firms. Bernard, Redding, and Schott (2010) use plant-level data at a fine level of industry disaggregation (five-digit SIC code) to investigate the dynamics of product creation within firms. Their study shows 94% of new products are created within existing firms. At a finer level, Broda and Weinstein (2010) use barcode data and confirm the role of product creation for existing firms and find the market share of new products is four times that of newly created firms. The BLS has some limitations for the study of the effect of firm creation on monopoly rents. It only captures changes in new firm creation, but not in new establishments built within an existing company. My model does not distinguish firm creation from the introduction of new products within existing firms. Therefore the measure of entry rates from the BLS gives a conservative estimate that is not likely to interfere with the intensive margin of investment that happens within firms.

The main driving factor of heterogeneity that arises from the model is the sensitivity ζ_J of entry to an aggregate measure of the productivity of entry X_t. To estimate this parameter, I proceed in three steps. For each industry, I extract the innovation component

of entry rates using an autoregressive process:

$$\mathsf{entry}^J_{t+1} = \rho_e(L)\mathsf{entry}^J_t + \varepsilon^J_{t+1},$$

where entry^J_t is the entry rate in industry J at time t, and L is the lag operator. I define ε^J as the industry-specific entry shock, that is, the unexpected component of entry rates.

To construct an empirical counterpart to the measure of aggregate productivity of the entry technology, I extract the first principal component of entry rates across industries in the data. The first principal component captures 56% of the variation of entry rates across industries and identifies a common aggregate component driving entry rates. I use an autoregressive process to extract the innovation process of the first principal component; I define this unexpected part as the shock to the marginal productivity of firm creation, ε^X_t. A positive shock to the principal component suggests that as aggregate entry is favorable, starting new firms is easier. I detail the procedure in appendix B.1.1. For robustness, I use the investment-specific shock as in Greenwood, Hercowitz, and Krusell (1997, 2000); Papanikolaou (2011) from the price of new equipment goods. I also describe my use of this alternative measure in appendix B.1.1. I obtain similar results with this other measure of the productivity of firm creation.

Finally, I estimate the response of unexpected changes in entry rates to unexpected changes in the first principal component, that is, shocks to entry:

$$\varepsilon^J_{t+1} = a^J + b^J\varepsilon^X_t + u_{t+1}.$$

Industries with larger b^J have a larger response of entry to changes in the aggregate factor X_t. I use b^J as a proxy for the supply elasticity of entry in the model ζ_J. I report summary statistics of the entry-sensitivity parameter in Table 9. Its average across industries is negative, but it varies greatly from -5 for the lowest quartile to 16 for the highest quartile. That is, a 1% shock to the aggregate entry factor will increase entry by 16%.

3.2 Preliminary Evidence

In this section, I confirm the main dimension of heterogeneity of the model using summary statistics. Then I present evidence on the role of entry on contemporaneous returns and profitability.

Table 1

Summary statistics of industry entry rates and firm characteristics by concentration quintiles (Herfindahl Index)

HH Quintile	Extensive margin								Firm characteristics		
	total: $\mathsf{entry}_{J,t}$			unexpected: $\varepsilon^e_{J,t}$			b^J				
	Average	Std. CS	Std. TS	Average	Std. CS	Std. TS	Average	Std. CS	R&D/A	Inv./A	E/A
Q1	0.91	0.67	0.24	-0.018	0.20	0.19	2.02	2.5	0.126	0.046	0.028
Q2	1.17	0.73	0.25	-0.027	0.24	0.22	2.06	2.2	0.129	0.057	0.032
Q3	1.26	0.70	0.27	-0.013	0.27	0.23	2.41	2.3	0.034	0.066	0.11
Q4	1.56	0.95	0.32	-0.012	0.31	0.27	3.16	2.8	0.035	0.076	0.11
Q5	2.06	1.95	0.42	-0.029	0.44	0.36	3.64	5.0	0.033	0.068	0.11
p value	< 0.001	0.015	0.015	0.25	< 0.001‘	0.015	0.03	-	< 0.001	< 0.001	< 0.001

For the extensive margin, an observation is one industry for one quarter, from 1992 to 2010. There are 5990 observations in the sample. Entry rates are quarterly rates of entry in percentage points. The cross-sectional dispersion of entry rates —Std. CS —is the standard deviation within one concentration quintile of the average entry rates of each industry for the whole time period. The time series volatility —Std. TS —is the average over all industries entry rates volatility within one concentration quintile.

For the intensive margin an observation is one firm for one year, from 1992 to 2012.

The p values represent a test of the difference across industries between the first concentration quintile and the fifth quintile.

3.2.1 Characteristics of Entry and Concentration

I report characteristics of industries' entry rates, averaged by industry concentration quintiles in Table 1. Industries in the highest concentration quintile have higher average entry rates. Their average entry rate (2.06% quarterly) is twice as large than for the lowest concentration industries (0.91%). Furthermore, the average time-series volatility and the cross-sectional dispersion of entry rates is much larger for the most concentrated industries, compared to the first quintile. Volatility is twice as large for high concentration industries (0.42%), suggesting large swings in entry rates for those industries. Dispersion in average entry rates across industries is also higher (1.95%) for the high concentration quintile, documenting a large heterogeneity in entry rates among this industry group. The pattern emerging from the industry-level unexpected shock in entry rates ε_J^E is similar. Industries with higher concentration have larger shocks on average. Their time-series volatility and cross-sectional dispersion is also higher on average.

This preliminary evidence supports the model's prediction that concentrated industries have higher entry rates because of higher monopoly rents and higher firm profitability. Higher time-series volatility in entry is a direct prediction of the model, because concentrated industries tend to have a higher supply elasticity of entry and hence more reaction to aggregate shocks in the economy. Finally, the cross-sectional dispersion in entry rates suggests substantial differences are present in entry rates among the most concentrated industries, compared to competitive industries that tend to be more homogeneous along that dimension.

The last two columns regarding the extensive margin adjustment report summaries of my estimates b^J of the response industries' entry rates to an aggregate entry shock, ε^X, defined above. This sensitivity is positive on average, because a positive shock that favors aggregate entry will increase entry rates for a majority of industries. The estimates of the industry-level response in entry rates to aggregate shocks capture the impulse response of M_J to a shock to X_t in the model. My estimates confirm the model's calibration, because sensitivities are larger for more concentrated industries. The dispersion of entry rates across industries within the category is also larger in the top quintile. This dispersion confirms the first conclusions drawn from entry rates across concentration quintiles that concentrated industries have higher entry rates, more variability in entry rates and a larger heterogeneity in the structure of entry-rate dynamics.

Finally, I report three measures of firm characteristics from COMPUSTAT for each quin-

tile: *research and development expenses, capital expenditures*, and *earnings*. Each variable is scaled by *total assets*. Profitability (earnings-assets ratio) is higher for the more concentrated industries, confirming the main mechanism of the model where the high-entry-rates industries have the highest profitability. Minimal variation exists in the investment rate of firms across concentration. Firms in more concentrated industries tend to invest more. However, a drop in research and development occurs for firms in higher concentration quintiles (Q3, Q4, and Q5). Hou and Robinson (2006) conclude that concentrated industries do not engage in risky innovation, and capitalize on their industries' barriers to entry. Looking at entry rates for those industries draws a different picture, because monopoly rents seem to attract new firms: the innovation process for concentrated industries lies at the extensive margin rather than at the intensive margin. Hence, analyzing the risk structure of industries requires understanding concentration and monopoly rents in conjunction with dynamics of entry.

3.2.2 Unexpected Entry Rates, Earnings, and Stock Returns

To further explore the link between concentration and entry rates, I conduct a panel regression of contemporaneous quarterly stock returns and yearly earnings on the industry-level shock to entry rates ε_J^E. The model predicts that profits and firm valuation see a sharp decline after an unexpected change in entry. This reaction is starker for firms in more concentrated industries. Hence I test this prediction using three different terciles of industry concentration, and I report the slope for each industry group in Table 2.

The first column shows an unexpected change in industry entry correlates negatively with contemporaneous excess returns. Slopes are negative and monotonically decreasing in concentration terciles. An unexpected positive change in entry rates of 0.1% in annual entry rates correlates with a 1% drop in annual excess returns for the lowest concentration tercile. The same entry shock of 0.1% is associated with a 2% drop in annual excess returns for firms in the highest concentration group. Both numbers are economically significant, but only the top two terciles of concentration are statistically significant.

The model suggests the effect on contemporaneous returns is due to a drop of profitability upon entry. In the second column, I estimate the magnitude of that effect and I show profitability, defined as the earnings-assets ratio, decreases with changes in entry rates as predicted. For the highest concentration tercile, a 0.1% shock to entry rates decreases profitability by -0.005 percentage points, that is, a 5% decrease in profitability.

Table 2

EFFECTS OF ENTRY RATES ON CONTEMPORANEOUS ANNUALIZES RETURNS AND EARNINGS FOR DIFFERENT INDUSTRY GROUPS

$$Y_{i,t}^{J} = \alpha + \boldsymbol{\beta^J}\ \varepsilon_{J,t}^{E} + u_{i,t}$$

Industry tercile	Concentration				Leverage	
	Herfindahl Index		Concentration Ratio			
	Excess Returns	Earnings	Excess Returns	Earnings	Excess Returns	Earnings
T1	−8.04	0.006	−6.48*	0.00005	−13.656	−0.0233
	(5.96)	(0.00625)	(3.68)	(0.005)	(17.51)	(0.069)
T2	−11.06**	−0.032	−36.6***	−0.042	−13.176	0.0167
	(4.90)	(0.033)	(11.88)	(0.061)	(11.98)	(0.02)
T3	−24.12**	−0.047*	-3.96	−0.0485*	−20.748**	-0.002
	(11.59)	(0.026)	(4.125)	(0.026)	(10.17)	(0.017)
All industries	−9.91**	−0.01*	−9.91**	−0.01*	−16.03	0.0047
	(4.86)	(0.006)	(4.86)	(0.006)	(11.45)	(0.028)
Observations	345,092	83,373	345,096	83,374	269,492	67,373

*, ** and ***: signicant at 0.1, 0.05 and 0.01 level, respectively, in a two-tailed test.
Clustered standard errors (by year and 4 digits industry code) of the slope coefficient of the regression, $\boldsymbol{\beta^J}$, are presented in parentheses below the coefcient estimates.
An observation is one firm year, from 1992 to 2010. Excess returns are annualized returns in excess of the risk free rate. Earnings are the ratio of earnings before interest, taxes, depreciation and amortization (item ebitda) to sales (item sale). Leverage is the ratio of debt in current liabilities and long term debt (item dlc and dltt) over market value and total debt.

For the lowest concentration industries, the slope is positive, though it is not statistically significant. Over all firms, the decline in profitability due to entry-rates shock is only 1%. I report the slopes in columns 3 and 4 for terciles of the concentration ratio. The coefficients are also in line with the results obtained using the Herfindahl index.

Equities are levered claims on firms' cash flows. Hence the effect of entry on profitability will be accentuated when looking at the stock returns of firms with high leverage ratios. I define leverage as the ratio of book liabilities to total assets. In columns 5 and 6 of table 2, I separate firms according to their market leverage and investigate the same panel regression between returns, earnings, and unexpected entry rates. The slope is highest for the highest tercile. Returns for high leverage firms drop by 2% annually after a 0.1% unexpected shock to entry rates in their industry. The effect, though economically significant for lower leverage levels, is not statistically significant.

3.2.3 Variance decomposition of returns

If shocks to entry affect returns, assessing how much of the variation in returns the aggregate entry factor can explain is empirically relevant. To this aim, I design a structural vector autoregressive model (VAR) and I decompose the variance of the forecast error for different horizons. The variance of the forecast error is the proportion of the variability of the errors in forecasting returns at time $t + h$ based on time t information, due to variability in the structural shocks to aggregate entry and to output. I give details of the VAR model and the exclusion restrictions in appendix B.2. Using three industry portfolios based on concentration terciles, I decompose the variance of the forecast error for each tercile for horizons up to five years. I find entry accounts for less than 10% of the variance of five-years-ahead forecast errors for the lowest concentration tercile. However, for the porftolio composed of the most concentrated firms, shocks on the aggregate entry factor account for 25% of the forecast error. This evidence corroborates the results from Table 2, showing shocks to entry are an important source of variation in stock returns for the more concentrated industries, but not so much for the more competitive industries.

4 Entry Rates, Concentration and the Cross-Section of Industry Returns

4.1 Methodology

The model's main predictions for equilibrium asset prices are the following: (a) a shock to the aggregate entry factor causes a drop in monopoly rents in industries with a high sensitivity of entry rates. (b) This effect is more pronounced within concentrated industries where monopoly rents are the highest. (c) The aggregate entry shock commands a negative price of risk. Firms in industries in which the displacement risk is most prevalent earn higher excess returns in equilibrium. To test the first two hypotheses, I distinguish industries based on their difference in entry rates' responses to the aggregate entry factor. I use two different measures. First, I separate industries according to their past average entry rates. Industries with high average entry rates are identified in my model as industries subject to a high elasticity of the supply of new firms.[34] Then I separate industries according to the sensitivity of their entry rates to shocks to the aggregate factor of entry, that is, the coefficient b^J estimated in section 3.1.3. This coefficient is a direct measure of the impulse response function of entry to a shock to X_t in the model. Hence I am able to directly test whether firms in high-entry-sensitivity industries have returns that covary more with the aggregate entry factor.

To reduce potential measurement error, I construct industries' portfolios based on different economic characteristics (past average entry rates, entry sensitivity, and concentration). I compute the value-weighted returns of each portfolio quintile, and of a portfolio that is long the highest quintile and short the lowest quintile. I call it the high-minus-low portfolio. For each portfolio I report their average monthly excess returns, annual Sharpe ratio, and their pricing error from the three-factor model of Fama and French (1993). That is, the intercept a of the regression $R_{i,t} - R_t^f = a + b(R_t^M - R_t^f) + h\,\mathrm{HML}_t + s\,\mathrm{SMB}_t + u_t$. I acquire the three factors from Ken French's website, the excess return on the market portfolio ($R^M - R^f$), the book-to-market portfolio (HML), and the size portfolio (SMB). Finally, I estimate the covariance of each industry's portfolio returns with two measures of the aggregate shock: the market portfolio and consumption growth. I use non-durable

[34] It is possible—by introducing different death rates, δ_i, across industries—to add another layer of heterogeneity in the model to generate exogenous differences in entry rates. I do not detail this distinction in the model, however, I find in simulations industries with higher entry rates in steady-state have a higher exposure to the entry-shock

consumption plus services from NIPA. I report Newey and West (1987) standard errors in parenthesis.

4.2 Average Industry Entry Rates and Average Returns

In Table 3, I report these summary statistics for five industry portfolios formed dynamically on quintiles of past average entry rates. These portfolio quintiles show an increasing pattern of average excess returns from -0.12% to 0.35%. The intercept of the three-factor model is also increasing from the lower quintile to the higher quintile. The pricing error of the high-low portfolio is 0.54% and significant at the 5% level. Its annual Sharpe ratio is also large at 54%. In the model, a shock to the aggregate productivity of consumption goods is neutral with respect to industries with different entry behavior. The covariance of portfolios' returns with the market portfolio and with consumption growth show an insignificant pattern. Finally, a decline occurs in each portfolio covariance with the innovation part of the principal component of entry. Nonetheless, the covariance of the high-minus-low portfolio with the entry factor is not statistically significant. It is, however, significant for a portfolio that is long in the fourth quintile and short in the first quintile. This series of covariances' estimates suggests the entry factor carries a negative price of risk, as I emphasized in the model. I summarize the covariance result for all this section, graphically in Figure 5. In the model, industries with higher average entry rates have higher fluctuations in entry rates. However, for robustness, I sort industries dynamically by the standard deviation of their entry rates. I present results in Table 14; I find the high-minus-low portfolio has 0.37% average monthly excess returns, although it is measured with noise (standard error is 0.26). More interesting, I find the covariance of the high-minus-low portfolio with the entry factor is negative at -0.22 (standard error is 0.12).

The model suggests looking at a second dimension of the data, the level of monopoly rents that I proxy for by concentration. To look at this other characteristic jointly with entry rates, I proceed as follows: I construct industry portfolios, and I rank industries in three terciles of concentration (Herfindahl)[35]. Conditional on an industry being in one of these three terciles, I proceed as before and I rank firms according to their past average entry rates. The model predicts firms in industries with high entry rates tend to be riskier,

[35] I use terciles of concentration and entry whenever I analyze the data along two dimensions. Results using twenty-five portfolios (double sorted quintiles of characteristics) are similar, although they are not significant due to noisy estimates.

Table 3

Industry Portfolios Monthly Excess Returns Sorted by Past Industry Average Entry Rates

Quintile	Low	Q2	Q3	Q4	High	High - Low
Mean excess return	−0.12	0.25	−0.09	0.29	0.35	0.47
	(0.48)	(0.55)	(0.48)	(0.63)	(0.42)	(0.28)
Sharpe ratio	−0.07	0.13	−0.06	0.15	0.24	0.47
Three factor alpha	−0.37	0.10	−0.29	0.42	0.17	0.54
	(0.26)	(0.19)	(0.26)	(0.30)	(0.16)	(0.28)
Risk exposure to A:						
Market	0.98	1.25	0.97	1.11	0.92	−0.06
	(0.06)	(0.07)	(0.09)	(0.11)	(0.05)	(0.07)
Consumption	0.28	0.29	0.41	0. 24	0.41	0.13
	(0.28)	(0.38)	(0.24)	(0.38)	(0.29)	(0.20)
Risk exposure to X:						
PC1	0.09	−0.01	0.06	−0.19	−0.09	−0.18
	(0.10)	(0.09)	(0.10)	(0.12)	(0.09)	(0.13)

I report statistics of monthly excess returns over the 30-day Treasury-bill rate for 5 portfolios of industries sorted on past average entry rates of industries (5 years rolling window). I report mean excess returns over the risk free rate and their annual Sharpe ratio (μ/σ). I also report risk exposures (univariate betas) with respect to the aggregate productivity shock ε_t^A in the model (market portfolio and consumption growth) and to the shock to aggregate entry (innovation to the first principal component of entry). The sample includes monthly data from 1997-2012. I report standard errors in parentheses using Newey-West estimates with four lags.

especially in high concentration industries. Hence I should see a pattern similar to Table 3, with a finer level of detail by focusing on the highest concentration tercile. I am able to point to the industries for which the mechanism of entry risk matters most. For the bottom two terciles of concentration, no clear direction exists between high and low average-entry-rates portfolios. The high-low portfolio for tercile 1 and 2 does not have significant excess returns or a statistically significant intercept in the Fama-French three-factor model. For firms in industries within the third concentration tercile, the difference in average returns across past entry rates is large, though it is non-monotonic. The high-minus-low portfolio has a high and statistically significant average excess return (1.5%), even after adjusting for the three-factor model, and its Sharpe ratio is sizeable at 77%. Loadings on the entry factors are also informative, even though they are hardly statistically significant. Portfolios with strongly negative covariance with the entry factor tend to earn higher average returns than portfolios with positive loadings. This covariance corroborates earlier evidence that the sign of the price of the entry-shock risk is negative. I represent graphically the loadings against the portfolios average returns in Figure 5.

For robustness, I report the statistics based on terciles computed after the concentration ratio measures in Table 12.

4.3 Industry Entry-Rates Sensitivity and Average Returns

I use the sensitivity of industries' changes in entry to shocks to the entry factor b^J to form industry portfolios. The sensitivity estimate follows the model in which industries differ according to the elasticity of the supply of new entrants. Following my analysis of the model, I compare industries with different sensitivities in the same concentration group. Conditional on an industry being in one concentration tercile, I sort this industry according to the sensitivity coefficient estimate b^J. As for the preceding table, I focus on the spread in average returns between high and low sensitivity industries, especially in the highest concentration tercile. As the model predicts, little variation occurs in average returns across industries within the first two terciles of concentration. This result follows the early evidence gathered from the summary statistics table 1: I showed little cross-sectional variation occurs in the industry sensitivity coefficient b^J for the low concentration industries. However, a large dispersion of the coefficient is present among the more concentrated industries. The average excess returns of the high-low portfolio in the highest concentration tercile has average excess returns of 0.42%, though it is not statistically significant. In

Table 4

Industry Portfolios Monthly Excess Returns Sorted by Past Industry Average Entry Rates And Concentration (Herfindahl)

	Low-Concentration				Mid-Concentration				High-Concentration			
Entry rate tercile	Low	Mid	High	High - Low	Low	Mid	High	High - Low	Low	Mid	High	High - Low
Mean excess return	−0.12	0.18	0.40	0.53	0.02	−0.05	0.08	0.06	−1.14	0.65	0.36	1.50
	(0.52)	(0.47)	(0.53)	(0.43)	(0.52)	(0.53)	(0.52)	(0.41)	(0.57)	(0.50)	(0.42)	(0.54)
Sharpe ratio	−0.07	0.11	0.24	0.42	0.01	−0.03	0.05	0.04	−0.59	0.35	0.23	0.77
Three factor alpha	−0.33	0.08	0.44	0.77	−0.39	−0.42	−0.16	0.23	−1.37	0.43	0.13	1.50
	(0.29)	(0.18)	(0.18)	(0.38)	(0.29)	(0.26)	(0.25)	(0.40)	(0.45)	(0.35)	(0.30)	(0.57)
Risk exposure to A:												
Market	1.11	1.05	1.07	−0.04	0.91	0.94	0.96	0.04	0.95	0.90	0.63	−0.32
	(0.07)	(0.07)	(0.06)	(0.10)	(0.1)	(0.12)	(0.06)	(0.10)	(0.10)	(0.12)	(0.10)	(0.15)
Consumption	0.14	0.40	0.30	0.16	0.24	0.69	0.41	0.17	0.24	0.38	0.36	0.12
	(0.36)	(0.30)	(0.38)	(0.21)	(0.31)	(0.29)	(0.34)	(0.28)	(0.32)	(0.40)	(0.51)	(0.40)
Risk exposure to X:												
PC1	0.13	0.02	−0.22	−0.34	0.01	−0.23	0.10	0.09	0.49	−0.04	0.22	−0.27
	(0.11)	(0.08)	(0.11)	(0.16)	(0.14)	(0.13)	(0.12)	(0.17)	(0.24)	(0.19)	(0.19)	(0.36)

I report statistics of monthly excess returns over the 30-day Treasury-bill rate for 5 portfolios of industries sorted on past average entry rates of industries (5 years rolling window) conditionnally on terciles of concentration (Herfindahl index). I report mean excess returns over the risk free rate and their annual Sharpe ratio (μ/σ). I also report risk exposures (univariate betas) with respect to the aggregate productivity shock ε_t^A in the model (market portfolio and consumption growth) and to the shock to aggregate entry (innovation to the first principal component of entry). The sample includes monthly data from 1997-2012. I report standard errors in parentheses using Newey-West estimates with four lags.

Table 13, I report the same statistics for a different concentration measure (concentration ratio). The first two terciles have little variation in average returns. In the highest tercile, the high-minus-low portfolio has a large monthly average excess return of 0.75%, which is statistically significant.

A caveat of this empirical exercise comes from the estimation of b^J that uses the whole sample period of entry rates. Hence industry portfolios are sorted conditional on future information, and the average returns might be subjected to look-ahead bias. Returns reflect cash-flow news and discount-rate news (Campbell and Shiller (1988)) Hence persistent in-sample cash-flow shocks might explain returns over that period. The sensitivity estimate b^J would also be higher because successive cash-flow shocks caused higher entry rates. Then differences in sensitivity would explain high average returns in my sample. I follow a procedure of Hou and Robinson (2006), following the profitability model of Fama and French (2000) and Vuolteenaho (2002) to compute the unexpected profitability of firms. I leave details of the procedure in the empirical appendix. I find that within the third tercile of concentration, unexpected profitability is on average lower for the firms in the higher tercile of sensitivity than for the lower tercile of sensitivity. If in-sample positive cash-flow news drove my results, then firms with the highest tercile of sensitivity would also have higher unexpected profitability on average.

5 Conclusion

In this paper, I introduced a general equilibrium model with heterogeneous industries, imperfect competition, and shocks to the aggregate cost of entry. Shocks to entry affect the monopolistic structure of industries differently depending on whether those industries have small or large barriers to entry, and small or large monopoly rents. I identify the impact of shocks using asset prices. In concentrated industries, where the level of monopoly rent tends to be high, changes in entry affect firm value significantly. I show this extensive margin of adjustment has a limited effect on the least concentrated industries.

Shocks to entry shift the allocation of production factors in the economy from consumption-goods production to new firm creation. This reallocation process decreases contemporaneous consumption and, depending on households' preferences for smoothing consumption across states (risk aversion) and across time (intertemporal substitution), shocks to entry will command a positive or a negative price of risk. I present evidence that the price of risk is negative, and after a shock to entry, the marginal utility of consumption increases.

Table 5

Industry Portfolios Monthly Excess Returns Sorted by Industry Entry Sensitivity to Entry Shocks And Concentration (Herfindahl)

	Low-Concentration				Mid-Concentration				High-Concentration			
Entry rate tercile	Low	Mid	High	High - Low	Low	Mid	High	High - Low	Low	Mid	High	High - Low
Mean excess return	0.59	0.71	0.50	−0.09	0.50	0.31	0.67	0.16	0.19	0. 26	0.60	0.42
	(0.34)	(0.26)	(0.33)	(0.21)	(0.33)	(0.34)	(0.31)	(0.24)	(0.37)	(0.30)	(0.35)	(0.35)
Sharpe ratio	0.35	0.51	0.32	−0.08	0.33	0.18	0.43	0.14	0.11	0.15	0.32	0.24
Three factor alpha	0.05	0.28	−0.17	−0.22	−0.15	−0.37	0.08	0.23	−0.40	−0.38	0.04	0.44
	(0.12)	(0.10)	(0.14)	(0.20)	(0.23)	(0.15)	(0.15)	(0.23)	(0.27)	(0.21)	(0.26)	(0.35)
Risk exposure to A:												
Market	1.14	0.96	1.08	−0.06	0.87	1.17	0.98	0.11	0.93	0.90	1.04	0.11
	(0.05)	(0.03)	(0.05)	(0.09)	(0.08)	(0.03)	(0.05)	(0.07)	(0.07)	(0.05)	(0.08)	(0.09)
Consumption	0.25	0.33	0.38	0.14	0.66	0.40	0.33	0.33	−0.08	0.28	0.36	0.44
	(0.38)	(0.23)	(0.26)	(0.28)	(0.26)	(0.34)	(0.25)	(0.18)	(0.30)	(0.30)	(0.35)	(0.32)
Risk exposure to X:												
PC1	−0.13	−0.00	0.06	0.19	−0.12	0.07	−0.10	0.02	0.15	0.35	0.03	−0.12
	(0.06)	(0.06)	(0.06)	(0.09)	(0.13)	(0.07)	(0.09)	(0.16)	(0.14)	(0.11)	(0.15)	(0.22)

I report statistics of monthly excess returns over the 30-day Treasury-bill rate for 3 portfolios of industries sorted on the sensitivity of their entry rates to first principal component of entry (b^J), conditionnally on terciles of concentration (Herfindahl index). I report mean excess returns over the risk free rate and their annual Sharpe ratio (μ/σ). I also report risk exposures (univariate betas) with respect to the aggregate productivity shock ε_t^A in the model (market portfolio and consumption growth) and to the shock to aggregate entry (innovation to the first principal component of entry). The sample includes monthly data from 1997-2012. I report standard errors in parentheses using Newey-West estimates with four lags.

I find firms in industries with high average entry rates, or industries with a high sensitivity of entry to the aggregate cost of entry, earn higher average returns. Moreover, the returns of these firms covary negatively with the aggregate entry factor.

My results shed light on the link between industry organization and aggregate fluctuations. Macroeconomics shocks heterogeneous industries in different ways. Understanding the cross section of industry returns contributes to an understanding of how aggregate shocks percolate the economy. To this task, the use of financial data is invaluable, because it can capture some of the heterogeneity in the real economy.

A Appendix: theory

A.1 The translog expenditure function

A.1.1 Description

The transcendental logarithmic utility function (translog) has been introduced in Christensen, Jorgenson, and Lau (1971, 1975) to empirically test demand systems that are non-additive and non-homothetic. Feenstra (2003) reenacted the interest in these preferences, showing that they stay well defined when the underlying choice set varies. This makes them useful in an environment with a dynamically changing choice set. I reproduce below the analysis carried in Feenstra (2003), and extend it to a continuum of varieties.

The translog preference specification is more conveniently expressed under its indirect utility form as an expenditure function:

$$\log(\mathcal{E}) = \log(\mathcal{C}) + a_0 + \int_0^M d\omega\ a(\omega)\log(p(\omega)) + \iint_{[0,M]^2} d\omega d\omega'\ \frac{b(\omega,\omega')}{2}\log(p(\omega))\log(p(\omega')),$$

where $\mathcal{E}$ is the total expenditure on the continuum of varieties on $[0, M]$ and $\mathcal{C}$ the utility derived from buying the varieties ω at price $p(\omega)$. Preference parameters are defined by where $a_0 = (\bar{M} - M)/(2\tau M\bar{M})$, $a(\omega) = 1/M$, $b(\omega,\omega') = \tau/M - \tau\mathbf{1}_{\omega=\omega'}$, where $\bar{M}$ is the number of varieties available in the economy, and M the goods available at a finite price. I will derive expressions for the price elasticity of demand χ and the marginal benefit of variety ϵ, that I use in the core of my model.

Using Shephard's lemma, the optimal demand for good ω is $c(\omega) = \partial\mathcal{E}/\partial p(\omega)$; the budget share of variety ω is:

$$\begin{aligned} s(\omega) = \frac{p(\omega)c(\omega)}{\mathcal{E}} = \frac{\partial\log\mathcal{E}}{\partial\log p(\omega)} &= \frac{1}{M} + \int d\omega' b(\omega,\omega')\log p(\omega) \\ &= \frac{1}{M} + \tau\left(\langle logp\rangle - \log p(\omega)\right), \end{aligned}$$

where $\langle\log p\rangle = M^{-1}\int_0^M d\omega\log p(\omega)$. The share of expenditures is decreasing in the relative distance of the variety log price to the average log price. The price elasticity of demand is computed using the expression of expenditure share:

$$\chi(\omega) = -\frac{\partial\log c(\omega)}{\partial\log p(\omega)} = 1 - \frac{\partial\log s(\omega)}{\partial\log p(\omega)} = 1 + \frac{\tau}{s(\omega)}$$

The markup of prices over marginal cost can be expressed as a function of the elasticity of demand χ:

$$\begin{aligned} \mu(\omega) - 1 = \frac{1}{\chi(\omega) - 1} &= \frac{s(\omega)}{\tau} \\ &= \frac{1}{\tau M} - \left(\langle\log p\rangle - \log p(\omega)\right) \end{aligned}$$

The other sufficient statistic for these preferences is the benefit of additional product variety $\rho(\omega)$. It is usually described by the ratio of the price of a variety $p(\omega)$ to the price index of the aggregated index $\mathcal{C}$. The price index is the ratio of total expenditure to the consumption index $\mathcal{E}/\mathcal{C}$.

$$\log(\mathcal{E}/\mathcal{C}) = a_0 + \langle \log p \rangle + \iint_{[0,M]^2} d\omega d\omega' \frac{b(\omega,\omega')}{2} \log p(\omega) \log p(\omega').$$

A.1.2 Symmetric equilibrium

I consider the case of a symmetric equilibrium where all varieties have the same price: $p(\omega) = p(\omega') = p$. In that case, $\langle \log p \rangle = \log p(\omega)$ and expenditure shares are constant, $s(\omega) = 1/M$. This simplifies the elasticities expressions:

$$\chi(\omega) = \chi(M) = 1 + \tau M,$$
$$\mu(\omega) - 1 = \mu(M) - 1 = \frac{1}{\tau M}.$$

I simplify the expression for price index using symmetric prices:

$$\log(\mathcal{E}/\mathcal{C}) = a_0 + \log p(\omega).$$

And finally I derive the expression for the benefit of product variety:

$$\rho(\omega) = \frac{\mathcal{E}/\mathcal{C}}{p(\omega)} = \rho(M) = \exp\left(-\frac{1}{2}\frac{\bar{M} - M}{\tau M \bar{M}}\right). \tag{A.1}$$

The marginal benefit of additional product benefit (elasticity) is:

$$\epsilon(M) = \frac{\partial \log \rho(M)}{\partial \log M} = \frac{1}{2\tau M}.$$

A.2 Competitive equilibrium

A.2.1 Setup

In this section, I derive formally the competitive equilibrium of the model with two industries. First I set up the optimization programs of the three parties of the economy (households, consumption good producers, innovators).

Households: The representative household preferences are recursive of the Epstein and Zin (1989) type; she maximizes her continuation utility J_t over sequences of the consumption index C_t:

$$J_t = \left[(1-\beta)C_t^{1-\nu} + \beta\left(\mathsf{R}_t(J_{t+1})\right)^{1-\nu}\right]^{\frac{1}{1-\nu}},$$

where where β is the time preference parameter, ν is the inverse of the intertemporal elasticity of substitution (IES) and γ is the coefficient of relative risk aversion (CRRA). $\mathsf{R}_t(J_{t+1}) = [\mathbf{E}_t\{J_{t+1}^{1-\gamma}\}]^{1/(1-\gamma)}$ is the risk adjusted continuation utility. In the core of the paper I assume preferences that are time separable constant relative risk aversion; it is a special case of this more general specification where the IES is the inverse of the CRRA. The representative household is subject to her sequential budget constraint:

$$\sum_j \left[\int_0^{M_{j,t}} p_{j,t}(\omega)\ c_{j,t}(\omega)d\omega + x_{j,t+1}v_{j,t}\frac{M_{j,t+1}}{1-\delta} + x^e_{j,t+1}v^e_{j,t}\right]$$
$$\leq w_t L + \sum_j \left[x_{j,t}M_{j,t}(v_{j,t}+\pi_{j,t}) + x^e_{j,t}(v^e_{j,t}+\pi^e_{j,t})\right]. \tag{A.2}$$

$x_{j,t}$ are the shares held by the representative household in a mutual fund specialized in consumption good producers of industry j; $x^e_{j,t}$ are shares held in a mutual fund that owns all the innovators in industry j. Households invest today by buying shares $x_{j,t+1}, x^e_{j,t+1}$ of the mutual funds at their respective market price: $v_{j,t}M_{j,t+1}/(1-\delta)$ and $v^e_{j,t}$. They receive proceeds from their shares in the funds as income, $M_{j,t}(v_{j,t}+\pi_{j,t})$ for consumption goods and $v^e_{j,t}+\pi^e_{j,t}$ from the innovation sector. Preferences over the industries goods and within industries over the differentiated varieties impose the following constraints:

$$C_t \leq \left[\eta_1 C_{1,t}^{\frac{\theta}{\theta-1}} + \eta_2 C_{2,t}^{\frac{\theta}{\theta-1}}\right]^{\frac{\theta}{\theta-1}} \tag{A.3}$$

$$C_{i,t} \leq \int_0^{M_{i,t}} \rho_{i,t}(\omega)c_{i,t}(\omega)d\omega \tag{A.4}$$

I call the respective Lagrange multipliers for equations A.2, A.3, and A.4: κ_t, ς_t, and $\xi_{i,t}$. Optimization conditions on respectively $C_{t+1}, C_t, C_{i,t}, c_{i,t}(\omega), x_{i,t+1}$ and $x^e_{i,t+1}$ read:

$$\begin{aligned}
&\varsigma_{t+1} = \partial J_t/\partial C_{t+1},\\
&\varsigma_t = \partial J_t/\partial C_t,\\
&\eta_i\varsigma_t\left(C_{i,t}/C_t\right)^{-1/\theta} = \xi_{i,t},\\
&\kappa_t p_{i,t}(\omega) = \xi_{i,t}\rho_{i,t}(\omega),\\
&\kappa_t v_{i,t} = (1-\delta)\mathbf{E}_t\left\{\kappa_{t+1}(v_{i,t+1}+\pi_{i,t+1})\right\},\\
&\kappa_t v^e_{i,t} = \mathbf{E}_t\left\{\kappa_{t+1}(v^e_{i,t+1}+\pi^e_{i,t+1})\right\}.
\end{aligned} \tag{A.5}$$

In this environment it is possible to price any asset in zero net supply by adding them to the sequential budget constraint; their valuation would be given by the standard Euler equation as is the case for the innovators and the consumption good producers.

Consumption good producers: Each firm in an industry produces a unique differentiated variety ω. Firms within an industry operate in a monopolistic competition settings, hence they take consumer demand for variety as given $c_{i,t}(\omega)$. They hire labor at market price w_t to produce

the variety using a linear technology. Their optimization program is:

$$\max_{p_{i,t}(\omega)} \pi_{i,t}(\omega) = p_{i,t}(\omega)c_{i,t}(\omega) - w_t l_{i,t}(\omega),$$

subject to their production possibility frontier and the consumer demand curve:

$$c_{i,t}(\omega) \leq A_t l_{i,t}(\omega), \tag{A.6}$$

$$\frac{\partial \log c_{i,t}(\omega)}{\partial \log p_{i,t}(\omega)} = -\chi_{i,t}(\omega). \tag{A.7}$$

I call the respective Lagrange multipliers for the constraints A.6 and A.7: $\lambda_{i,t}(\omega)$ and $\nu_{i,t}(\omega)$. Optimization condistions on respectively $l_{i,t}(\omega), c_{i,t}(\omega)$ and $p_{i,t}(\omega)$ read:

$$\begin{aligned}
w_t &= A_t \lambda_{i,t}, \\
p_{i,t}(\omega) &= \lambda_{i,t}(\omega) + \frac{\nu_{i,t}(\omega)}{c_{i,t}(\omega)}, \\
c_{i,t}(\omega) &= \chi_{i,t}(\omega)\frac{\nu_{i,t}(\omega)}{p_{i,t}(\omega)}.
\end{aligned}$$

These conditions lead directly to the markup pricing that is a classic result of a monopolistic competition market structure:

$$p_{i,t}(\omega) = \frac{\chi_{i,t}(\omega)}{1+\chi_{i,t}(\omega)}\lambda_{i,t}(\omega) = \mu_{i,t}(\omega)\lambda_{i,t}(\omega)$$

With the translog specification, the price elasticity of demand is given by $\chi_{i,t} = 1 + \tau_i M_{i,t}$ as I showed in section A.1. In that case the markup in an industry is linked to the mass of firm in that industry by $\mu_{i,t} = 1 + 1/(\tau_i M_{i,t})$.

Innovators: Innovators operate a limited supply technology where they hire labor to create firms that will produce new varieties. They sell the new firms at their market value $v_{i,t}$, hence their profit function reads:

$$\max_{M^e_{i,t}} \pi^e_{i,t} = M^e_{i,t} v_{i,t} - w_t L^e_{i,t},$$

subject to their production frontier, that I specify using a convex cost function:

$$\Phi_i(M^e_{i,t}, M_{i,t}) = \frac{a_i}{1+\zeta_i^{-1}} \left(\frac{M^e_{i,t}}{M_{i,t}}\right)^{1+\zeta_i^{-1}} M_{i,t} \leq L^e_{i,t}.$$

Innovators are in perfect competition with each other. Hence there is no option value of firms entry, and maximizing innovators value is equivalent to maximizing their static profit. I call the Lagrange

multiplier on the cost $q_{i,t}$, the optimization with respect to $M^e_{i,t}, L^e_{i,t}$ program reads:

$$v_{i,t} = q_{i,t} a_i (M^e_{i,t}/M_{i,t})^{\zeta_i^{-1}}, \tag{A.8}$$

$$q_{i,t} = w_t/X_t. \tag{A.9}$$

A.2.2 Equilibrium:[36]

An equilibrium is a set of prices $(p_{i,t}(\omega), w_t, v_{i,t}, v^e_{i,t})$, a set of allocations $(c_{i,t}(\omega), C_{i,t}, C_t, L^e_{i,t}, L^p_{i,t}, M^e_{i,t}, M_{i,t}, x_{i,t}, x^e_{i,t})$ such that: (a) given prices, allocations maximize the households program; (b) given prices allocations maximize firms profits ; (c) labor markets, good markets and asset markets clear.

To characterize the equilibrium, I derive the aggregate production function, firms' valuation and their dynamic through the Euler equation. But first I calculate the equilibrium profit of the differentiated varieties producers in each industry.

Within each industry the firm equilibrium is symmetric. Firms face the same optimization program, and the same consumer demand curve; hence they price is constant across varieties in one industry $p_{i,t}(\omega) = p_{i,t}(\omega')$ and so is demand. Using A.1, the price elasticity of demand and the markups are only functions of the mass of firms in the industry at time t: $\mu_i(M_{i,t}) = 1 + 1/(\tau_i M_{i,t})$. The final price of a variety is set at a markup over marginal cost, $p_{i,t}(\omega) = \mu_i(M_{i,t}) w_t/A_t$. The price of an individual variety with respect to the industry price index is given by equation (A.1) and yields: $P_{i,t} = \mu_i(M_{i,t})/\rho_i(M_{i,t})\ w_t/A_t$.[37] The numeraire is the final consumption index C_t, hence we have $P_t = 1$. The consumption index C_t is indexed using a CES aggregator with elasticity of substitution θ, hence the price index is given by $P_t = \left[(\eta^j)^\theta P_{j,t}^{1-\theta}\right]$. Setting this price index to one pins down the wage as a function of markups and the benefit of variety:

$$w_t = A_t \left[(\eta^j)^\theta \rho_{j,t}^{\theta-1} \mu_{j,t}^{1-\theta}\right]^{\frac{1}{\theta-1}}.$$

Next I derive demand for individual variety so as to express profit as a function of aggregate quantities. Demand for each industry with respect to their price index is given by an isoelastic demand curve $C_{i,t} = \eta_i^\theta (P_{i,t}/P_t)^{-\theta} C_t$. This, joined with A.4, yields:

$$c_{i,t}(\omega) = \eta_i^\theta \rho_{i,t}^{\theta-1} \mu_{i,t}^{-\theta} \left(\frac{w_t}{A_t}\right)^{-\theta} \frac{C_t}{M_{i,t}}.$$

The profit at time t for a firm producing good ω in industry i is:

$$\pi_{i,t} = \pi_{i,t}(\omega) = \frac{\mu_{i,t} - 1}{\mu_{i,t}^\theta} \eta_i^\theta \rho_{i,t}^{\theta-1} \left(\frac{w_t}{A_t}\right)^{1-\theta} \frac{C_t}{M_{i,t}}.$$

[36] I use the *Einstein summation notation* in the expression of the equilibrium to avoid expressions cluttered with summation signs. If u and v are collections of number indexed on $\{1 \cdots, N\}$, as $\{u_j\}_{j=1}^N, \{v_j\}_{j=1}^N$, then $u^j v_j \triangleq \sum_j u_j v_j$.

[37] Subsequently I will omit the dependence of μ_i and ρ_i to $M_{i,t}$ for notational convenience and I will simply write $\mu_{i,t}$ and $\rho_{i,t}$. The reader should keep in mind that markups and benefit of variety are only time-varying to the extent that $M_{i,t}$ is time-varying.

Firm value is set by the marginal decision of the innovation sector (A.8, A.9), their optimization conditions give us:

$$v_{i,t} = \frac{w_t}{X_t} a_i \left(M^e_{i,t}/M_{i,t}\right)^{\zeta_i^{-1}}.$$

Finally I remark that $\kappa_t = \varsigma_t$ and one period ahead stochastic discount factor $S_{t,t+1}$ is given in equilibrium by:

$$S_{t,t+1} = \frac{S_{t+1}}{S_t} = \beta \left(\frac{C_{t+1}}{C_t}\right)^{-\nu} \left(\frac{J_{t+1}}{\mathsf{R}_t(J_{t+1})}\right)^{\nu-\gamma}$$

At last using (A.5), we derive the Euler equation for a firm in industry i:

$$\begin{aligned}
&\frac{A_t}{X_t}\left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\mu_{j,t}^{1-\theta}\right]^{\frac{1}{\theta-1}} \partial_1\Phi_i(M^e_{i,t}, M_{i,t}) = \\
&\quad (1-\delta)\mathbf{E}_t \frac{S_{t+1}}{S_t}\left\{\frac{A_{t+1}}{X_{t+1}}\left[(\eta^j)^\theta \rho_{j,t+1}^{\theta-1}\mu_{j,t+1}^{1-\theta}\right]^{\frac{1}{\theta-1}} \partial_1\Phi_i(M^e_{i,t+1}, M_{i,t+1})\right. \\
&\quad \left. + \left(1-\frac{1}{\mu_{i,t+1}}\right)\frac{\eta_i^\theta \rho_{i,t+1}^{\theta-1}\mu_{i,t+1}^{1-\theta}}{\left[(\eta^j)^\theta \rho_{j,t+1}^{\theta-1}\mu_{j,t+1}^{1-\theta}\right]}\frac{C_{t+1}}{M_{i,t+1}}\right\}
\end{aligned} \tag{A.10}$$

I calculate the aggregate consumption index as a function of employment used for consumption production. Labor used in each industry for production is $L^p_{i,t} = \int d\omega l_{i,t}(\omega)$. Using the property of the symmetric equilibrium I can rewrite this as $A_t L^p_{i,t} = \eta_i^\theta \rho_i^{\theta-1}\mu_{i,t}^{-\theta}(w_t/A_t)^{-\theta} C_t$. Adding up the labor used in each industry such that $L^p_t = \sum_i L^p_{i,t}$, aggregate consumption reads:

$$C_t = \frac{\left[(\eta^j)^\theta \mu_{j,t}^{1-\theta}\rho_{j,t}^{\theta-1}\right]^{\frac{\theta}{\theta-1}}}{\left[(\eta^j)^\theta \mu_{j,t}^{-\theta}\rho_{j,t}^{\theta-1}\right]} A_t L^p_t \tag{A.11}$$

Finally, in this paper I do not focus on the valuation of innovation specific firms, $v^e_{i,t}$.[38] However the optimization condition from the households yield an Euler equation specific to the innovation sector:

$$\begin{aligned}
v^e_{i,t} =& \mathbf{E}_t \frac{S_{t+1}}{S_t}\left\{v^e_{j,t} + \pi^e_{j,t}\right\} = \\
& \mathbf{E}_t \frac{S_{t+1}}{S_t}\left\{v^e_{j,t} + \frac{w_t}{X_t}\left[M^e_{i,t+1}\partial_1\Phi_i(M^e_{i,t+1}, M_{i,t+1}) - \Phi_i(M^e_{i,t+1}, M_{i,t+1})\right]\right\}
\end{aligned}$$

A.3 Elasticities

To understand the dynamics of entry in the model, I calculate the elasticities of the demand and supply curve of entry in the model as described in section 2.4.1. The elasticity of the entry rate to

[38] See Papanikolaou (2011) for an analysis separating returns in the innovation (investment goods) sector and in the consumption good sector.

firm value is easily obtained from the first order condition on the innovation sector:

$$\frac{\partial \log(M_i^e/M_i)}{\partial \log v_i} = \zeta_i.$$

The elasticity of profits to changes in entry can be separated in two blocks, an aggregate elasticity common to all industries and an industry specific component:

$$\frac{\partial \log \pi_i}{\partial \log M_i} = \frac{\partial}{\partial \log M_i} \underbrace{\left(\frac{\mu_i - 1}{\mu_i^\theta} \eta_i^\theta \rho_i^{\theta-1} M_i^{-1} \right)}_{\text{industry component:}\epsilon_i} + \frac{\partial}{\partial \log M_i} \underbrace{\left(\left(\frac{w}{A} \right)^{-\theta} C \right)}_{\text{aggregate component}}$$

The industry component of the elasticity ϵ_i accounts for industry heterogeneity in the impact of entry on valuation:

$$\epsilon_i = -2 + \frac{\theta}{1 + \tau_i M_i} + \frac{\theta - 1}{2\tau_i M_i} \tag{A.12}$$

The elasticity is negative for the calibrations I consider. However across industries, a lower level of concentration means a larger elasticity (closer to zero). This is due to a variety effect in the demand of consumers for products in industry i. As the set of goods available in the industry increases, demand for each good decreases. However industry demand increases due to consumers love for variety. Increase in industry demand due to taste for variety is controlled by the taste for variety parameter ρ_i. Since the elasticity of ρ_i to the mass of firms in the industry decreases with the total mass of firms in the industry, the demand effect will be smaller for competitive industries and larger in concentrated industries. In my calibrations variations in the elasticity of profits to firms mass across industries are small.

A.4 Planner problem

A.4.1 Derivation of the planner problem

In this section, I derive formally the planner problem of the model with two industries. The optimization program is:

$$\max_C J_t = \left[(1-\beta) C_t^{1-\nu} + \beta \left(\mathsf{R}_t(J_{t+1}) \right)^{1-\nu} \right]^{\frac{1}{1-\nu}},$$

Subject to the the following constraints

$$
\begin{aligned}
&C_t \leq \left[\eta_1 C_{1,t}^{\frac{\theta}{\theta-1}} + \eta_2 C_{2,t}^{\frac{\theta}{\theta-1}}\right]^{\frac{\theta}{\theta-1}}, \\
&C_{i,t} \leq \rho_i(M_{i,t}) \int_0^{M_{i,t}} c_{i,t}(\omega) d\omega, \\
&c_{i,t}(\omega) \leq A_t l_{i,t}(\omega), \\
&\sum_j \int_0^{M_{j,t}} l_{j,t}(\omega) d\omega + L_{j,t}^e \leq L, \\
&M_{i,t+1} = (1-\delta)\left[M_{i,t} + M_{i,t}^e\right], \\
&\frac{1}{X_t} \frac{a_i}{1+\zeta_i^{-1}} \left(\frac{M_{i,t}^e}{M_{i,t}}\right)^{1+\zeta_i^{-1}} \leq L_{i,t}^e.
\end{aligned}
$$

The Lagrange multipliers associated with this program are respectively $\vartheta_{t+1}, \vartheta_t, \varpi_{i,t}, \lambda_{i,t}(\omega), \upsilon_t, \psi_{i,t}, \nu_{i,t}$, and the first order conditions are:

$$
\begin{aligned}
\vartheta_{t+1} &= \partial J_t / \partial C_{t+1}, & \vartheta_t &= \partial J_t / \partial C_t, \\
\varpi_{i,t} &= \vartheta_t \eta_i (C_{i,t}/C_t)^{-1/\theta}, & \lambda_{i,t}(\omega) &= \varpi_{i,t} \rho_{i,t}(\omega) \\
\upsilon_t &= A_t \lambda_{i,t}(\omega), & \upsilon_t &= \nu_{i,t} \\
(1-\delta) X_t \psi_{i,t} &= a_i (M_{i,t}^e / M_{i,t})^{\zeta_i^{-1}} \nu_{i,t}, \\
\psi_{i,t} &= (1-\delta)\mathbf{E}_t \psi_{i,t+1} + \mathbf{E}_t \left\{ \varpi_{i,t} \rho_{i,t+1} c_{i,t+1} - \upsilon_{t+1} l_{i,t+1} + \varpi_{i,t+1} \rho'_{i,t+1} \int_0^{M_{i,t+1}} d\omega c_{i,t+1}(\omega) \right\}.
\end{aligned}
$$

As in the case of the competitive equilibrium, firms set prices symmetrically within an industry. The shadow value of a firm is the Lagrange multiplier on the firm dynamics constraint $\psi_{i,t}$, after some calculations this is:

$$
\psi_{i,t} = \frac{\partial J_t}{\partial C_t} \frac{A_t}{X_t} \left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]^{\frac{1}{\theta-1}} \frac{a_i}{1-\delta} (M_{i,t}^e / M_{i,t})^{\zeta_i^{-1}}
$$

This leads to the Euler equation for the Pareto equilibrium:

$$
\begin{aligned}
&\frac{A_t}{X_t} \left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]^{\frac{1}{\theta-1}} \partial_1 \Phi_i(M_{i,t}^e, M_{i,t}) = \\
&(1-\delta)\mathbf{E}_t \frac{S_{t+1}}{S_t} \left\{ \frac{A_{t+1}}{X_{t+1}} \left[(\eta^j)^\theta \rho_{j,t+1}^{\theta-1}\right]^{\frac{1}{\theta-1}} \partial_1 \Phi_i(M_{i,t+1}^e, M_{i,t+1}) + \frac{\varepsilon_{i,t+1}}{M_{i,t+1}} \frac{\eta_i^\theta \rho_{i,t+1}^{\theta-1}}{\left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]} C_{t+1} \right\},
\end{aligned}
$$

where the stochastic discount factor is as in the competitive equilibrium:

$$
\frac{S_{t+1}}{S_t} = \beta \left(\frac{C_{t+1}}{C_t}\right)^{-\nu} \left(\frac{J_{t+1}}{\mathsf{R}_t(J_{t+1})}\right)^{\nu-\gamma}
$$

Finally, aggregate consumption in the Pareto equilibrium is:

$$C_t = \left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]^{\frac{1}{\theta-1}} A_t L_t^p \tag{A.13}$$

A.4.2 An equivalence result

In this section show that the Pareto equilibrium of the economy is akin to an investment model with multiple sectors and investment adjustment costs. To be more precise I show that the Pareto equilibrium could be rewritten as the following familiar investment optimization program:

$$\begin{aligned}
&\max_{(M_{i,t}^e)_i} \; J_t \\
\text{s.t.} \quad & C_t = \left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]^{\frac{1}{\theta-1}} A_t \left(L - \sum_j \Phi_j(M_{j,t}^e, M_{j,t})/X_t \right) \\
& M_{i,t+1} = (1-\delta)\left(M_{i,t} + M_{i,t}^e\right).
\end{aligned}$$

The first order condition for this program is:

$$\begin{aligned}
&\frac{A_t}{X_t}\left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]^{\frac{1}{\theta-1}} \partial_1 \Phi_i(M_{i,t}^e, M_{i,t}) = \\
&(1-\delta)\mathbf{E}_t \frac{S_{t+1}}{S_t}\left\{ \frac{A_{t+1}}{X_{t+1}}\left[(\eta^j)^\theta \rho_{j,t+1}^{\theta-1}\right]^{\frac{1}{\theta-1}} \partial_1 \Phi_i(M_{i,t+1}^e, M_{i,t+1}) + \frac{\varepsilon_{i,t+1}}{M_{i,t+1}} \frac{\eta_i^\theta \rho_{i,t+1}^{\theta-1}}{\left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]} C_{t+1} \right\}
\end{aligned} \tag{A.14}$$

However model of the extensive-margin of investment differ from conceptually from RBC type models. Investment motives in the classic investment model with adjustment costs comes from the wedge between the price of installed capital and the marginal value of new capital (investment at the intensive margin). This mechanism is sometime referred to as the q-theory of investment. Rouwenhorst (1995) and Whited (1998) find empirically implausible values of the adjustment cost in order to match firms' asset prices. I introduce a concurring mechanism for investment motives, but at the extensive margin of adjustment. Hence my analysis add to the literature on investment and asset prices.

A.5 Aggregate Inefficiencies of the Competitive Equilibrium and Optimal taxation

In the competitive equilibrium, allocations are such that the level of aggregate consumption is smaller than the efficient (Pareto) level of aggregate consumption. This is due to markup induced distortions that I analyze in detail below. The distance between aggregate consumption in the competitive and the Pareto equilibrium is time varying and generates "endogenous" movement in measured productivity.

Lemma A.1. *The aggregate production function in the Pareto equilibrium of the economy is:*

$$C_t^{PE} = \left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]^{\frac{1}{\theta-1}} A_t L_t^p.$$

The production function in the competitive equilibrium is:

$$C_t^{CE} = \frac{\left[(\eta^j)^\theta \mu_{j,t}^{1-\theta} \rho_{j,t}^{\theta-1}\right]^{\frac{\theta}{\theta-1}}}{\left[(\eta^j)^\theta \mu_{j,t}^{-\theta} \rho_{j,t}^{\theta-1}\right]} A_t L_t^p$$

The competitive equilibrium is suboptimal with respect to the Pareto equilibrium:

$$C_t^{CE} = \Lambda_t C_t^{PE} = \frac{\left[(\eta^j)^\theta \mu_{j,t}^{1-\theta} \rho_{j,t}^{\theta-1}\right]^{\frac{\theta}{\theta-1}}}{\left[(\eta^j)^\theta \mu_{j,t}^{-\theta} \rho_{j,t}^{\theta-1}\right] \left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]^{\frac{1}{\theta-1}}} C_t^{PE} \leq C_t^{PE}$$

Proof. First let us define the normalized weight $r_{i,t} = \eta_i^\theta \rho_{i,t}^{\theta-1} / \left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]$, such that $r_t^j \mathbf{1}_j = 1$. Then Λ_t writes:

$$\Lambda_t = \left[r_t^j \mu_{j,t}^{1-\theta}\right]^{\frac{\theta}{\theta-1}} / \left[r_t^j \mu_{j,t}^{-\theta}\right]$$

Jensen inequality applied to $[r_t^j \mu_{j,t}^{1-\theta}]$ using the convex function $\varphi : x \mapsto x^{\theta/(\theta-1)}$, gives the result that $\Lambda_t \leq 1$. The inequality is strict if and only if there is dispersion in markup, that is if there exists at least one distinct pair of industries ($i \neq j$) such that $\mu_{i,t} = \mu_{j,t}$. ∎

Endogenous movements are given by the Λ_t process that sums up the cost of markup heterogeneity across industries.

I introduce a dynamic optimal taxation scheme to implement the Pareto equilibrium as a competitive equilibrium. First I derive necessary and sufficient conditions on model quantities for the CE to be efficient (i.e. allocations from the PE). Then I implement these conditions using a tax on sales for each industry and I write conditions on these taxes to induce efficiency. The optimal taxation schedule sheds light on the distortions at stake in the CE and their dynamics.

There are three conditions to implement the PE as a CE. Indeed there are three sources of distortions in the economy:

(a) Dynamic distortions arise from the monopolistic structure of the market in each industry. Times with high markups have inefficiently low levels of production. Then it is optimal for the planner to shift inputs across time from low markup times where the good production is high to the high markups times. If the planner knows that the productivity of entry is likely to be lower in the future (bad X_t draw), then it would be optimal for the planner to induce firm entry in the industry now and allocate inputs good towards production in the future where markups are likely to be higher.

(b) Static distortions are due to an the heterogeneity of the markups of firms across different industries. The intuition for the inefficiency of having heterogenous markups across industries is similar to the dynamic distortions. It is optimal for the planner to shift inputs from the

high markups industries to the low markup industries. The size of the static distortion in the economy is the wedge between the aggregate consumption function in the PE and in the CE.

(c) An inefficient level of entry due to the inadequacy between the private motives for firms' entry, monopoly rents through markups, and the public motives, extra consumer surplus through taste for variety.

Lemma A.2 (Bilbiie, Ghironi, and Melitz (2008); Lerner (1934))**.** *The competitive and planner equilibria are equivalent if and only if an equilibrium satisfies the following conditions:*

(a) Markups are constant across time: $\forall i,\ \mu_{i,t} = \mu_{i,t+1}$.

(b) Markups are constant across industries: $\forall i, j,\ \mu_{i,t} = \mu_{j,t}$

(c) Firms incentives to entry (markups) equates consumers taste for variety: $\forall i,\ \mu_i(M_i) = \epsilon_i(M_i)$

This lemma borrows from Bilbiie, Ghironi, and Melitz (2008) who solved the optimal taxation problem in the case of the dynamic distortion and the alignment of incentives between taste for variety and firms' motives for entry.

Proof. **Sufficiency:** Substituting the 3 conditions in the planner first order condition (A.14), the equations is identical to the Euler equation of the competitive equilibrium (A.10). Finally the second condition is such that the aggregate production function in the planner equilibrium (A.13) is identical to the competitive equilibrium (A.11).

Necessity: I will prove necessity by contraposition for each condition succesively:

(a) Suppose that there are equilibrium quantities $(C_t, M_{i,t})$ for both the competitive and planner equilibrium such that there exists one industry i with $\mu_{i,t} \neq \mu_{i,t+1}$ (on a non zero measure set). Substituting in the Euler equation for the competitive problem:

$$\frac{A_t}{X_t}\left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]^{\frac{1}{\theta-1}} \partial_1 \Phi_i(M^e_{i,t}, M_{i,t}) = \mathbf{E}_t \frac{S_{t+1}}{S_t}\left\{\frac{A_{t+1}}{X_{t+1}}\left[(\eta^j)^\theta \rho_{j,t+1}^{\theta-1}\right]^{\frac{1}{\theta-1}} \partial_1 \Phi_i(M^e_{i,t+1}, M_{i,t+1}) \frac{\mu_{i,t}}{\mu_{i,t+1}} + \frac{\mu_{i,t}}{\mu_{i,t+1}} \frac{\varepsilon_{i,t+1}}{M_{i,t+1}} \frac{\eta_i^\theta \rho_{i,t+1}^{\theta-1}}{\left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]} C_{t+1}\right\},$$

, Substracting this to the planner Euler equation yields:

$$0 = \mathbf{E}_t \frac{S_{t+1}}{S_t}\left(1 - \frac{\mu_{i,t}}{\mu_{i,t+1}}\right)\left\{\frac{A_{t+1}}{X_{t+1}}\left[(\eta^j)^\theta \rho_{j,t+1}^{\theta-1}\right]^{\frac{1}{\theta-1}} \partial_1 \Phi_i(M^e_{i,t+1}, M_{i,t+1}) + \frac{\varepsilon_{i,t+1}}{M_{i,t+1}} \frac{\eta_i^\theta \rho_{i,t+1}^{\theta-1}}{\left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]} C_{t+1}\right\},$$

This last statement is false as long as there exists a non-zero risk neutral probability event where firm value and cash-flows are positives.

(b) Suppose that there are equilibrium quantities $(C_t, M_{i,t})$ for both the competitive and planner equilibrium such that $\mu_{1,t} \neq \mu_{2,t}$. In that case the static distortions introduced by the markups

require additional resources to produce quantity C_t^{CE} in the competitive equilibrium. Let us define the weights $b_{i,t} = \left((\eta^j)^\theta \rho_{j,t}^{\theta-1}\right)^{-1} \eta_i^\theta \rho_{i,t}^{\theta-1}$, and we can rewrite consumption as:

$$C_t^{\text{CE}} = \frac{\left[b_t^j \mu_{j,t}^{1-\theta}\right]^{\frac{\theta}{\theta-1}}}{\left[b_t^j \mu_{j,t}^{-\theta}\right]} \left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]^{\frac{1}{\theta-1}} AL_t^p = \frac{\left[b_t^j \mu_{j,t}^{1-\theta}\right]^{\frac{\theta}{\theta-1}}}{\left[b_t^j \mu_{j,t}^{-\theta}\right]} C_t^{\text{PE}}.$$

The result is derived from Jensen[39] inequality applied to the fraction showing that it is smaller than one provided that $\mu_{1,t} \neq \mu_{2,t}$.

(c) Suppose that there are equilibrium quantities $(C_t, M_{i,t})$ for both the competitive and planner equilibrium such that $\varepsilon_{i,t} \neq \mu_{i,t} - 1$. As in the first case, I substitute the other condition in the competitive Euler equation, and substract it to the planner Euler equation:

$$0 = \mathbf{E}_t \frac{S_{t+1}}{S_t} \left\{ \left[(\mu_{i,t+1} - 1) - \varepsilon_{i,t+1}\right] \frac{\eta_i^\theta \rho_{i,t+1}^{\theta-1}}{\left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]} \frac{C_{t+1}}{M_{i,t+1}} \right\}.$$

This achieves the proof. ∎

I implement these conditions through a tax on sales, a well known policy instrument[40] instrument when correcting for distortions induce by monopolies. The planner implementation of the PE as a CE is achieved through the following proposition:

Proposition A.3. *The planner can implement the Pareto equilibrium from the competitive equilibrium using a tax α_t on firms' sales, such that:*

(a) It solves the dynamic distortion problem:

$$\forall\ i, j, \quad \frac{1 - \alpha_{i,t}}{\mu_{i,t}} = \frac{1 - \alpha_{j,t}}{\mu_{j,t}} \tag{A.15}$$

(b) It solves the static distortion problem:

$$\forall\ i, \quad \frac{1 - \alpha_{i,t}}{\mu_{i,t}} = \frac{1 - \alpha_{i,t+1}}{\mu_{i,t+1}} \tag{A.16}$$

(c) It equates private and public motives for entry:

$$\forall\ i, \quad \frac{\mu_{i,1}}{1 - \alpha_{i,t}} \left(1 - \frac{1 - \alpha_{i,t+1}}{\mu_{i,t+1}}\right) = \varepsilon_{i,t+1} \tag{A.17}$$

Proof. Taxation on sale is reversed to firms through lump sum subsidies on profits, $T_{i,t}$. The modified profit function for a firm in industry i is:

$$\pi_{i,t} = (1 - \alpha_{i,t}) p_{i,t} c_{i,t} - w_t l_{i,t} + T_{i,t},$$

[39] This result has been emphasized by Opp, Parlour, and Walden (2012)

[40] This optimal policy is not unique

The optimal pricing in equilibrium is changed as $p_{i,t} = \mu_{i,t}/(1-\alpha_{i,t})w_t/A_t$. A balanced budget requires that in equilibrium $T_{i,t} = \alpha_{i,t}p_{i,t}c_{i,t}$. Final profits for the firms are:

$$\pi_{i,t} = \left(1 - \frac{1-\alpha_{i,t}}{\mu_{i,t}}\right) p_{i,t}c_{i,t}.$$

If the planner decreases taxes, the observed markup $\mu_{i,t}/(1-\alpha_{i,t})$ goes down and so does the final profit. To solve the static distortion problem it is sufficient to equates the observed markup across industries. This implies the first condition (A.15).

After implementing the taxations, I derive the other conditions from the first order conditions of the CE, assuming that condition (A.15) holds:

$$\begin{aligned}
&\frac{1-\alpha_{i,t}}{\mu_{i,t}}\frac{A_t}{X_t}\left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]^{\frac{1}{\theta-1}} \partial_1\Phi_i(M^e_{i,t}, M_{i,t}) = \\
&(1-\delta)\mathbf{E}_t\frac{S_{t+1}}{S_t}\left\{\frac{1-\alpha_{i,t+1}}{\mu_{i,t+1}}\frac{A_{t+1}}{X_{t+1}}\left[(\eta^j)^\theta \rho_{j,t+1}^{\theta-1}\right]^{\frac{1}{\theta-1}} \partial_1\Phi_i(M^e_{i,t+1}, M_{i,t+1})\right. \\
&\left.+\left(1-\frac{1-\alpha_{i,t+1}}{\mu_{i,t+1}}\right)\frac{\eta_i^\theta \rho_{i,t+1}^{\theta-1}}{\left[(\eta^j)^\theta \rho_{j,t}^{\theta-1}\right]}\frac{C_{t+1}}{M_{i,t+1}}\right\}.
\end{aligned}$$

Conditions (A.16,A.17) are sufficient to ensure that the optimization condition of the CE maps that of the PE. ∎

I consider two different cases to illustrate how this policy works in practice:

(a) Industry 1 has higher markups than sector 1 at time t, $\mu_{1,t} > \mu_{2,t}$. This leads to $\alpha_{2,t} > \alpha_{1,t}$, the planner imposes higher taxes on sales of goods in industry 2. Standard monopoly theory states that monopolistic firms produce an inefficiently low level of output. This effect is more acute in the sector 1, with high markups (where firms enjoy greater monopoly power). To that effect the planner shifts inputs from firm creation to production to implement the PE. Using the sales tax as the only fiscal instrument, the planner subsidizes sales in high market power sectors to shift resources from entry to production. Regarding the lower markup sector 2, the planner tax sales more heavily to induce more entry.[41]

(b) Industry 1 reaction to the *entry shock* is greater than industry 2. Let us imagine a positive shock to X_t, that is a lower cost of entry. In reaction, markups will decrease due to accrued entry and a decrease in market power, $\mu_{1,t+1}/\mu_{1,t} < \mu_{2,t+1}/\mu_{2,t}$. Using condition (A.16), the planner should increase the sales tax in sector 1 more than in sector 2, $\alpha_{1,t} > \alpha_{2,t}$. If markups increase in sector 2 with respect to sector 1, consumption good production should be incentivized more in that sector. As markups represent private motives for entry, the planner should induce firms to produce more consumption goods in the high markup sector 2. To smooth out private motives the planner implements a more cyclical policy for sectors with large markup variation (2 here). She subsidizes sales to induce production in low entry cost states and tax sales in high entry cost states.

[41] This statement is relative as their might be subsidies or taxation in both sectors, depending on the other necessary conditions for optimality of the CE.

A.6 Calibration and simulation

Table 6
CALIBRATED PARAMETERS

Parameter	Symbol	Value
Preferences (dynamic):		
Discount rate	β	0.99
Elasticity of intertemporal substitution	ν	0.3
Relative risk aversion	γ	1.2
Preferences (variety):		
Elasticity of substitution across industries	θ	2.5
Maximum amount of variety in industry	$\bar{M}_i$	50
Demand for variety elasticity parameter	τ_i	1
Production Technology:		
Labor supply	L	1
Volatility of production in consumption good sector	σ_A	2%
Persistence of aggregate productivity	ρ_A	0.95
Innovation Technology:		
Cost of entry (competitive industries)	a_i	0.15 - 0.35
Cost of entry (concentrated industries)	a_i	0.4 - 3.5
Elasticity of supply (competitive industries)	ζ_i	1.25 - 2
Elasticity of supply (concentrated industries)	ζ_i	1.1 - 7
Exogenous death rate	δ	5%
Volatility of aggregate entry shock	σ_X	5%
Persistence of aggregate entry factor	ρ_X	0.75

B Empirical appendix

B.1 Measurement

B.1.1 Entry aggregate factor

To capture the aggregate shock X_t in the model to the cost of new firm production I use two measures. First I use the entry rates at the industry level from the BLS and I extract its first principal component $\mathsf{PC1}_t$. I define a shock to the marginal productivity of new firms ε_t^X as the

residual of an autoregressive process of the first principal component:

$$\mathsf{PC1}_{t+1} = \rho\ \mathsf{PC1}_t + \varepsilon^X_{t+1}$$

I include output growth in the regression to orthogonalize the shock to aggregate productivity, A_t in the model. For robustness I use a measure from the literature on investment specific shocks (see Greenwood, Hercowitz, and Krusell (1997, 2000); Papanikolaou (2011)), the price of new equipment goods q_t. I extract the investment specific shock as the residual of an autoregressive process of the price of investment. The specification follows Fisher (2006) and Papanikolaou (2011); the shock ε^X_t is defined as:

$$\log q_t = \bar{g}_1 t\ \mathbf{1}_{t<1982} + \bar{g}_2 t\ \mathbf{1}_{t\geq 1982} + \rho \log q_{t-1} - \varepsilon^x_t.$$

B.1.2 Measures of entry

The sample is a panel dataset of firms entry at quarterly frequency starting 1992:3 by 3 digits industry level. Entry rates are the number of firms entering in one period an industry divided by the number of firms in the industry. Net entry rates are entry rates net of firms exiting the industry. The employment versions of the variables are weighted by firms' employee numbers . I represent summary statistics by a time series and a cross-section. (a) I aggregate the entry rates by industries at each time period to construct the aggregate time series; (b) I aggregate the entry rates over time to construct the cross-section.

B.1.3 Measures of concentration

I use two concentration measures, the Herfindahl index and the 4 firm concentration ratio. Both measures are defined from the sales market shares for each firm ω from an industry J, $s^J_t(\omega)$. The Herfindahl index is the sum of the squares of market shares in the industry:

$$\mathsf{HH}_J = \sum_{\omega\in J} (s^J(\omega))^2.$$

The concentration ratio is defined as the ratio of sales by the four largest firm in the industry to the total sales in the industry:

$$\mathsf{CR}_J(4) = \sum_{\mathrm{rank}(s^J(\omega))\leq 4} s^J(\omega).$$

There is a direct mapping from these measures to the mass of firms in industry j in the model, M_j. As all firms within an industry are identical I simplify both indexes. The Herfindahl index in my model is $\mathsf{HH}_j = 1/M_j$ and the 4 firm concentration ratio is $\mathsf{CR}_j = 4/M_j$. Hence Herfindahl indexes and concentration ratios are the direct empirical counterpart of the mass of firms in industry M_j.

B.2 Variance decomposition using a VAR model

Using the Herfindahl index I create three time series of returns for each concentration portfolio, r^{h}_t, where $\mathsf{h} = 1, 2$ or 3 depending on the concentration tercile. I investigate the role of the two main

variable of my theorerical model on returns for the returns of firms of different concentrations. I specify a VAR model with aggregate output y_t and the aggregate component of entry e_t. The VAR model is the following dynamic system of simultaneous equation:

$$\begin{bmatrix} 1 & b_{12} & b_{13} \\ b_{21} & 1 & b_{23} \\ b_{31} & b_{32} & 1 \end{bmatrix} \begin{bmatrix} r^{\mathsf{h}}_{t+1} \\ y_{t+1} \\ \mathsf{e}_{t+1} \end{bmatrix} = \begin{bmatrix} \gamma_{10} \\ \gamma_{20} \\ \gamma_{30} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} \end{bmatrix} \begin{bmatrix} r^{\mathsf{h}}_{t} \\ y_{t} \\ \mathsf{e}_{t} \end{bmatrix} + \begin{bmatrix} \varepsilon^{\mathsf{h}}_{t+1} \\ \varepsilon^{y}_{t+1} \\ \varepsilon^{\mathsf{e}}_{t+1} \end{bmatrix},$$

or simply in matrix form: $\boldsymbol{B}\boldsymbol{z}_{t+1} = \boldsymbol{\gamma}_0 + \boldsymbol{\Gamma}\boldsymbol{z}_t + \boldsymbol{\varepsilon}_{t+1}$, and $\mathbf{E}\{\boldsymbol{\varepsilon}_t\boldsymbol{\varepsilon}_t'\} = \mathbf{D}$ is diagonal, where $\boldsymbol{z_t} = [r^{\mathsf{h}}_t, y_t, \mathsf{e}_t]'$. The reduced form of the structural VAR is given by simply solving for $\boldsymbol{z}$ in the precedent equation:

$$\boldsymbol{z}_{t+1} = \boldsymbol{B}^{-1}\boldsymbol{\gamma}_0 + \boldsymbol{B}^{-1}\boldsymbol{\Gamma}\boldsymbol{z}_t + \boldsymbol{B}^{-1}\boldsymbol{\varepsilon}_{t+1}.$$

Without restrictions, parameters of the structural VAR are not identified. Given estimates of the reduced form VAR there is not a unique solution to the structural VAR model. There are 21 parameters in the structural VAR (18 coefficients and 3 covariance coefficients) and only 18 in the reduced form VAR (12 coefficients and 6 covariance coefficients). Hence I form the following three zero exclusion restrictions: $b_{21} = 0, b_{31} = 0$ and $b_{32} = 0$. The first two exclusion restrictions assume that returns today do not affect output or entry rates. The last restriction assumes that entry today does not affect output contemporaneously. For robustness, I try another exclusion restriction to identify shocks in the VAR. I make the assumptions that returns do not affect output and entry rates contemporaneously as before. The third exclusion is changed as I assume that output does not affect entry contemporaneously. I find similar results in this specification as well.

Table 7

PART OF THE FORECAST ERROR VARIANCE EXPLAINED BY THE AGGREGATE ENTRY COMPONENT

	Variance Explained (%)					
Forecast horizon	3 months	6 months	1 year	2 years	3 years	5 years
Low Tercile: r^1_t	2.00	3.36	5.65	8.07	9.10	10.03
Mid Tercile: r^2_t	1.93	5.19	12.36	22.89	28.96	35.88
High Tercile: r^3_t	1.53	3.68	8.60	15.88	20.09	24.91

B.3 Unexpected profitability

I follow the profitability model of Fama and French (2000) augmented by Vuolteenaho (2002). The model of profitability is:

$$(E/A)_{t+1} = a + b_1(V/A)_{t+1} + b_2\mathrm{DD}_{t+1} + b_3(D/B)_{t+1} + b_4(E/A)_t + u_{t+1},$$

where E/A is earnings scaled by assets, V/A is the market value of assets to the book value of assets, DD a dummy variable for non-dividend paying firms and D/B is the dividend to book equity ratio. Expected profitability is the fitted value from this regression. Unexpected profitability is the difference between realized profitability and expected profitability, that is the regression error.

Table 8

Profitability statistics for different industries

	Low-Concentration			Mid-Concentration			High-Concentration		
Sensitivity rate tercile	Low	Mid	High	Low	Mid	High	Low	Mid	High
Profitability	3.9	-3.1	7.9	8.2	6.9	9.7	4.5	8.9	6.7
Unexpected profitability	−0.12	−0.87	0.44	0.66	0.53	1.16	1.27	0.70	0.30

One observation is one firm for one year, from 1992 to 2010. Profitability and unexpected profitability are in percentages.

B.4 Tables and Figures

Table 9

Summary statistics of entry rates from the BLS

			Cross Section			Time Series		
		Mean	SD	25%	75%	SD	25%	75%
Entry rates	Entry #	4.748	2.515	3.058	5.679	0.425	4.359	5.131
	Entry emp.	1.510	1.422	0.679	1.762	0.301	1.247	1.798
Entry shock	Entry #	-0.0195	0.0325	-0.0354	-0.00894	0.166	-0.109	0.0654
	Entry emp.	-0.0191	0.0216	-0.0241	-0.00735	0.0891	-0.0625	0.0185
Entry rate sensitivity	Entry #	1.302	20.14	-6.214	9.114			
	Entry emp.	-0.830	16.45	-5.669	4.346			
Observations		6699		77			87	

One observation is one industry for one quarter, from 1992 to 2010. There are 5990 observations in the sample. All numbers are percentages.

Industry level advertising computed at the 3 digits industry level by the ratio of total advertising expenses (item xad) in an industry to total sales (item sale). Median industry advertising is the median across firms within an industry of the ratio of advertising expenses (xad) to sales (sale).

The p values represent a test of the difference across industries between the first concentration quintile and the fifth quintile.

Table 10

Summary statistics of entry rates by market leverage

Leverage	Entry rates				Entry elasticity	
Quintile	total: $\mathsf{entry}_{J,t}$		unexpected: $\varepsilon^{e}_{J,t}$		β_J	
	μ	σ	μ	σ	μ	σ
Q1	0.94	0.73	-0.01	0.28	1.65	3.03
Q2	0.95	0.74	-0.013	0.26	1.93	3.01
Q3	0.98	0.78	-0.012	0.27	2.00	2.78
Q4	0.99	0.8	-0.013	0.29	2.00	2.71
Q5	0.99	0.8	-0.018	0.30	1.67	2.87
p value	0.58	0.94	0.17	0.94	0.27	-

One observation is one industry for one year, from 1992 to 2010. There are 5990 observations in the sample. All numbers are percentages.
Industry level advertising computed at the 3 digits industry level by the ratio of total advertising expenses (item xad) in an industry to total sales (item sale). Median industry advertising is the median across firms within an industry of the ratio of advertising expenses (xad) to sales (sale).
The p values represent a test of the difference across industries between the first concentration quintile and the fifth quintile.

Table 11

Summary statistics of concentration measures

		Cross Section			Time Series		
	Mean	SD	25%	75%	SD	25%	75%
CR2	0.547	0.248	0.351	0.774	0.0186	0.524	0.541
CR4	0.703	0.216	0.532	0.907	0.0182	0.679	0.700
Herfindahl	0.283	0.251	0.108	0.403	0.0142	0.249	0.273
Observations	1700		85			20	

One observation is one industry for one year, from 1992 to 2010. There are 5990 observations in the sample. All numbers are percentages.

Table 12

Industry Portfolios Monthly Excess Returns Sorted by Past Industry Average Entry Rates And Concentration (Concentration Ratio)

	Low-Concentration				Mid-Concentration				High-Concentration			
Entry rate tercile	Low	Mid	High	High - Low	Low	Mid	High	High - Low	Low	Mid	High	High - Low
Mean excess return	−0.05	0.16	0.33	0.38	0.20	0.02	0.06	−0.15	−1.08	0.66	0.32	1.40
	(0.50)	(0.48)	(0.54)	(0.37)	(0.53)	(0.60)	(0.41)	(0.42)	(0.62)	(0.53)	(0.49)	(0.55)
Sharpe ratio	−0.03	0.09	0.20	0.32	0.12	0.01	0.04	−0.10	−0.56	0.34	0.20	0.77
Three factor alpha	−0.24	0.03	0.39	0.63	−0.23	−0.37	−0.10	0.14	−1.30	0.42	0.01	1.31
	(0.24)	(0.21)	(0.18)	(0.33)	(0.30)	(0.33)	(0.21)	(0.39)	(0.46)	(0.33)	(0.29)	(0.54)
Risk exposure to A:												
Market	1.07	1.07	1.08	0.02	0.96	0.91	0.88	−0.08	1.07	1.07	1.08	0.02
	(0.07)	(0.07)	(0.05)	(0.10)	(0.08)	(0.15)	(0.06)	(0.11)	(0.10)	(0.09)	(0.11)	(0.15)
Consumption growth	0.17	0.35	0.37	0.19	0.29	0.86	0.41	0.12	0.16	0.25	0.34	0. 18
	(0.37)	(0.28)	(0.39)	(0.19)	(0.32)	(0.32)	(0.31)	(0.29)	(0.35)	(0.46)	(0.29)	(0.37)
Risk exposure to X:												
PC1	0.42	−0.01	0.35	−0.07	0.10	−0.18	−0.03	−0.13	0.02	0.04	−0.24	−0.26
	(0.23)	(0.18)	(0.16)	(0.31)	(0.12)	(0.18)	(0.11)	(0.16)	(0.10)	(0.09)	(0.11)	(0.15)

I report statistics of monthly excess returns over the 30-day Treasury-bill rate for 5 portfolios of industries sorted on past average entry rates of industries (5 years rolling window) conditionnally on terciles of concentration (Concentration ratio). I report mean excess returns over the risk free rate and their annual Sharpe ratio (μ/σ). I also report risk exposures (univariate betas) with respect to the aggregate productivity shock ε_t^A in the model (market portfolio and consumption growth) and to the shock to aggregate entry (innovation to the first principal component of entry). The sample includes monthly data from 1997-2012. I report standard errors in parentheses using Newey-West estimates.

Table 13

Industry Portfolios Monthly Excess Returns Sorted by Industry Entry Sensitivity to Entry Shocks And Concentration (Concentration ratio)

	Low-Concentration				Mid-Concentration				High-Concentration			
Entry rate tercile	Low	Mid	High	High - Low	Low	Mid	High	High - Low	Low	Mid	High	High - Low
Mean excess return	0.58	0.74	0.62	0.03	0.40	0.61	0.48	0.08	0.20	0.25	0.95	0.75
	(0.34)	(0.27)	(0.34)	(0.23)	(0.20)	(0.33)	(0.29)	(0.22)	(0.32)	(0.29)	(0.40)	(0.34)
Sharpe ratio	0.33	0.54	0.38	0.03	0.27	0.37	0.33	0.07	0.13	0.15	0.47	0.44
Three factor alpha	0.04	0.31	−0.09	−0.12	−0.22	−0.03	−0.07	0.15	−0.38	−0.39	0.36	0.75
	(0.13)	(0.09)	(0.13)	(0.20)	(0.19)	(0.14)	(0.15)	(0.21)	(0.22)	(0.19)	(0.27)	(0.33)
Risk exposure to A:												
Market	1.16	0.95	1.12	−0.04	0.86	1.09	0.94	0.08	0.85	0.91	1.09	0.24
	(0.06)	(0.03)	(0.04)	(0.09)	(0.06)	(0.04)	(0.05)	(0.06)	(0.05)	(0.06)	(0.07)	(0.09)
Consumption	0.04	0.04	−0.03	−0.07	0.26	−0.01	−0.15	−0.41	−0.13	−0.15	−0.01	0.12
	(0.29)	(0.19)	(0.23)	(0.22)	(0.23)	(0.27)	(0.21)	(0.14)	(0.19)	(0.22)	(0.31)	(0.26)
Risk exposure to X:												
PC1	−0.11	−0.05	0.01	0.13	0.05	0.12	0.01	−0.04	0.07	0.34	-0.07	−0.15
	(0.07)	(0.06)	(0.06)	(0.09)	(0.09)	(0.08)	(0.09)	(0.12)	(0.12)	(0.10)	(0.15)	(0.20)

I report statistics of monthly excess returns over the 30-day Treasury-bill rate for 3 portfolios of industries sorted on the sensitivity of their entry rates to first principal component of entry (b^J), conditionnally on terciles of concentration (Concentration ratio). I report mean excess returns over the risk free rate and their annual Sharpe ratio (μ/σ). I also report risk exposures (univariate betas) with respect to the aggregate productivity shock ε_t^A in the model (market portfolio and consumption growth) and to the shock to aggregate entry (innovation to the first principal component of entry). The sample includes monthly data from 1997-2012. I report standard errors in parentheses using Newey-West estimates.

Table 14

Industry Portfolios Monthly Excess Returns Sorted by Standard Deviation of Past Industry Entry Rates

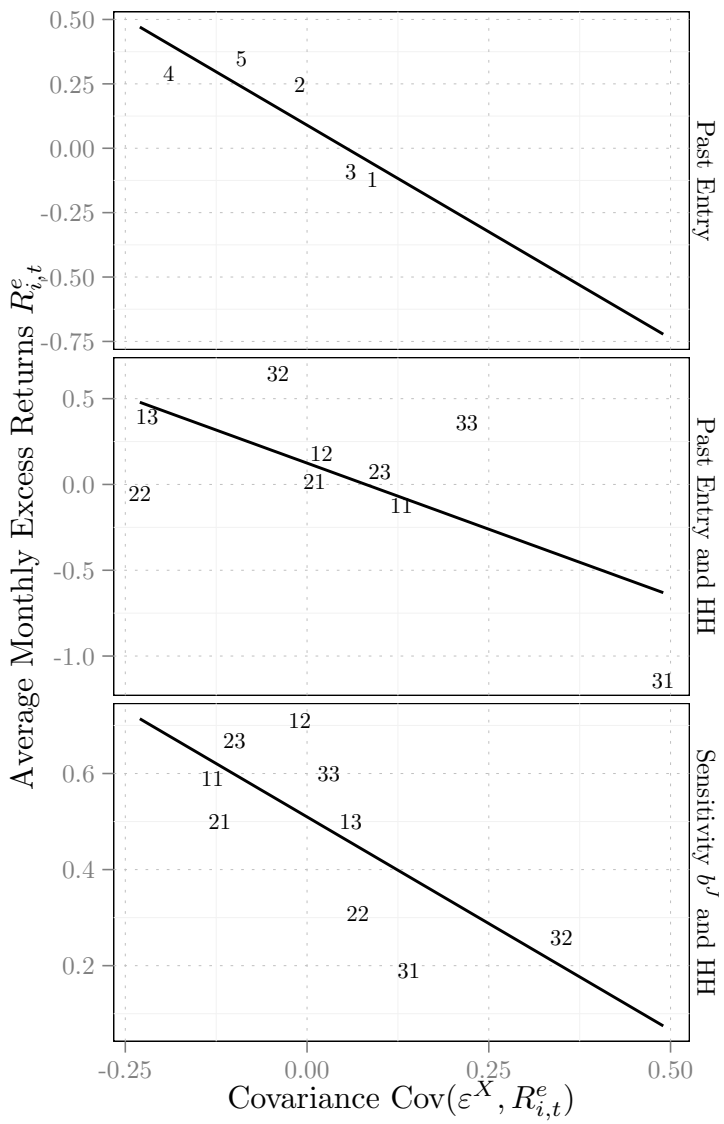
Quintile	Low	Q2	Q3	Q4	High	High - Low
Mean excess return	0.40	0.54	0.32	0.80	0.78	0.37
	(0.39)	(0.41)	(0.49)	(0.41)	(0.43)	(0.26)
Sharpe ratio	0.27	0.34	0.17	0.54	0.48	0.33
Three factor alpha	−0.16	−0.02	−0.23	0.28	0.17	0.33
	(0.26)	(0.19)	(0.26)	(0.30)	(0.23)	(0.26)
Risk exposure to A:						
Market	0.98	1.01	1.19	0.95	0.92	−0.05
	(0.04)	(0.06)	(0.09)	(0.05)	(0.06)	(0.07)
Consumption	0.25	0.20	0.13	0.32	0.32	0.07
	(0.27)	(0.33)	(0.38)	(0.26)	(0.27)	(0.17)
Risk exposure to X:						
PC1	0.14	−0.06	−0.01	−0.12	−0.09	−0.22
	(0.07)	(0.06)	(0.08)	(0.07)	(0.09)	(0.12)

I report statistics of monthly excess returns over the 30-day Treasury-bill rate for 5 portfolios of industries sorted on past standard deviation of entry rates by industries (5 years rolling window). I report mean excess returns over the risk free rate and their annual Sharpe ratio (μ/σ). I also report risk exposures (univariate betas) with respect to the aggregate productivity shock ε_t^A in the model (market portfolio and consumption growth) and to the shock to aggregate entry (innovation to the first principal component of entry). The sample includes monthly data from 1997-2012. I report standard errors in parentheses using Newey-West estimates.

Figure 5

Portfolios average returns and covariance with the entry factor

I represent monthly excess returns for industry portfolios on the y-axis and their covariance with the "entry factor" on the x-axis. The first panel figures 5 portfolios from table 3, sorted on past average industry entry rates (1-low entry rates to 5-high entry rates). On the second panel I represent portfolios from table 3 sorted on concentration terciles and past average entry rates. 11,12 and 13 are portfolios of industries with low concentration, from low entry rates 11 to high entry rates 13. 31,32 and 33 are industries with high concentration, from low entry rates 31 to high entry rates 33. The last panel figure portfolios from table 5 sorted by industry concentration and sensitivity of entry rates to aggregate entry. 11,12 and 13 are portfolios of industries with low concentration, from low sensitivity 11 to high sensitivity 13. 31,32 and 33 are industries with high concentration, from low sensitivity 31 to high sensitivity 33.



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