

# Financial Constraints and Moral Hazard: The Case of Franchising\*

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## Abstract

We study how the financial constraints of agents affect the behavior of principals in a moral hazard framework. Specifically, we examine how the amount of collateral an agent can put up influences her incentives to work, and thus her attractiveness to the principal. We study this moral hazard problem theoretically and empirically in the context of franchising. We find that a 30 percent decrease in the collateralizable housing wealth of potential franchisees – a measure of their financial resources – leads to an 11 percent reduction in jobs in franchised chains because franchisors enter into franchising later and grow their chains more slowly.

**Keywords:** Contracting, moral hazard, incentives, principal-agent, empirical, collateralizable housing wealth, entry, growth

**JEL:** L14, L22, D22, D82, L8

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# 1 Introduction

The recent Great Recession has led to a significant decline in households' wealth. The resulting decline in households' collateralizable wealth has been suggested as a major factor adversely affecting the viability and growth of small businesses.<sup>1</sup> Franchised businesses are an important subgroup of small businesses. According to the 2007 Economic Census, which surveyed 4.3 million establishments to collect data on the extent of franchising, franchised businesses account for 453,326 establishments and nearly \$1.3 trillion in sales. They employed 7.9 million workers, or about 5% of the total workforce in the U.S.<sup>2</sup> In a franchised establishment, the franchisee, who is typically an individual or a household, earns the profits of the establishment after paying the franchisor – mainly in the form of royalty – for the right to sell the franchisor's product and/or the right to use its trademarks. Thus, in the literature, the relationship between franchisor and franchisee has usually been cast in a principal-agent framework where the franchisor is the principal and the franchisee is the agent.

From a broader theoretical point of view, residual claims need not be the sole source of incentives, however. In particular, how much collateral an agent is able to put up also may affect her incentives to work hard because the cost of default for the agent is increasing in the amount of collateral. In other words, the possibility that she may lose the investment that she has made in the business gives the agent strong incentives to work hard. This makes the amount of collateral available to an agent an important factor affecting the principal's incentives to engage in the relationship.

Franchising is an ideal context to study the issue of agents' financial constraints and moral hazard.<sup>3</sup> First, as mentioned above, the franchising industry is economically important. Second, moral hazard is a key feature of franchise relationships. Third, the issue of franchisee access to financing to invest in their franchise has always been a major concern for participants in the industry.<sup>4</sup> In particular, most franchisors, including established franchisors with access to capital markets, require that their franchisees put forth significant portions of the capital needed to open their franchise. They argue that this is necessary for incentive purposes, so that franchisees have "skin in the game." But given this need for franchisees to bring capital to the business for incentive purposes, the financial constraints that franchisees face can affect the value of franchising to the chain. In other words, industry participants suggest that franchisees' financial constraints can affect the development and growth of franchised chains. Yet despite the central role of the financial

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<sup>1</sup>For example, in their report for the Cleveland Fed, Schweitzer and Shane (2010) write "(we) find that homes do constitute an important source of capital for small business owners and that the impact of the recent decline in housing prices is significant enough to be a real constraint on small business finances."

<sup>2</sup>See also Jarmin, Klimek and Miranda (2009) for evidence on the increasing role of chains in the retail and service sectors.

<sup>3</sup>Franchising is, however, not the only context to study this issue. The involvement of investments by the agent is typical in all relationships characterized by revenue sharing, including franchising but also sharecropping, licensing, and many others.

<sup>4</sup>See for example Reuteman (2009) and Needleman (2011).

constraints of potential franchisees in the development of franchised chains – and possibly other principal-agent relationships – this issue has not been studied in the theoretical or empirical contract literature.<sup>5</sup>

In this paper, we set up a principal-agent model where franchisee effort and the profitability of franchised outlets depend on how much collateral a franchisee is able to put up. In the model, the franchisee signs two contracts to start her franchised outlet, namely a debt contract with a bank, so she can finance the required capital, and a franchise contract with her franchisor.<sup>6</sup> After committing to these, the franchisee decides on her effort level. Revenue is then realized, at which point she decides whether or not to default on her debt contract. A higher level of collateral means higher costs of defaulting, and hence a greater incentive to choose high effort. Given agent heterogeneity in terms of collateralizable wealth, the chain chooses the optimal franchise contract. In line with practice in the industry, we assume that the chain chooses a single franchise contract against the distribution of potential franchisee types. Simulation results suggest that, in equilibrium, the expected profit generated by a franchised outlet for the chain is increasing in the average collateral of potential franchisees as well as other factors such as the number of potential franchisees and the importance of franchisee effort in the business.

In our empirical analyses, we estimate the determinants of the timing of chains' entry into franchising – an aspect of the franchisors' decision process that has never been looked at – along with their growth decisions pre and post entry into franchising. The estimation is based on data from 945 chains that started in business, and subsequently started franchising, some time between 1984 and 2006. We combine our chain-level data with other information about local macroeconomic conditions. In particular, we use collateralizable housing wealth, measured at the state level, to capture the average financial resources of potential franchisees in each state. As mentioned above, changes in financial resources for small and young businesses have been linked specifically to variation in housing values.<sup>7</sup>

The estimation results we obtain are intuitive and consistent with the implications of our simple incentive model. In particular, we find that collateralizable housing wealth has a positive effect on the value of opening a franchised outlet relative to opening a company-owned outlet. This accords with the intuition that franchisee borrowing against their collateral to start their business increases

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<sup>5</sup>One notable exception is Laffont and Matoussi (1995), who consider the role of agents' financial constraints in agriculture. In their model, when a tenant is financially constrained, it is impossible for her to sign a contract that offers a high share of output because such contracts also require a high upfront rental fee. In our context, franchisee wealth is used as a collateral, and the extent of collateral serves as an additional source of incentives beyond residual claims.

<sup>6</sup>Franchisors do not typically provide capital to their franchisees directly. In its disclosure document from 2001, for example, AFC Enterprises, the then franchisor for Church's Chicken, writes "We do not offer direct or indirect financing. We do not guarantee your notes, leases, or other obligations." See for example <http://guides.wsj.com/small-business/franchising/how-to-finance-a-franchise-purchase/> for more on this.

<sup>7</sup>See also Fort, Haltiwanger, Jarmin and Miranda (2013) and Adelino, Schoar and Severino (2013) for evidence that housing price variations affect the growth of young firms and the propensity to engage in self employment.

their incentives to work hard, and hence the profitability of franchising to franchisors. Conversely, and consistent with the same intuition, we find that both the amount of capital required to open an outlet and the interest rate have a negative effect on the extent of franchising. Finally, we find that the benefit of franchising is greatest for chains involved in the provision of at-home services and auto and repair shops, both types of businesses for which it is vital for local managers (or franchisees) to put effort into the supervision of workers and oversight of operations.

To understand the magnitude of the effect of franchisees' financial constraints on franchisors' decisions, we simulate the effect of a 30 percent decrease in the collateralizable housing wealth of potential franchisees, a change consistent with the recent decline in housing values. We find that chains enter into franchising somewhat later, and open fewer franchised and, more importantly from a job creation perspective, fewer total outlets. Specifically, we find that the number of total outlets of chains five years after they start in business decreases by 2.73 on average. The average decrease in the number of total outlets ten years after a chain start in business is 4.84. Combined with Census Bureau information about the importance of franchising in the U.S. economy, our results suggest that such a 30 percent decrease in collateralizable housing wealth for franchisees could affect as many as 720,000 to 740,000 jobs.

This paper contributes to the empirical literature on contracting and contract theory. To this day, there remains little empirical work on contracting relative to the large amount of theoretical research in this area. Moreover, much of the empirical literature focuses on the role of residual claims and regresses contract types, or the relative use of one contract type versus the other, on principal and agent characteristics (for example, Brickley and Dark (1987), Lafontaine (1992), Laffont and Matoussi (1995), Akerberg and Botticini (2002), Dubois (2002) and Lafontaine and Shaw (2005)).<sup>8</sup> In the present paper, we study instead the effect of agents' financial constraints on the growth and the timing of entry into franchising. We view the incentive effect of collateralizable wealth as particularly complementary to that of the residual claims or incentive compensation that are the typical focus of the agency literature. This is because collateralizable wealth gives incentives to franchisees in the early years of operation for their business, a period during which profits, and hence residual claims, are often negative but the amount of wealth put up in the business is at its maximum.

This paper is also related to an emerging literature in macroeconomics on deleveraging, which considers how a decline in home equity can lead to a recession (e.g. Philippon and Midrigan (2011))

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<sup>8</sup>See Chiappori and Salanié (2003) for a survey of studies in agrarian markets and Lafontaine and Slade (2007) for a survey of studies in franchising. A separate set of papers examines executive or salesforce compensation. Most of these focus on the terms of the contract, however, rather than the choice of contract type. Work on inter-firm contracting, on the other hand, typically has been policy driven, focusing on the effects of various contract terms, i.e. specific vertical restraints. Recent contributions in this area include Asker (2005) and Brenkers and Verboven (2006) on exclusive dealing, Crawford and Yurukoglu (2012) on bundling, and Ho, Ho and Mortimer (2012) on full-line forcing. Others have examined the use and effect of non-linear wholesale prices (Villas-Boas (2007), Bonnet and Dubois (2010)) or revenue sharing in distribution contracts (Mortimer (2008), Gil and Lafontaine (2012)). See Lafontaine and Slade (2012) for a review of the empirical literature on inter-firm contracts.

and Mian and Sufi (2012)). In these papers, the decline in housing values leads to a decline in aggregate demand and eventually a recession.<sup>9</sup> Consistent with recent evidence in Adelino, Schoar and Severino (2013) and Fort, Haltiwanger, Jarmin and Miranda (2013), we highlight a different channel through which decreased collateralizable housing values can affect economic growth and jobs. In our paper, a decrease in collateralizable housing wealth makes a potential franchisee unattractive to a chain by decreasing the power of incentives. As a result, for those chains that would otherwise have found franchising attractive, now fewer stores are opened and fewer jobs are created. We highlight this channel in our simulations by varying the collateralizable housing wealth in the relative profitability of a franchised outlet while holding demand shifters, such as our measure of income, fixed. Per the deleveraging literature, the collateralizable housing wealth is expected to also affect demand. We can separately identify its effect on the overall growth (through the demand channel) and on the relative growth of franchised outlets (through the collateral and incentive channel) because we observe two growth paths, the growth path in the number of company-owned and the growth path in the number of franchised outlets. In other words, we observe the relative growth of the number of franchised outlets as well as the overall growth in the chain. The former variation helps us to identify the effect of collateralizable housing wealth via the incentive channel that we emphasize, while the latter variation allows us to control for the potential effect of collateralizable housing wealth via the demand channel.

The rest of the paper is organized as follows. We describe the data in Section 2. In Section 3, we develop the empirical model starting with a theoretical principal-agent framework. The estimation results are described in Section 4. Section 5 quantifies how much tighter financial constraints of potential franchisees influence the franchising decision of chains. We conclude in Section 6.

## 2 Data

### 2.1 Data Sources and Variable Definitions

In this section, we describe our main data sources and how we measure the variables of interest. Further details on these can be found in Appendix A.

Our data on franchised chains, or franchisors, are from various issues of the Entrepreneur magazine’s “Annual Franchise 500” surveys and the yearly “Source Book of Franchise Opportunities,” now called “Bond’s Franchise Guide.” Our data are about business-format franchised chains. Business-format franchisors are those that provide “turn-key” operations to franchisees in exchange for the payment of royalties on revenues and a fixed upfront franchise fee. They account for all of the growth in number of franchised outlets since at least the 1970’s (see Blair and Lafontaine (2005),

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<sup>9</sup>Another channel through which a decline in housing value can lead to a recession is that firms’ collateral value drops when the real estate price decreases. As a result, firms may invest less. See Gan (2007) and Chaney, Sraer and Thesmar (2012) for evidence regarding how firms’ collateral value affects their investment decisions.

Figure 2-1), and are an important factor in the growth of chains in the U.S. economy. According to the Census bureau, business-format franchisors operated more than 387,000 establishments in 2007, and employed a total of 6.4 million employees. Traditional franchising, which comprises car dealerships and gasoline stations, accounted for the remaining 66,000 establishments and 1.5 million employees.

For each franchisor in our data, we observe when the chain first started in business and when it started franchising. We refer to the difference between the two as the waiting time. For example, if a chain starts franchising in the same year that it goes into business, the waiting time variable is simply zero. In addition, we observe the U.S. state where each chain is headquartered, its business activity, the amount of capital required to open an outlet (Capital Required) and the number of employees that the typical outlet needs (Number of Employees). We view the Capital Required and Number of Employees needed to run the business as intrinsically determined by the nature of the business concept, which itself is intrinsically connected to the brand name. As such, we treat these characteristics as fixed over time for a given franchisor. Yet we find some variation in the data. We use the average across all the observations we have for these two variables for each franchised chain under the presumption that most of the differences in the data reflect noise. Finally, for each year when a franchised chain is present in the data, we observe the number of company-owned outlets and the number of franchised outlets. These two variables describe a chain's growth pattern over time.

We expect differences in the type of business activity to affect the value of franchising for the chains. We therefore divide the chains among six "sectors" according to their business activity: 1- the set of chains that sell to other businesses rather than end consumers (Business Products and Services), 2- restaurants and fast-food (Restaurants), 3- home maintenance and related services, where the service provider visits the consumer at home (Home Services), 4- services consumed at the place of business of the service provider, such as health and fitness, or beauty salons (Go To Services), 5- the set of chains that sell car-related products and repair services (Auto; Repair), and 6- retail stores (Retailer).<sup>10</sup>

Our main explanatory variable of interest, however, is a measure of franchisee collateralizable wealth. We construct this variable by combining information from several sources. First, we obtained yearly housing values per state from the Federal Housing Finance Agency and the Census Bureau. Second, we obtained yearly data about home ownership rates across states from the Census Bureau. Finally, we obtained a region/year-level measure of average proportion of mortgage outstanding for homeowners using data from the joint Census-Housing and Urban Development (HUD) biennial reports, which summarize information on mortgages on a regional basis (Northeast,

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<sup>10</sup>We exclude hotel chains from our data because we have too few of them in our sample, and the type of services they offer cannot easily be grouped with the categories we use. Moreover, in this industry, firms use a third contractual form, namely management contracts, in addition to franchising and company ownership. Finally, there is much more brand switching in this sector than in any other franchising sector.

Midwest, South and West). Since the reports are biennial, we ascribe the value to the year of, and to the year before, the report. As the first report was published in 1985, this implies that the data we need to generate our main explanatory variable of interest begin in 1984. All states within a region receive the same value for these variables in the same year. We then combine this information with the state-level time series of housing value and home ownership rate to calculate our measure of Collateralizable Housing Wealth:  $(1 - \text{the average proportion of mortgage still owed}) \times (\text{the home ownership rate}) \times (\text{housing value for each state/year})$ . See Appendix A for further details.

## 2.2 Linking Chain-Level and State-Level Data

Because we are interested in how the chains grow as well as how long they wait, after starting in business, until they begin franchising, we need to observe the macroeconomic conditions that each chain faces from the time it starts its business. Since the data for collateralizable wealth is only available from 1984 onward, we must restrict our analyses to franchisors that started in business from that year on. Our data sources provide information on 1344 such U.S.-based franchisors.<sup>11</sup>

After eliminating franchised chains for which we have some missing data, as well as hotel chains (for reasons given in footnote 10), and deleting observations for 72 outlier franchisors who either grow very fast (the number of outlets increases by more than 100 in a year) or shrink very fast,<sup>12</sup> our final sample consists of 3872 observations covering 945 distinct franchised chains headquartered in 48 states, all of which started in business – and hence also franchising – in 1984 or later. Therefore, the franchised chains in our data are mostly young regional chains: on average, they started in business in 1990 and started franchising a few years later, in 1993.

We combine the data on chains with our state/year collateralizable wealth and other yearly state-level macroeconomic data, namely per capita Gross State Product (GSP), which we interpret as a measure of average yearly income, and yearly state population. Our goal, with these macroeconomic variables, is to capture the environment within which the chain is likely to want to expand and seek franchisees. Franchised or not, chains typically expand first in their state of headquarters and then move on to establish outlets in other, mostly nearby or related states (e.g. see Holmes (2011) for the case of Wal-Mart). We can see this tendency also in our data because in post-1991 survey years, franchisors report the states where they operate the most outlets. For example, one of the largest chains in our data is Two Men and a Truck, a Michigan-based chain founded in 1984 that started franchising in 1989, and had 162 franchised and 8 company-owned outlets in 2006. Two Men and a Truck had more outlets in Michigan than anywhere else until 2005, more than 20 years after its founding. Its second largest number of outlets was in Ohio until the late 1990's. By

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<sup>11</sup>This constraint means that well-known and established brands such as McDonald's and Burger King and many others, established in the 1950s and 1960s, are excluded from our analyses.

<sup>12</sup>A franchisor is considered shrinking very fast if more than half of the existing outlets exit in a year. To avoid removing small chains, however, for which a decrease in outlets from say 2 to 1 or 4 to 2 might well occur, we also require that the probability of such amount of exits be less than 1e-10 even when the exit rate is as high as 50%.

the early 2000's, Florida had become the state where it had its second largest number of outlets, but it took until 2006, 22 years after founding, for its number of outlets in that state to become larger than its number of outlets in Michigan.

Given that we are trying to capture expansion patterns for relatively young franchised chains, we use the information for the 1049 franchisors in our data that we observe at least once within 15 years after they start franchising – i.e. we include some chains that are excluded from our main analyses for lack of data on other variables – to construct a square matrix, the element  $(i, j)$  of which is the percentage of franchisors that are headquartered in state  $i$  and report state  $j$  as the state where they have the most outlets. We use only one year of data per franchisor, namely the latest year within this 15 year period, to construct the matrix. The resulting matrix, in Appendix A.4, confirms that most young chains operate most of their outlets in the state where they are headquartered. This can be seen by the fact that the diagonal elements of the matrix are fairly large, typically larger than any off-diagonal element. However, holding the state of origin constant and looking along a row in this matrix, it is also clear that franchisors headquartered in certain, typically smaller states, view some other, usually nearby states, as good candidates to expand into even early on in their development. For example, 25% of the franchisors from Nevada have more outlets in California than in any other state. Only 13% of them report having more outlets in Nevada than anywhere else. Similarly, many franchisors headquartered in Utah (48% of them) have expanded into California to a greater extent than they have in their own state. Only 36% of them have most of their establishments in Utah proper.

We interpret this matrix as an indication of where the franchisors from each state are most likely to want to expand during the period that we observe them. We therefore use the elements of this matrix, along a row – i.e. given a state of headquarters – to weigh our state/year-level macroeconomic variables and match them to our chain/year variables. In our robustness analyses, we consider an alternative matrix where we account for the proportion of each chain's outlets in the top three states in the construction of the weights. Appendix A provides further details.

### 2.3 Summary Statistics and Basic Data Patterns

Summary statistics for all our variables, including our weighted macroeconomic and collateralizable wealth measures, are presented in Table 1. We also present here summary statistics for our one national-level macroeconomic variable, the national interest rate, which we measure using the effective federal funds rate, obtained from the Federal Reserve.

Table 1 confirms that most of the chains in our data waited only a few years after starting in business to become involved in franchising, with an average of only 3 years between the two. The majority of the chains in our data also are small, and they rely on franchising a lot: the mean number of franchised outlets is 36, while the mean number of company owned outlets is only 3.45.



After they start franchising, the chains tend to open mostly franchised outlets. Despite this, they do not grow very fast. For example, the median growth in franchised outlets three years after a chain starts franchising is 10, while the median change in number of company-owned outlets during these three years is zero. Similarly, the median growth in franchised and company-owned outlets in the five years after a chain starts franchising are 19 and 0, respectively.

In terms of our chain-level explanatory variables, Table 1 shows that the typical establishment in these chains employs four or five employees. Chains also are not very capital intensive, with an average amount of capital required to open an outlet at \$92,000. The variation around this mean, however, is quite large. Franchisors in our data are also distributed fairly evenly across our main sectors, with the exception of Auto; Repair which is the least populated of our sectors.

Finally, the descriptive statistics for our state/year level weighted macroeconomic variables show that individuals held about 36K in collateralizable housing wealth in 1982-84 constant dollars over the 1984 - 2006 period, while per capita real income averaged 19K over the same period. (See Table 4 in the Data Appendix and related discussion for more on the descriptive statistics for these variables using different weights.)

Table 1: Summary Statistics

	Mean	Median	S. D.	Min	Max	Obs
Waiting Time (Years)	3.15	2	3.16	0	18	945 <sup>a</sup>
Company-owned Outlets	3.45	1	7.41	0	106	3872 <sup>b</sup>
Franchised Outlets	36.34	18	44.74	0	285	3872
Required Employees	5.58	3.50	7.67	0.50	112.5	945
Required Capital (Constant 82-84 \$100K)	0.92	0.54	1.44	0	19.72	945
Business Products & Services	0.12	0	0.33	0	1	945
Home Services	0.14	0	0.35	0	1	945
Go To Services	0.21	0	0.41	0	1	945
Auto; Repair	0.07	0	0.26	0	1	945
Restaurants	0.21	0	0.41	0	1	945
Retail	0.25	0	0.43	0	1	945
Coll. Housing Wealth (82-84 \$10K)	3.62	3.34	1.31	1.83	14.17	1104 <sup>c</sup>
Population (Million)	8.84	8.23	5.52	0.52	31.68	1104
Per-Capita Gross State Product (82-84 \$10K)	1.89	1.79	0.63	1.22	7.47	1104
Population (Million)	8.84	8.23	5.52	0.52	31.68	1104
Interest Rate (%)	5.33	5.35	2.41	1.13	10.23	23 <sup>d</sup>

<sup>a</sup>At the chain level

<sup>b</sup>At the chain/year level

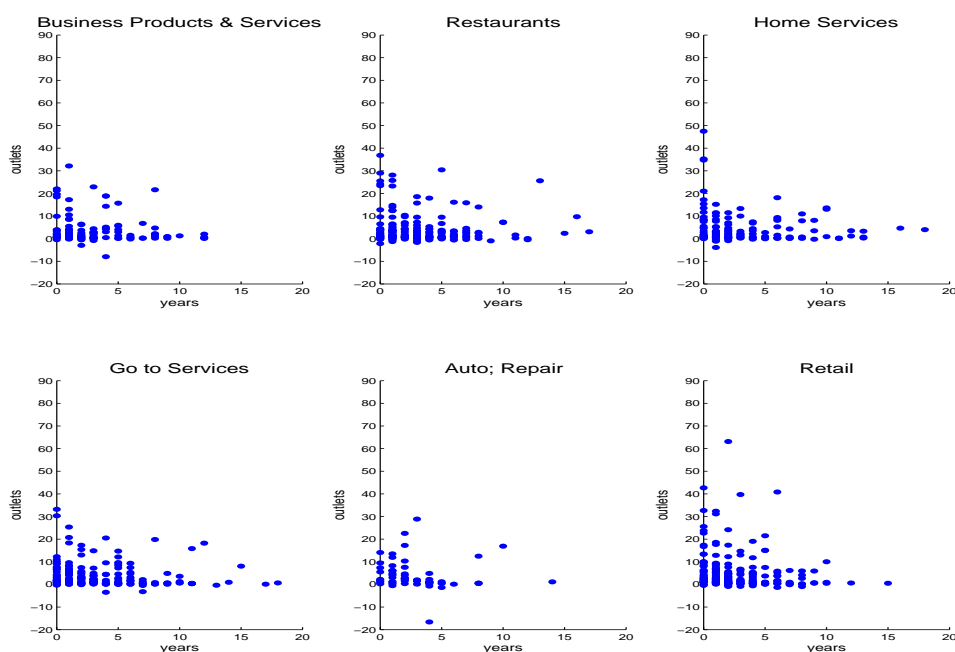
<sup>c</sup>At the state/year level, for 48 states between 1984 and 2006.

<sup>d</sup>At the year level

Figure 1 gives more detail about the overall growth in the number of outlets across the chain/years in our data. Specifically, for each chain, we compute the yearly change in the total number of outlets (including both company-owned outlets and franchised outlets), and then take the average over the

years we observe each chain.<sup>13</sup> We show this average yearly growth in number of outlets against the chain’s waiting time (i.e. the number of years between when it starts in business and when it begins franchising). Figure 1 shows that chains that enter into franchising faster also grow faster on average. This is true across all sectors.

Figure 1: Timing of Entry and Growth by Sector (Waiting Time before Franchising and Average Yearly Change in Total Number of Outlets)

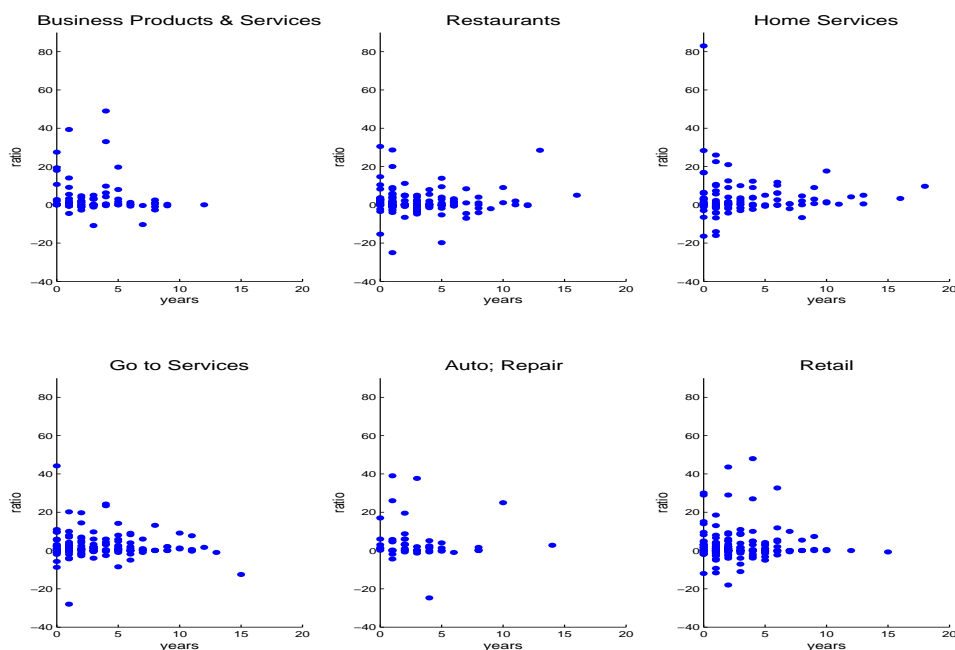


Similarly, we show the relative growth in the number of franchised outlets in Figure 2. In this figure, for each chain, we compute the yearly change in the number of franchised outlets and the yearly change in the number of company-owned outlets separately, and then we average the yearly ratios of these two over time.<sup>14</sup> Figure 2 shows that chains that start franchising faster not only grow faster overall (per Figure 1) but also grow relatively faster through franchised outlets. This is quite intuitive. Chains make decisions about entry into franchising based on their expectations of growth after entry. In the context of franchising, a chain with a business model that is particularly suitable for franchising probably starts franchising earlier. In other words, the decisions on the timing of entry into franchising and expansion paths – in terms of both company-owned and franchised outlets – are intrinsically linked. Our model below takes this fact into account explicitly.

<sup>13</sup>When the data on the number of outlets is missing for all chains, as in, for example, 1999, we compute the change in number of outlets from 1998 to 2000 and divide the result by 2 to compute the yearly change.

<sup>14</sup>When there is no change in the number of company-owned outlets between two years, we replace the ratio by the change in number of franchised outlets, thereby treating the number of company outlets as if it has increased by 1, to avoid division by 0.

Figure 2: Timing of Entry and Relative Growth by Sector (Waiting Time before Franchising and Average Ratio of Change in Number of Franchised to Change in Number of Company-owned Outlets)



### 3 The Model

In this section, we develop our empirical model of franchisors’ franchising decision. We begin with a theoretical principal-agent model with a typical chain who faces a set of heterogeneous potential franchisees. Specifically, franchisees differ in the amount of collateral they can put forth. The model emphasizes how these differences in collateralizable wealth affect the chain’s decisions to grow via franchised and/or company-owned outlets, and, in turn, its decision as to when to start franchising. We then use this simple theoretical model to provide intuition and guide the empirical specification. In the next section, we take the empirical model to data and estimate the determinants of chains’ entry (into franchising) and growth decisions.

#### 3.1 A Principal-Agent Model of Franchising

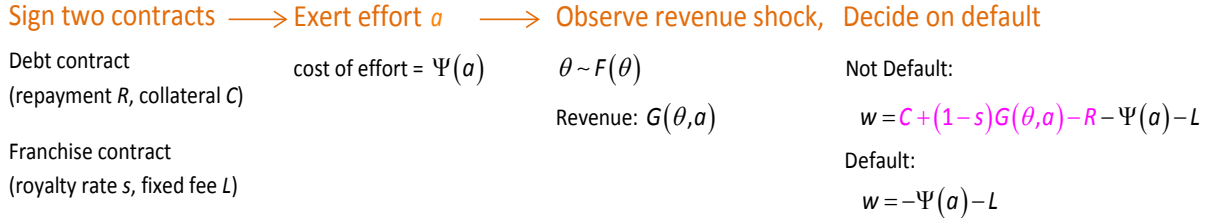
Suppose that revenue for a specific chain outlet can be written as a function  $G(\theta, a)$ . The variable  $\theta$  captures the quality of the idea of the chain, the local conditions for that specific outlet and a profit shock. It is random and drawn from some distribution  $F(\theta)$ . Let  $a$  be the effort level of the manager/franchisee of the outlet. The revenue function is increasing in both  $\theta$  and  $a$ . The cost of effort is given by a cost function  $\Psi(a)$ , which is increasing and strictly convex with  $\lim_{a \rightarrow \infty} \Psi'(a) = \infty$  and  $\Psi(a) > 0$  for any  $a > 0$ .

Suppose that opening an outlet in this chain requires capital of  $I$ . We assume that a franchisee's liquidity is smaller than  $I$  so that she needs to borrow from a bank in the form of a debt contract which specifies the required repayment  $R$  as a function of the collateral  $C$  and the investment  $I$ . The repayment  $R(C, I)$  is decreasing in  $C$  but increasing in  $I$ .<sup>15</sup>

We first describe the franchisee's effort choice and her decision to default or not on the obligation to repay the bank given a collateral amount  $C$ . We then discuss the chain's decision-making process facing a set of potential franchisees with heterogeneous collateralizable wealth.

The franchisee's problem is illustrated in Figure 3. After signing both the franchise contract with the franchisor, and the debt contract with the bank, the franchisee chooses her effort level  $a$ . The revenue shock  $\theta$  is then realized. If the business turns out to be profitable, the franchisee will choose not to default on her obligation, i.e. she will pay the repayment  $R$ . Doing so is worthwhile because it allows her to keep her collateral  $C$  and her assets  $(1 - s)G(\theta, a)$ , where  $s$  is the royalty rate, namely the share of revenues that the franchisee pays to the franchisor.<sup>16</sup> The franchisee's payoff is thus  $C + (1 - s)G(\theta, a) - R(C, I) - \Psi(a) - L$  when she does not default, where  $L$  is a lump-sum one-time fixed fee (i.e. a franchise fee).

Figure 3: Franchisee's Problem



If the franchisee chooses to default, the bank seizes the collateral  $C$ .<sup>17</sup> The franchisee's payoff then is  $-\Psi(a) - L$ .<sup>18</sup> The franchisee defaults if and only if  $C + (1 - s)G(\theta, a) - R(C, I) < 0$ . Let  $\theta^*$  be the critical state of the world below which default occurs, i.e.,

$$R(C, I) - C = (1 - s)G(\theta^*, a). \quad (1)$$

Since, for given  $I$  in the debt contract, the repayment is decreasing in  $C$ , and revenue is increasing in both the revenue shock  $\theta$  and franchisee effort  $a$ , then  $\frac{\partial \theta^*}{\partial C} < 0$ . In other words, as the collateral increases, the repayment is smaller and it is less likely that the franchisee will default.<sup>19</sup>

<sup>15</sup>This is a simplified version of a debt contract that allows us to incorporate the main factors that we care about in a simple way.

<sup>16</sup>Royalty payments are almost always a proportion of revenues in business-format franchising.

<sup>17</sup>We assume that the liquidation value is zero. All we really need is that it is smaller than  $(1 - s)G(\theta, a)$ .

<sup>18</sup>Besides the collateral  $C$ , there might be other costs of defaulting such as the adverse effect of defaulting on the franchisee's credit record. We ignore such costs for simplicity. Adding a constant to represent these costs would not affect our results qualitatively.

<sup>19</sup>See Einav, Jenkins and Levin (2012) for evidence that credit contract design also matters in the consumer credit

Suppose the franchisee is risk averse and her utility function is  $-e^{-\rho w}$ , where  $\rho > 0$  is her constant absolute risk aversion parameter and  $w$  is her payoff. Then, the expected utility of the franchisee can be written as:

$$U = \int_{-\infty}^{\theta^*} -e^{-\rho[\Psi(a)-L]} dF(\theta) + \int_{\theta^*}^{\infty} -e^{-\rho[C+(1-s)G(\theta,a)-R(C,I)-\Psi(a)-L]} dF(\theta). \quad (2)$$

For any given  $I$ ,  $C$  and  $s$ , the franchisee maximizes her expected utility (2) by choosing her effort level  $a$ . In Supplemental Appendix C, we show that when the risk aversion coefficient  $\rho$  is small,  $\frac{\partial^2 U}{\partial a \partial C} > 0$  at  $a^*$ , the interior solution of this utility maximization problem. Therefore,  $\frac{\partial a^*}{\partial C} > 0$  by the implicit theorem and the second-order condition  $\frac{\partial^2 U}{\partial a^2} < 0$ . Intuitively, for fixed  $I$ , as collateral increases, and thus repayment decreases, the marginal benefit from not defaulting increases. In other words, the marginal utility from increasing effort so as to avoid defaulting increases with  $C$ . Therefore, the more collateralizable wealth a franchisee has, the higher her effort level.<sup>20</sup> In the end, the franchisee's expected utility depends on  $C$ ,  $s$ , and the fixed fee  $L$ . We denote her expected utility by  $\tilde{U}(s, L, C)$ . As for the franchisor, her expected profit from this specific franchisee is  $\tilde{\pi}_f(s, L, C) = \int_{-\infty}^{\infty} sG(\theta, a^*) dF(\theta) + L$ .

We now describe the franchisor's problem.<sup>21</sup> Suppose that for each specific opportunity that a franchisor has for opening an outlet, there are  $N$  potential franchisees each of whom has a collateralizable wealth  $C_i$  drawn from a distribution  $F_C$ . Let  $F_N$  be the distribution of  $N$ . For given  $(F_N, F_C)$ , the chain chooses the franchise contract  $(s, L)$ , i.e. it chooses the royalty rate  $s$  and the fixed fee  $L$ . If the fixed fee that the chain charges is high enough, some potential franchisees may find that their participation constraint ( $\tilde{U}(s, L, C_i) > -e^{-\rho w}|_{w=C_i} = -e^{-\rho C_i}$ ) is not satisfied. From the remaining set of potential franchisees, the chain picks the one that generates the most expected profit. It then compares this expected profit from establishing a franchised outlet to the

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market for subprime loans. In particular, the likelihood of repayment is substantially lower for larger loans.

<sup>20</sup>Our model emphasizes the moral hazard problem in that we focus on how the amount of collateral that the franchisee provides affects her incentives to put forth effort. Asymmetric information – or hidden information – issues could also play a role in the franchisor's decision to require franchisees to rely on their collateral. For example, some franchisees may have a lower cost of exerting effort, and franchisors would want to select such franchisees. Since only franchisees who have low costs of exerting effort would agree to put a lot down as collateral, the collateral requirement can help resolve this asymmetric information problem as well. Note that in such a scenario, the selected franchisees also work hard, which is consistent with the intuition we highlight in our model. It is unclear, therefore, what kind of intrinsic quality of a manager would matter without interacting with the effort they provide. Moreover, franchisors use several mechanisms to evaluate and screen potential franchisees over a period of several months typically, including face-to-face meetings, often extensive periods of training, and so on. Finally, we focus on effort and moral hazard because franchisors indicate that franchisee effort is a major reason why they use franchising. Some franchisors include an explicit clause in their franchise contracts imposing a requirement for best and full-time effort. For example, McDonald's 2003 contract includes the following clause: 13. *Best efforts.* Franchisee shall diligently and fully exploit the rights granted in this Franchise by personally devoting full time and best efforts [...] Franchisee shall keep free from conflicting enterprises or any other activities which would be detrimental or interfere with the business of the Restaurant. [McDonald's corporation Franchise Agreement, p. 6.]

<sup>21</sup>As will be clear below, we do not allow for strategic considerations in the growth and entry decisions of the chains. We do not believe that such considerations play a major role in these decisions given that the markets these firms operate in are quite competitive, especially for the young small franchised chains in our data.

expected profit from a company-owned outlet. We assume that a minimum level of effort  $a_0$  can be induced even for an employed manager. This can be thought of as an observable component of effort or a minimum standard that can be monitored at low cost. The profit of a company-owned outlet is therefore determined by  $a_0$  and  $\theta$ . We denote the expected profit of a company-owned outlet, net of the compensation of the manager, by  $\tilde{\pi}_c$ . Therefore, the franchisor's problem is

$$\tilde{\pi} = \max_{(s,L)} E_N E_{(C_1, \dots, C_N)} \max \left\{ \max_{i=1, \dots, N} \tilde{\pi}_f(s, L, C_i) \mathbf{1} \left( \tilde{U}(s, L, C_i) > -e^{-\rho C_i} \right), \tilde{\pi}_c, 0 \right\}. \quad (3)$$

Since we cannot derive a full analytical solution to a general model such as the one above, with uncertainty of defaulting and heterogeneous franchisees, in the next section, we use a parameterized version of the model to illustrate some properties of the franchisee's behavior and the franchisor's profit function.

### 3.2 An Illustrative Example

We describe the parameterized version of the model fully in Appendix B, and only introduce some necessary notation here.

Let  $\bar{N}$  be the mean of the number of potential franchisees for a given opportunity, and  $\bar{C}$  be the mean of potential franchisees' collateralizable wealth. We assume that the revenue function  $G(\theta, a) = \theta + \beta a$ , where  $\beta$  captures the importance of the outlet manager's effort. For fixed royalty rate  $s = 5\%$ , we can compute the optimal effort level as the importance of the manager's effort ( $\beta$ ) and the collateralizable wealth of a potential franchisee ( $C$ ) vary. Results are shown in Figure 4. The figure illustrates our model prediction above that the franchisee's choice of effort level is increasing in  $C$ . When the collateral  $C$  increases, the franchisee has more incentive to work hard as the marginal benefit from not defaulting is higher. Per the standard result in the literature, Figure 4 also shows that the optimal effort level is increasing in the importance of the manager's effort  $\beta$ . A similar intuition applies: as  $\beta$  increases, the marginal utility of effort increases, which leads to a higher optimal effort level.

The parameterized model also yields a number of intuitive properties for the chain's expected profit function. Figure 5 provides a graphical illustration of these properties. Note that the profit of opening a company-owned outlet in our example is 1, which is based on the normalization that a hired manager's effort  $a_0$  is 0.

Four features of the expected profit for the chain can be seen from Figure 5. First, the chain's expected profit is increasing in the average collateralizable wealth of the potential franchisees,  $\bar{C}$ . This is intuitive as the chain's expected profit is increasing in the franchisee's effort, which is itself increasing in  $C$ . In that sense, our model explains the common practice of franchisors to insist that franchisees put their own wealth at stake. Second, it is increasing in the importance of the franchisee effort  $\beta$  as a larger  $\beta$  also means a higher incentive for the franchisee to exert effort. Third, the

Figure 4: Franchisee's Effort

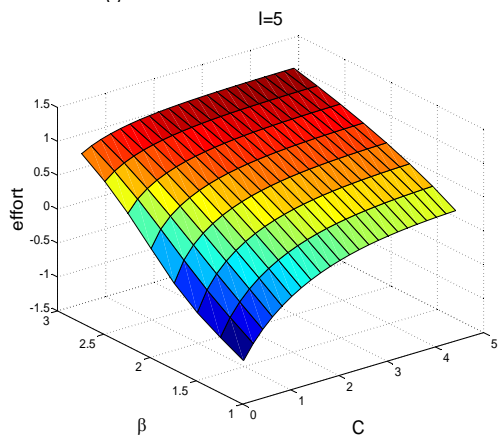
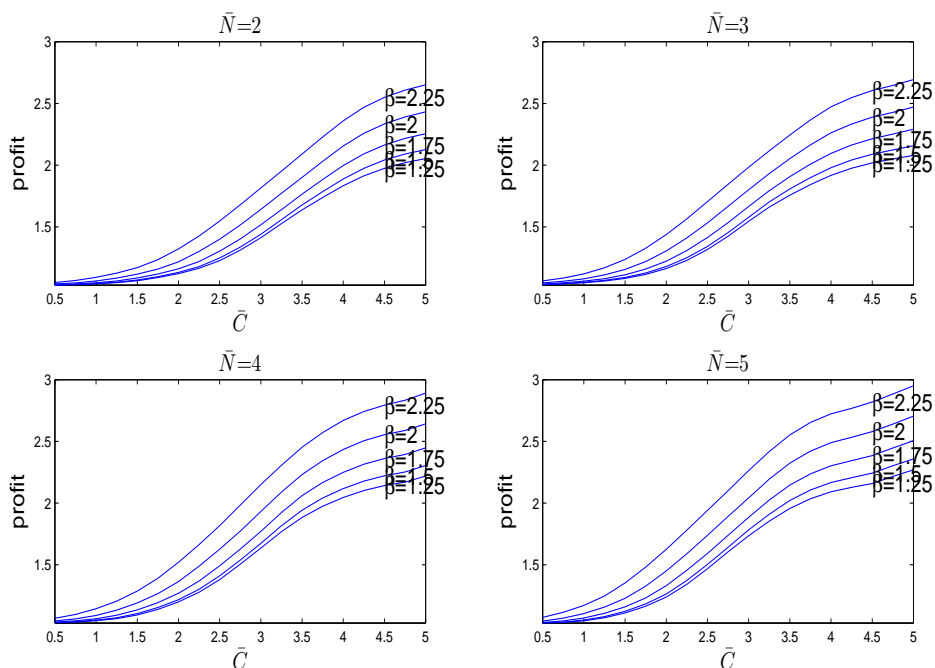


Figure 5: Chain's Expected Profit:  $\tilde{\pi}$  in Equation (3)



slope of the chain's profit with respect to  $C$  is increasing in  $\beta$ , implying that the marginal effect of  $C$  on profit is increasing in  $\beta$ . This is again intuitive because the revenue function is  $\theta + \beta a$ , where the effort level is increasing in  $C$ . Fourth and finally, as we can see by looking across the four panels in Figure 5, the chain's profit is increasing in the average number of potential franchisees  $\bar{N}$ . In other words, for a given distribution of collateralizable wealth, more potential franchisees means that there is a greater chance of finding a franchisee with sufficient collateralizable wealth to make her a good candidate for the chain.

### 3.3 The Empirical Model

Our data describe the timing of when a chain starts franchising and how it grows – and sometimes shrinks – over time through a combination of company-owned and franchised outlets. The model above gives predictions on the relative attractiveness of a franchised outlet to a chain, which then determines the timing of its entry into franchising and its growth decisions. One empirical approach we could adopt given this would be to parameterize the model above as in Appendix B and take its implications to data and estimate the primitives of that model. However, this approach is computationally intensive. For each trial of the model parameters, we would have to solve a principal-agent model with heterogeneous agents and uncertainty about defaulting. This makes it costly to incorporate covariates. More importantly, this approach also requires that we make functional form assumptions on primitives that the data and context provide little information about. We therefore take a different approach and use the findings above as guidance to specify the profit functions directly.

#### Model Primitives

We assume that opportunities to open outlets in these chains arrive exogenously. For example, an opportunity can arise when a store in a mall goes out of business and makes the site available. We assume that the arrival of opportunities follows a Poisson process with rate  $m_i$  for chain  $i$ , where  $m_i = \exp(m + u_{mi})$  and  $u_{mi}$ 's are i.i.d. and follow a truncated normal distribution with mean 0 and variance  $\sigma_m^2$ , truncated such that the upper bound of  $m_i$  is 200 per year.

When an opportunity  $\tau$  arrives in year  $t$  after chain  $i$  has started franchising, the owner can choose to open a company-owned outlet, a franchised outlet or pass on the opportunity. We assume that the value of a company-owned outlet and that of a franchised outlet for the chain given an opportunity  $\tau$  can be written as, respectively

$$\begin{aligned}\pi_{ci\tau} &= \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c + u_{ci} + \varepsilon_{ci\tau}, \\ \pi_{fi\tau} &= \pi_{ci\tau} + \mathbf{x}_{it}^{(f)} \boldsymbol{\beta}_f + u_{fi} + \varepsilon_{fi\tau},\end{aligned}\tag{4}$$

where  $\mathbf{x}_{it}^{(c)}$  is a vector of observable chain  $i$ , or chain  $i$ /year  $t$ , specific variables that affect the profitability of opening a company-owned outlet, i.e., covariates that affect the distribution of  $\theta$  in section 3.1. The vector  $\mathbf{x}_{it}^{(f)}$  consists of the observables that influence the relative profitability of a franchised outlet relative to a company owned outlet. According to the results in section 3.2 this vector includes the financial constraints of chain  $i$ 's potential franchisee pool. It also includes determinants of the importance of manager effort ( $\beta$ ) such as the number of employees, given that employee supervision is a major task for managers in the types of businesses that are franchised, as well as the interaction of the number of employees and the average collateralizable wealth, per the third finding on chain profit described above. Finally, it depends on the population in the relevant



market environment since the population level influences the number of potential franchisees.

In equation (4),  $u_{ci}$  and  $u_{fi}$  represent the unobserved profitability of a company-owned and a franchised outlet respectively for chain  $i$ . The former captures notably the unobserved value of the chain's product. The latter accounts for the fact that some business formats are more amenable to franchising than others. In particular, brand value matters more for some types of businesses than others. As a result, they are more susceptible to franchisee free riding, namely the possibility that franchisees will behave in ways that are beneficial to them but detrimental to the chain, by for example not incurring the costs of keeping the premises clean or the product fresh (see e.g. Brickley and Dark (1987) and Blair and Lafontaine (2005) for more on this). The unobserved relative profitability of franchising will be lower for such chains. The error terms  $\varepsilon_{ci\tau}$  and  $\varepsilon_{fi\tau}$  capture the unobserved factors that affect the profitability of each type of outlet given opportunity  $\tau$ . We assume that  $\varepsilon_{ci\tau} = \epsilon_{ci\tau} - \epsilon_{0i\tau}$  and  $\varepsilon_{fi\tau} = \epsilon_{fi\tau} - \epsilon_{ci\tau}$ , and that  $(\epsilon_{ci\tau}, \epsilon_{fi\tau}, \epsilon_{0i\tau})$  are i.i.d. and drawn from a type-1 extreme value distribution.

### Chains' Growth Decisions

Given the above primitives of the model, and using  $\mathbf{x}_{it} = (\mathbf{x}_{it}^{(c)}, \mathbf{x}_{it}^{(f)})$ , the probability that chain  $i$  opens a company-owned outlet conditional on the arrival of an opportunity in year  $t$  after chain  $i$  has started franchising is

$$p_{ac}(\mathbf{x}_{it}, u_{ci}, u_{fi}) = \frac{\exp(\mathbf{x}_{it}^{(c)}\boldsymbol{\beta}_c + u_{ci})}{\exp(\mathbf{x}_{it}^{(c)}\boldsymbol{\beta}_c + u_{ci}) + \exp(\mathbf{x}_{it}^{(c)}\boldsymbol{\beta}_c + u_{ci} + \mathbf{x}_{it}^{(f)}\boldsymbol{\beta}_f + u_{fi}) + 1}, \quad (5)$$

where the subscript  $a$  stands for ‘‘after’’ (after starting franchising) and the subscript  $c$  stands for ‘‘company-owned.’’ Similarly, the probability of opening a franchised outlet conditional on the arrival of an opportunity is

$$p_{af}(\mathbf{x}_{it}, u_{ci}, u_{fi}) = \frac{\exp(\mathbf{x}_{it}^{(c)}\boldsymbol{\beta}_c + u_{ci} + \mathbf{x}_{it}^{(f)}\boldsymbol{\beta}_f + u_{fi})}{\exp(\mathbf{x}_{it}^{(c)}\boldsymbol{\beta}_c + u_{ci}) + \exp(\mathbf{x}_{it}^{(c)}\boldsymbol{\beta}_c + u_{ci} + \mathbf{x}_{it}^{(f)}\boldsymbol{\beta}_f + u_{fi}) + 1}. \quad (6)$$

If, however, chain  $i$  has not started franchising by year  $t$ , the probability of opening a company-owned outlet conditional on the arrival of an opportunity is

$$p_{bc}(\mathbf{x}_{it}, u_{ci}, u_{fi}) = \frac{\exp(\mathbf{x}_{it}^{(c)}\boldsymbol{\beta}_c + u_{ci})}{\exp(\mathbf{x}_{it}^{(c)}\boldsymbol{\beta}_c + u_{ci}) + 1}, \quad (7)$$

where the subscript  $b$  stands for ‘‘before’’ (before starting franchising).

Given that the opportunity arrival process follows a Poisson distribution with rate  $m_i$  for chain  $i$ , the number of new company-owned outlets opened in year  $t$  before chain  $i$  starts franchising follows

a Poisson distribution with mean  $m_i p_{bc}(\mathbf{x}_{it}, u_{ci}, u_{fi})$ . Similarly, the number of new company-owned outlets opened after chain  $i$  starts franchising follows a Poisson distribution with mean  $m_i p_{ac}(\mathbf{x}_{it}, u_{ci}, u_{fi})$ ; and the number of new franchised outlets has mean  $m_i p_{af}(\mathbf{x}_{it}, u_{ci}, u_{fi})$ .

It is difficult to separately identify the opportunity arrival rate and the overall profitability of opening an outlet. For example, when we observe that a chain opens a small number of outlets per year, it is difficult to ascertain whether this is because the chain had only a few opportunities during the year, or because it decided to take only a small proportion of a large number of opportunities. We therefore normalize  $u_{ci}$  to be 0. We assume that  $u_{fi}$  follows a normal distribution with mean 0 and variance  $\sigma_u^2$ .

### Chains' Decision to Enter into Franchising

When an owner starts a new business, she may or may not be aware that franchising exists, or that it could be a viable option for her kind of business. We capture this in our model by allowing future franchisors to be aware or thinking about franchising in their first year in business with some probability  $q_0 \leq 1$ . For every other year after the first, those that are not yet aware become aware that franchising is a viable option for their business with some probability,  $q_1$ .

Once the potential franchisor becomes aware, at the beginning of each year from that point on, she decides whether to pay the sunk cost to start franchising. The start of franchising is costly because franchisors must develop operating manuals, contracts, disclosure documents and processes to support and control franchisees when they become involved in franchising. The business owner must devote significant amounts of time to these activities, in addition to relying on lawyers and accountants, and they risk affecting the existing business adversely in the process.<sup>22</sup> Note that all of these costs are sunk: none of them are recoverable in the event that the business owner decides to stop franchising or goes out of business. Let  $\omega_{it}$  be the sunk cost that chain  $i$  has to pay to start franchising. The entry-into-franchising decision therefore depends on how the value of entry into franchising minus the setup cost compares with the value of waiting.

The value of entry into franchising is the expected net present value of all future opportunities after entry into franchising. The expected value of an opportunity  $\tau$  after entry into franchising is

$$\begin{aligned} & E_{(\varepsilon_{ci\tau}, \varepsilon_{fi\tau})} \max \{ \pi_{ci\tau}, \pi_{fi\tau}, 0 \} \\ & = \log \left( \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c \right) + \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c + \mathbf{x}_{it}^{(f)} \boldsymbol{\beta}_f + u_{fi} \right) + 1 \right). \end{aligned}$$

Given that the expected number of opportunities is  $m_i$ , the expected value of all opportunities in period  $t$  when the chain can franchise is  $m_i \log \left( \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c \right) + \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c + \mathbf{x}_{it}^{(f)} \boldsymbol{\beta}_f + u_{fi} \right) + 1 \right)$ .

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<sup>22</sup>There are specialized consulting firms that can help with this process. Hiring such firms easily costs a few hundreds of thousands of dollars, however. These are substantial amounts for most of the retail and small-scale service firms in our data. But the cost of the owner spending time investigating and considering how to organize a franchise, may be incurred at the expense of time on the business itself.

We assume that  $\mathbf{x}_{it}$  follows a Markov process. Thus, the value of entry satisfies

$$VE(\mathbf{x}_{it}, \mathbf{u}_i) = m_i \log \left( \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c \right) + \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c + \mathbf{x}_{it}^{(f)} \boldsymbol{\beta}_f + u_{fi} \right) + 1 \right) + \delta E_{\mathbf{x}_{it+1}|\mathbf{x}_{it}} VE(\mathbf{x}_{it+1}, \mathbf{u}_i), \quad (8)$$

where  $\delta$  is the discount factor and  $\mathbf{u}_i = (u_{mi}, u_{fi})$  are the unobservable components in the opportunity arrival rate ( $m_i = \exp(m + u_{mi})$ ) and in the relative profitability of a franchised outlet, respectively.

If chain  $i$  has not entered into franchising at the beginning of year  $t$ , it can only choose to open a company-owned outlet – or do nothing – when an opportunity arises in year  $t$ . The expected value of opportunities in year  $t$  is therefore  $m_i E_{\varepsilon_{citr}} \max \{ \pi_{ict}, 0 \} = m_i \log \left( \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c \right) + 1 \right)$ . As for the continuation value, note that if the chain pays the sunk cost to enter into franchising next year, it gets the value of entry  $VE(\mathbf{x}_{it+1}, \mathbf{u}_i)$ . Otherwise, it gets the value of waiting  $VW(\mathbf{x}_{it+1}, \mathbf{u}_i)$ . So the value of waiting this year is

$$VW(\mathbf{x}_{it}, \mathbf{u}_i) = m_i \log \left( \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c \right) + 1 \right) + \delta E_{\mathbf{x}_{it+1}|\mathbf{x}_{it}} E_{\omega_{it+1}} \max \{ VE(\mathbf{x}_{it+1}, \mathbf{u}_i) - \omega_{it+1}, VW(\mathbf{x}_{it+1}, \mathbf{u}_i) \}. \quad (9)$$

Let  $V(\mathbf{x}_{it}, \mathbf{u}_i)$  be the difference between the value of entry and the value of waiting:  $V(\mathbf{x}_{it}, \mathbf{u}_i) = VE(\mathbf{x}_{it}, \mathbf{u}_i) - VW(\mathbf{x}_{it}, \mathbf{u}_i)$ . Subtracting equation (9) from equation (8) yields

$$V(\mathbf{x}_{it}, \mathbf{u}_i) = m_i \left[ \log \left( \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c \right) + \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c + \mathbf{x}_{it}^{(f)} \boldsymbol{\beta}_f + u_{fi} \right) + 1 \right) - \log \left( \exp \left( \mathbf{x}_{it}^{(c)} \boldsymbol{\beta}_c \right) + 1 \right) \right] + \delta E_{\mathbf{x}_{it+1}|\mathbf{x}_{it}} E_{\omega_{it+1}} \min \{ \omega_{it+1}, V(\mathbf{x}_{it+1}, \mathbf{u}_i) \} \quad (10)$$

Chain  $i$  starts franchising at the beginning of year  $t$  if and only if the difference between the value of entry and the value of waiting is larger than the entry cost, i.e.,  $V(\mathbf{x}_{it}, \mathbf{u}_i) \geq \omega_{it}$ . We assume that the entry cost shock  $\omega_{it}$  follows a log-normal distribution with mean and standard deviation parameters  $\omega$  and  $\sigma_\omega$ . Let  $\Phi(\cdot, \sigma_\omega)$  be the distribution function of a standard normal random variable. Then, the probability of entry conditional on  $i$  thinking about franchising is

$$g(\mathbf{x}_{it}; \mathbf{u}_i) = \Phi \left( \frac{\log V(\mathbf{x}_{it}; \mathbf{u}_i) - \omega}{\sigma_\omega} \right). \quad (11)$$

## Likelihood Function

The parameters of the model are estimated by maximizing the likelihood function of the sample using simulated maximum likelihood. For each chain  $i$  in the data, we observe when it starts in business (denoted by  $B_i$ , and treated as exogenous) and when it starts franchising (denoted by  $F_i$ ). So, one component of the likelihood function is the likelihood of observing  $F_i$  conditional on

chain  $i$ 's unobservable component of the arrival rate and its unobservable profitability of opening a franchised outlet:

$$p(F_i|\mathbf{u}_i). \quad (12)$$

See Supplementary Appendix D for details on computing this component of the likelihood.

We also observe the number of company-owned outlets (denoted by  $n_{cit}$ ) and the number of franchised outlets (denoted by  $n_{fit}$ ) for  $t = F_i, \dots, 2006$ .<sup>23</sup> Therefore, another component of the likelihood function is the likelihood of observing  $(n_{cit}, n_{fit}; t = F_i, \dots, 2006)$  conditional on chain  $i$ 's timing of entry into franchising ( $F_i$ ) and the unobservables ( $\mathbf{u}_i$ ):

$$p(n_{cit}, n_{fit}; t = F_i, \dots, 2006 | F_i; \mathbf{u}_i). \quad (13)$$

For more than 25% of the chains in the data, the number of outlets decreases at least once during the time period we observe this chain. To explain these negative changes in number of outlets, we assume that an outlet, franchised or company-owned, can exit during a year with probability  $\gamma$ . The number of company-owned outlets in year  $t$  is therefore

$$n_{cit} = n_{cit-1} - \text{exits}_{cit-1} + (\text{new outlets})_{cit}, \quad (14)$$

where  $\text{exits}_{cit-1}$  follows a binomial distribution parameterized by  $n_{cit-1}$  and  $\gamma$ . As explained above,  $(\text{new outlets})_{cit}$  follows a Poisson distribution with mean  $m_i p_{ac}(\mathbf{x}_{it}, \mathbf{u}_i)$  or  $m_i p_{bc}(\mathbf{x}_{it}, \mathbf{u}_i)$  depending on whether the chain starts franchising before year  $t$  or not. Similarly,

$$n_{fit} = n_{fit-1} - \text{exits}_{fit-1} + (\text{new outlets})_{fit}, \quad (15)$$

where  $(\text{new outlets})_{fit}$  follows a Poisson distribution with mean  $m_i p_{af}(\mathbf{x}_{it}, \mathbf{u}_i)$ . The recursive equations (14) and (15) are used to derive the probability in (13). See Supplementary Appendix D for further details.

Since our data source is about franchised chains, we only observe a chain if it starts franchising before the last year of our data, which is 2006. Therefore, the likelihood of observing chain  $i$ 's choice as to when it starts franchising ( $F_i$ ) and observing its outlets  $(n_{cit}, n_{fit}; t = F_i, \dots, 2006)$  in the sample depends on the density of  $(F_i, n_{cit}, n_{fit}; t = F_i, \dots, 2006)$  conditional on the fact that we observe it, i.e.,  $F_i \leq 2006$ . This selection issue implies, for example, that among the chains that start in business in the later years of our data, only those that find franchising particularly appealing will appear in our sample. We account for this in the likelihood function by conditioning

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<sup>23</sup>Since our data source is a survey on franchisors, we only observe the number of outlets of a chain after it starts franchising. But we actually do not observe it for all years between  $F_i$  and 2006, the last year of our sample, for two reasons. First, as is explained in section A, we are missing data for all franchisors for 1999 and 2002. Second, some chains may have exited before 2006. For simplicity in notation, we omit this detail in this section.

as follows:

$$\mathcal{L}_i = \frac{\int p(F_i|\mathbf{u}_i) \cdot p(n_{cit}, n_{fit}; t = F_i, \dots, 2006|F_i; \mathbf{u}_i) dP_{\mathbf{u}_i}}{\int p(F_i \leq 2006|\mathbf{u}_i) dP_{\mathbf{u}_i}}. \quad (16)$$

Our estimates of the parameters  $(\beta_c, \beta_f, m, \gamma, \sigma_m, \sigma_u, \omega, \sigma_\omega, q_0, q_1)$  maximize the log-likelihood function obtained by taking the logarithm of (16) and summing up over all chains.

## Identification

We now explain the sources of identification for our estimated parameters. As mentioned above, collateralizable housing wealth affects the relative profitability of opening a franchised outlet via its effect on the franchisee's incentives to put forth effort. It may also, however, affect the general profitability of an outlet in the chain by affecting the demand for the chain's products or services. We can separately identify these effects because we observe two growth paths, the growth path in the number of company-owned and the growth path in the number of franchised outlets. In other words, we observe the relative growth of the number of franchised outlets as well as the overall growth in the chain. The former variation makes it possible for us to identify the effect of collateralizable housing wealth via the incentive channel that we emphasize, while the latter variation allows us to identify the effect of collateralizable housing wealth via the demand channel.<sup>24</sup>

Variation in the total number of outlets, however, can arise not only from variation in the profitability of outlets for this chain but also from variation in the arrival rate that is specific to this chain. We therefore do not include the same covariates in the arrival rate and in the general profitability of an outlet. This exclusion restriction allows us to identify the coefficients in the general profitability of an outlet and the arrival rate separately. We do allow a constant term in the profitability of an outlet (denoted by  $\beta_{c1}$ ) and need to identify it separately from the average opportunity arrival rate ( $m$ ). This identification is possible because we observe some chains in the data in the year when they start franchising. In other words, we know about the accumulated number of company-owned outlets they have chosen to open (minus any closings) before they started franchising, which provides information on their overall growth before they have the option to franchise. Once the relative profitability of a franchised outlet is identified, the ratio of the overall growth before and after a chain starts franchising identifies  $\beta_{c1}$ . When a chain is very profitable even when it is constrained to open only company-owned outlets, adding the option of franchising has a smaller impact on its overall growth, and vice versa. Once the constant  $\beta_{c1}$  is identified, variation in the total growth can be used to pin down the average arrival rate  $m$ .

The observed shrinkage in the number of outlets gives us a lower bound estimate of the outlet

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<sup>24</sup>We assume that the unobservable profitability of a chain and the unobservable relative attractiveness of franchising to a chain are uncorrelated with the observable covariates. In particular, they are uncorrelated with the average collateralizable housing wealth in this chain's market. This is reasonable because franchisees are a small proportion of all households in a state. One chain's profitability, which may affect its franchisees' ability to pay off their mortgages does not affect the average collateralizable housing wealth in a state. Chaney, Sraer and Thesmar (2012) study how the value of one firm's real estate affects the investment of *that firm*. They use local constraints on land supply to deal with the endogeneity problem.

exit rate. An “exclusion” restriction further helps us identify this parameter: for some chains in our data, we observe them in the year that they start franchising. The number of franchised outlets that a chain has in the year that it starts franchising presumably does not incorporate any exits, so we take this number to be the number of new franchised outlets opened that year rather than a combination of newly opened and closed outlets.

Dispersion in the total number of outlets identifies the standard deviation of the arrival rate ( $\sigma_m$ ). Dispersion in relative growth identifies the variation of the unobserved relative profitability of a franchised outlet ( $\sigma_u^2$ ). Given the growth patterns, data on waiting time (the difference between when a chain starts franchising and when a chain starts in business) identifies the distribution of the cost of entering into franchising, i.e.,  $(\omega, \sigma_\omega)$ . Furthermore, the probability of not being aware or thinking about franchising in the first year in business  $1 - q_0$  is also identified by the observed variation in waiting time as it is essentially the probability mass of the entry cost at infinity. The identification for  $q_1$  is similar.

## 4 Estimation Results

### 4.1 Baseline Estimation Results

The estimation results, in Table 2, indicate that both population and per-capita gross state product, our measure of income, affect the profitability of outlets positively, presumably by increasing the demand for the products of the chains. Collateralizable housing wealth, however, has a negative effect on the general profitability of a chain’s outlets. In other words, once we control for income (per-capita gross state product) and our other macroeconomic variables, collateralizable housing wealth reduces how much consumers want to consume the products of the chains. One potential explanation for this result is that rent may be high in those regions where collateralizable housing wealth is high, making outlets less profitable. Alternatively, for given income, higher wealth may indeed have a negative effect on the demand for the type of products sold by franchised chains.

Collateralizable housing wealth, on the other hand, has a positive effect on the value of opening a franchised outlet relative to opening a company-owned outlet in our data. In other words, when franchisees have more collateral to put forth, the chains increase their reliance on franchising relative to company ownership. This is in line with the intuition from our simple principal-agent model, where franchisee borrowing against their collateral to start their business increases their incentives to work hard and hence the profitability of franchising to the franchisors.

Other results are also in line with the intuition from our model. First, we find that the interest rate affects the attractiveness of franchising negatively. Since a higher interest rate normally would imply a higher repayment for given collateral, an increase in the interest rate decreases the

Table 2: Estimation Results

	parameter	standard error
Log of opportunity arrival rate		
constant	3.093***	0.013
std. dev.	1.267***	0.023
Profitability of a company-owned outlet		
constant	-3.379***	0.045
population	0.231***	0.004
per-capita state product	0.010***	0.001
collateralizable housing wealth	-0.069***	0.006
Relative profitability of a franchised outlet		
collateralizable housing wealth	0.186***	0.007
interest rate	-0.079***	0.002
capital needed	-0.355***	0.009
population	-0.001	0.001
employees	-0.002	0.004
(coll. housing wealth)×(employees)	0.011***	0.001
business products & services	0.131***	0.050
home services	0.360***	0.038
go to services	-0.189***	0.049
auto; repair	0.368***	0.073
restaurants	-0.634***	0.038
constant (retailer)	2.510***	0.071
std. dev.	2.002***	0.025
Outlet exiting rate	0.309***	0.001
Log of entry cost		
mean	2.685***	0.141
std. dev.	0.421***	0.143
Probability of thinking of franchising		
at the time starting business	0.144***	0.017
in subsequent years	0.173***	0.013

\*\*\* indicates 99% level of significance.

opportunity cost of defaulting, which leads to reduced incentives for the franchisee and hence a lower value of franchising to the franchisor. Similarly, when the amount to be borrowed goes up, the opportunity cost of defaulting decreases, which makes franchising less appealing to a chain. This explains the negative effect of required capital on the relative profitability of franchising. The estimated coefficient of population in the relative profitability of a franchised outlet is statistically insignificant. One interpretation is that the main effect of population operates through the demand for the product of the chain, rather than through the availability of franchisees.

We use the amount of labor needed in a typical chain outlet to measure the importance of the manager's effort. While the estimate of its effect is statistically insignificant, we find a statistically significant positive effect for its interaction with collateralizable wealth. This is consistent with the implication that franchisee incentives arising from having more collateral at stake are particularly valuable in businesses where the manager's role is more important to the success of the business. Similarly, the coefficients for the sector dummy variables suggest that, controlling for the level of labor and capital needed, the benefit of franchising is greatest for home services and auto repairs, i.e. that these types of businesses are particularly well suited to having an owner operator, rather than a hired manager, on site to supervise workers and oversee operations more generally. These results again provide support for the idea that franchisee effort is a central factor in franchisors' franchising decisions.

We also find a large and highly significant rate of closure of outlets in our data. Our estimate implies that about 31% of all outlets close every year. This is larger than the 15% exit rate documented in Jarmin, Klimek and Miranda (2009) for single retail establishments and 26% found by Parsa, Self, Njite and King (2005) for restaurants. We expect some of the differences in our estimate arises because our data comprises mostly new franchised chains in their first years in franchising. Two things happen to these chains that can explain our high exit rate. First, many of them are experimenting and developing their concept while opening establishments. Some of this experimentation will not pan out, resulting in a number of establishments being closed down. Second, when chains begin to franchise, they often transform some of the outlets they had established earlier as company outlets into franchised outlets. In our outlet counts, such transfers would show up as an increase in number of franchised outlets, combined with a reduction, and thus exit, of a number of company owned outlets.

Finally, we find evidence that only a fraction of the chains in our data are aware or thinking of franchising from the time they start in business. The majority of them, namely (100%-14%), or 86%, do not think of franchising in their first year in business.<sup>25</sup> The probability that they become aware or start thinking about franchising the next year or the years after that is larger, at 17% each year.

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<sup>25</sup>Note that around 17% of chains in our data start franchising right away, which is greater than our estimate of 14% who are aware of franchising when they start their business. This discrepancy arises because the observed proportion is conditional on starting to franchise by 2006.



The estimated average entry cost – the cost of starting to franchise – is 16.01 ( $= e^{2.685+0.421^2/2}$ ). According to our estimates, this is about 10 times the average value of franchised outlets that the chains choose to open.<sup>26</sup> In the data, on average, seven franchised outlets are opened in the first year when a chain starts franchising. The average growth in number of franchised outlets in the first two years in franchising is seventeen. So, it takes on average between one and two years for a chain to grow ten franchised outlets to recoup the sunk cost of entering into franchising.

To see how well our estimated model fits the entry and the expansion patterns of the chains in the data, we compare the observed distribution of the waiting time – left panel of Figure 6(a) – to the same distribution predicted by the model *conditional on* a chain having started franchising by 2006. Since a chain is included in our data only after it starts franchising and the last year of our sample is 2006, this conditional distribution is the model counterpart of the distribution in the data. We make a similar comparison for the distributions of the number of company-owned and franchised outlets also in Figures 6(b) and 6(c), respectively.<sup>27</sup> In all cases, we can see that our estimated model fits the data rather well but, not surprisingly, the distributions predicted by the model are smoother than those in the data.

In Supplemental Appendix E, we also simulate the distribution of the number of company-owned and franchised outlets when the decision on the timing of entry into franchising is taken as exogenous, i.e. the selection issue is ignored. In this case, the simulation underestimates the number of franchised outlets quite a bit. This is because ignoring selection means that we draw the unobservable profitability of a franchised outlet from the unconditional distribution so that, even when the draw is so small that the chain should not have started franchising, the simulated number of franchised outlets corresponding to this draw is included to compute the distribution of the predicted number of franchised outlets.

## 4.2 Robustness

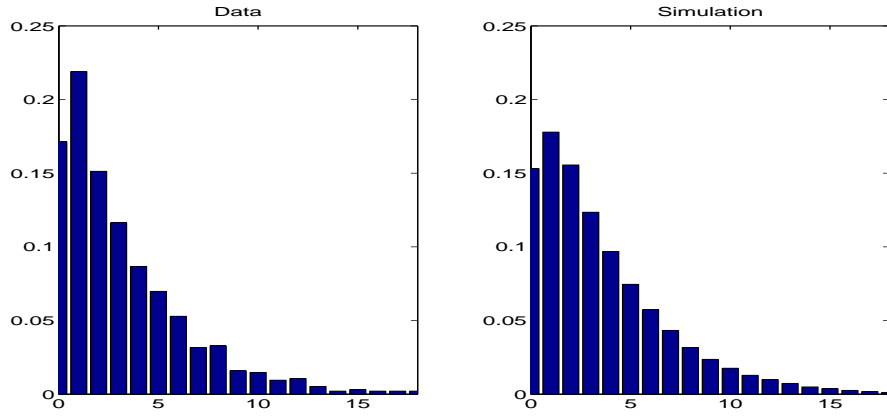
To address potential concerns that our results might be too dependent on the specific way in which we linked local macroeconomic variables to the franchise chain data, we estimated our model also using a different weight matrix. This alternative weight matrix incorporates information concerning the proportion of each chain’s outlets in its top three states (three states where it has the most outlets). The construction of this weight matrix is described further, and the actual matrix is also shown, in Appendix A.4. The estimation results, in Table 3, show that using the alternative weight matrix yields results that are very similar to those we presented above. In terms of our main variable of interest, moreover, we find a coefficient for collateralizable wealth and its

<sup>26</sup>The value of an opened franchised outlet is  $E(\pi_{fi\tau} | \pi_{fi\tau} > \pi_{ci\tau} \text{ and } \pi_{fi\tau} > 0)$ . It is 1.67 on average (across chain/years) according to our estimates.

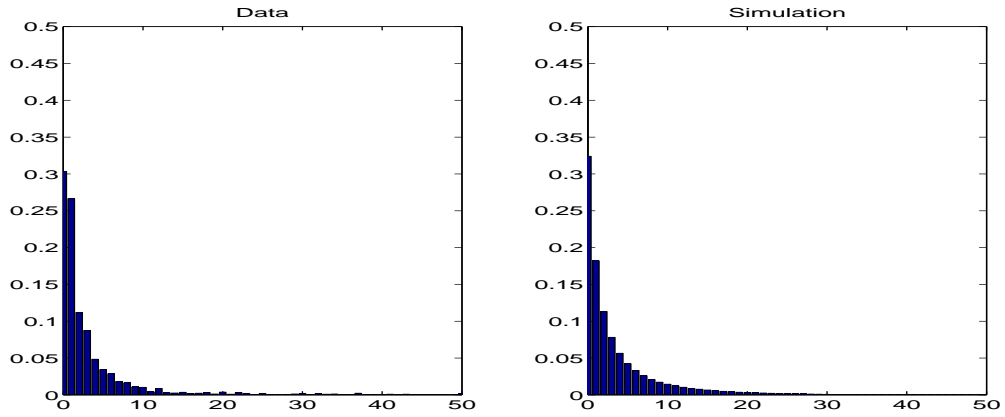
<sup>27</sup>Since there are only a few chain/years with more than 50 company-owned outlets, and more than 200 franchised outlets, we truncate the graphs on the right at 50 and 200 respectively for readability.

Figure 6: Fit of the Model

(a) Distribution of Waiting Time: Data vs. Simulation



(b) Distribution of the Number of Company-owned Outlets: Data vs. Simulation



(c) Distribution of the Number of Franchised Outlets: Data vs. Simulation

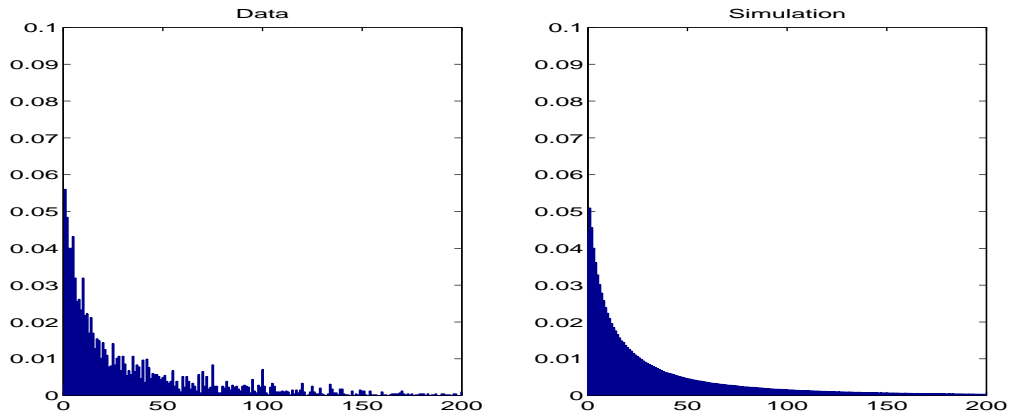


Table 3: Robustness Analyses: Different Weight Matrix to Link Chain-level and State-level Data

	parameter	standard error
Log of opportunity arrival rate		
constant	3.069***	0.013
std. dev.	1.279***	0.023
Profitability of a company-owned outlet		
constant	-3.652***	0.043
population	0.278***	0.004
per-capita state product	0.011***	0.001
collateralizable housing wealth	-0.040***	0.006
Relative profitability of a franchised outlet		
collateralizable housing wealth	0.209***	0.006
interest rate	-0.080***	0.002
capital needed	-0.393***	0.010
population	-0.003**	0.001
employees	0.001	0.003
(coll. housing wealth)×(employees)	0.012***	0.001
business products & services	0.072*	0.054
home services	0.233***	0.043
go to services	-0.250***	0.049
auto; repair	0.152**	0.067
restaurants	-0.638***	0.038
constant (retailer)	2.447***	0.056
std. dev.	1.964***	0.023
Outlet exiting rate	0.309***	0.001
Log of entry cost		
mean	2.858***	0.257
std. dev.	0.431*	0.264
Probability of thinking of franchising		
at the time starting business	0.146***	0.018
in subsequent years	0.173***	0.013

\*\*\* indicates 99% level of significance.

\*\* indicates 95% level of significance.

\* indicates 90% level of significance.

interaction with labor that are even larger than in our baseline specification (0.209 instead of 0.186 for the direct effect). We conclude that our results are robust to reasonable variations in the way we link the macroeconomic data to our data on chains, and that our current baseline results provide relatively conservative estimates of the effects of interest.

## 5 Assessing the Economic Importance of Collateralizable Housing Wealth

In this section, we use our baseline results to conduct a simulation where collateralizable housing wealth is decreased by 30% in all state/years in the data. This exercise helps us understand the economic magnitude of the estimated effect of collateralizable housing wealth on the extent of franchising and the expansion of the chains. A 30% decline in collateralizable housing wealth, moreover, is in line with the reduction in housing values that occurred in recent years, a period that lies outside our data period.<sup>28</sup>

To emphasize the incentive rather than the demand channel, we focus on results from a change in collateralizable wealth in the relative profitability of franchising only.<sup>29</sup> Figure 7 shows the distribution of the change in waiting time that results from this change in collateralizable wealth. For each chain/simulation draw, we compute the waiting time with and without a 30% decrease in local collateralizable housing wealth. We then compute the average waiting time across simulations for this chain.<sup>30</sup> The histogram of the average changes in waiting time, in Figure 7, shows that all chains in our data go into franchising on average (averaged over simulations) later with than without the change in franchisee financial constraints. The average effect of decreased collateral wealth on the chains' decisions to start franchising is 0.24 years. The average waiting time is 3.15 years. So, the average delay is about 8% of the average waiting time.

Figure 8 shows the average change in the number of outlets that results from the 30% decrease in potential franchisee collateralizable wealth. The results of our simulations imply that the number of total outlets of chains five years after they start in business decreases by 2.73 on average (averaged over simulations and the 764 chains in our sample that started in business no later than 2002).<sup>31</sup> In

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<sup>28</sup>Median net worth fell 38.8 percent between 2007-2010 mostly because of the reduction in housing values (see Bricker, Kennickell, Moore and Sabelhaus (2012)). Since our data end in 2006, our estimates are obtained based on information that predates the housing crisis.

<sup>29</sup>Our estimation results imply that collateralizable wealth has a negative effect on the demand side. If we allow this channel to operate as well, we get lower net effects, in the order of 5% to 6% reductions in total number of outlets, instead of the 11% we report below. Of course, the results we report are the relevant one for our purposes.

<sup>30</sup>We use the simulated distribution without the decrease in collateralizable housing wealth rather than the empirical distribution directly from the data as the benchmark for two reasons. First, we do not want estimation errors to contribute to the observed differences between the distributions with and without the decrease in collateralizable housing wealth. Second, since we are interested in the effect of tightening franchisee's financial constraints on waiting time, we need to plot the *unconditional* distribution of the waiting time, which is not observable in the data. In the data, we only observe the distribution conditional on entry into franchising before 2006.

<sup>31</sup>The average number of outlets five years after a chain starts its business is 25.78 in the data. The simulated

Figure 7: The Effect of Potential Franchisees' Financial Constraints on Chain's Waiting Time

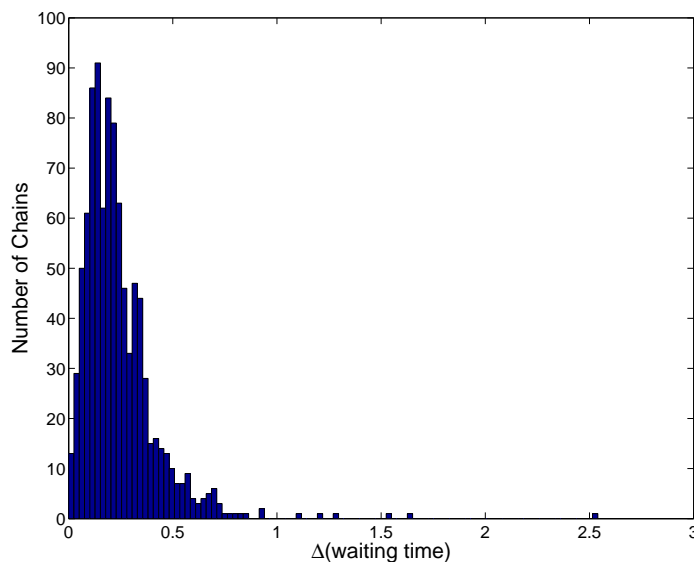
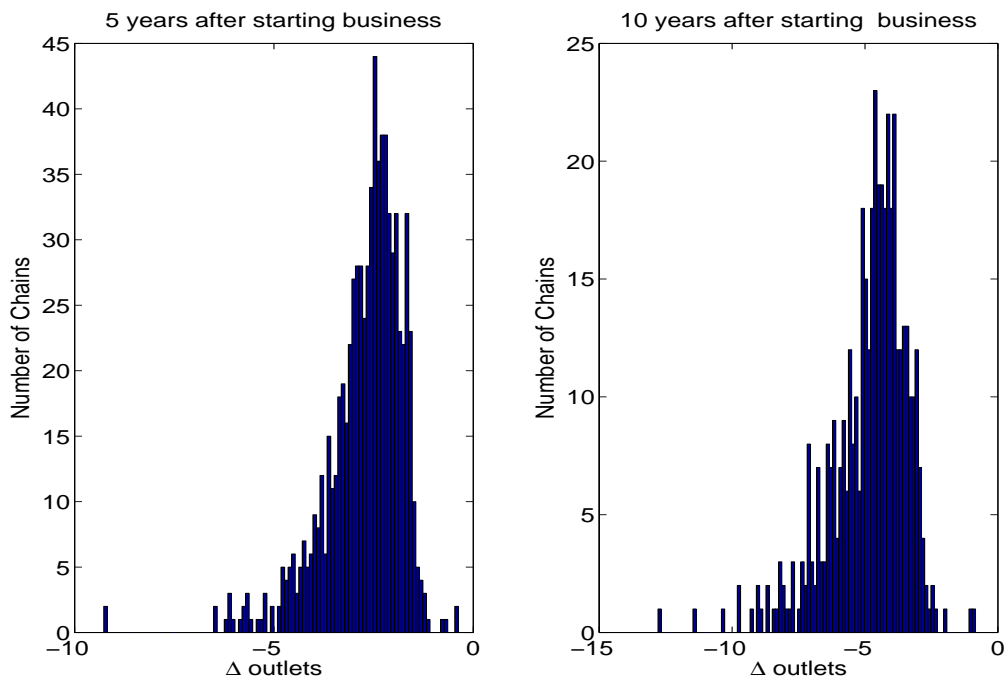


Figure 8: The Effect of Potential Franchisees' Financial Constraints on the Number of Outlets



total, these 764 chains would fail to open 2086 outlets with 13,068 jobs in the process according to our data on number of employees per establishment.<sup>32</sup> Similarly, there are 447 chains in our sample counterpart (without any change in collateralizable housing wealth) is 24.38.

<sup>32</sup>The jobs numbers also are averaged over simulations. We can simulate the lack of job creation because we observe the typical number of employees needed in an outlet for each chain.

that started franchising no later than 1997. Our simulation indicates that these chains would have 2163 fewer outlets ten years after starting in business, or 4.84 fewer outlets each on average. The direct corresponding job loss would be 14883.

Of course, the franchised chains in the above simulation are only a subset of all franchisors. To understand the overall impact of the tightening of franchisees' financial constraints might be, we can use the average percentage changes in the number of outlets five and ten years after a chain starts its business. They are, respectively, 11.26% and 11.54%. Per the Economic Census, business-format franchised chains had more than 380,000 establishments, and accounted for 6.4 million jobs in the U.S. in 2007. Using these figures, and the percentage changes in outlets that we obtain, the predicted number of jobs affected could be as large as 720,000 to 740,000. Note that this is a partial equilibrium result for understanding the economic magnitude of the key estimated parameter. For example, we hold the number of employees in an outlet constant in the simulations. Yet this could be a margin on which the chains would adjust. This number is rather constant within chains over time in our data, however, which is to be expected given the standardized business concepts that these chains emphasize. For another example, the lack of growth of franchised chains also might allow other firms to go into business. However, the financial constraints faced by franchisees has been touted as a major factor impeding the growth of small businesses generally. Hence it is not clear that the reduction in number of outlets we document could be made up by an increase in the number of other businesses.

## 6 Conclusion

In this paper, we have shown theoretically and empirically that the entry of a chain into franchising and its growth via franchised relative to company-owned outlets are intrinsically linked. We have also shown that both of these depend in a systematic way on the availability of financial resources of potential franchisees. The magnitude of the effects is sizable, suggesting that financial constraints play an important role for the type of small business owners that franchisors try to attract into their ranks. In other words, our results show that franchisees' investments in their businesses are an important component of the way franchisors organize their relationships with their franchisees. When the opportunities for such investments are constrained, franchising as a mode of organization becomes less efficient, and the chains rely on it less. This, in turn, reduces their total output.

We view the incentive effect of collateralizable housing wealth that we emphasize as quite complementary to that of the residual claims that have been the typical focus of the agency literature. The reliance on franchisee collateralizable housing wealth gives strong incentives to franchisees in the early years of their business, a period during which profits, and hence residual claims, are small or even negative, but the amount of wealth put up in the business is most often at its maximum.

Franchising thus provides an ideal setting to study this issue of incentives and collateral.

From a methodological perspective, our data, like those that are typically available to study small businesses, only show the net change in number of outlets each year. Nonetheless, our paper provides a framework to estimate the creation and exit of outlets separately, and explains the data needed for the identification. More generally, we view our empirical model as a step toward developing empirically tractable analyses of factors that principal-agent models suggest are important, but that are often difficult to capture empirically within the confines of what are often limited, and in our case, aggregated data on firm decisions. Authors often face similar data constraints in other contexts, and so we hope that our approach will provide some useful building blocks for them as well.

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# Appendices

## A Data Appendix

This appendix provides further details on data and measurement issues.

### A.1 Franchisor Sample and Characteristics

We constructed our sample of franchised chains from yearly issues of the Entrepreneur Magazine from 1981 to 1993, and an annual listing called the Bond's Franchise Guide (previously the Source Book of Franchise Opportunities) for 1994 to 2007. In each case, the publication is published a year late relative to the year of data collection, so we obtain the 1980 to 1992 data from the first source and the 1993 to 2006 data from the second. The last year of our sample is 2006 (from the 2007 publication). Also, because the Bond Guide was not published in 2000 and 2003, we are missing data for all franchisors for 1999 and 2002.

Because our state-level macroeconomic variables of interest are only available from 1984 onward, we must constrain our sample to US-based franchisors that started in business in 1984 or later. This means that our sample comprises mostly young brands, with small number of establishments: well-known brands such as McDonald's and Burger King for example were established in the 1950s and 1960s. After eliminating chains with missing data and some others for reasons discussed in the text, our final sample consists of 3872 observations covering 945 distinct franchised chains, for an average of four observations on average per chain. This short duration for our panel is explained in part by the large number of entry into and exit from franchising (or business) of the chains<sup>33</sup> as well as the lack of data for 1999 and 2002.

For each franchisor/year in our sample, we have data on the amount of capital required to open an outlet (Capital Required) and the number of employees that the typical outlet needs (Number of Employees). We transform the former to constant 1982-84 dollars using Consumer Price Index data from the Bureau of Labor Statistics. For the latter, we count part-time employees as equivalent to 0.5 of a full-time employee.

We view the Capital Required (in constant dollars) and the Number of Employees needed to run the business as intrinsically determined by the nature of the business concept, which itself is intrinsically connected to the brand name. So, they should not change from year to year. Yet we find some variation in the data. Since the data are collected via surveys, they are subject to some errors from respondents or transcription. We therefore use the average across all the observations we have for these two variables for each franchised chain under the presumption that most of the differences over time reflect noise in the type of survey data collected by our sources. There is also some

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<sup>33</sup>See e.g. Blair and Lafontaine (2005) for more on the entry and exit rate of chains.

variation in the reported years in which the chain begins franchising and when it starts in business. For these variables, we use the earliest date given because we see that franchisors sometimes revise these dates to more current values for reasons we do not fully understand. However, we make sure that the year of first franchising is after the first year in business. We also push the year of franchising to later if we have data indicating no franchised establishments in the years when the chain states it starts franchising.

## A.2 Collateralizable Housing Wealth

We measure collateralizable housing wealth using

- data on a yearly housing price index at the state level from the Federal Housing Finance Agency. These data are revised at the source quite frequently, perhaps as often as every time a new quarter is added. They also have been moved around several web sites. The version used here is the “States through 2010Q3 (Not Seasonally Adjusted) [TXT/CSV]” series in the All-Transactions Indexes section at <http://www.fhfa.gov/Default.aspx?Page=87>. The base period of the index is 1980Q1;
- data on housing values by state in 1980 from the Census Bureau (the base year of the aforementioned housing price index). These data are in constant year 2000 based dollars. We transform them to constant 1983-84 based constant dollars using the Consumer Price Index.

The combination of the above two sets of data allows us to generate time series of yearly housing values per state, from 1980 onward. We then complement these with the following:

- yearly data about home ownership rates across states from the Census Bureau’s Housing and Household Economic Statistics Division;
- data from the joint Census-Housing and Urban Development (HUD) biennial reports, based on the American Housing Surveys, which summarize information on mortgages on a regional basis (Northeast, Midwest, South and West). Specifically, from this source, we obtained measures of regional housing values, total outstanding principal amount, and number of houses owned free and clear of any mortgage. These can be found in Tables 3-14 and 3-15 of the biennial reports. The data for housing values and for total outstanding principal are reported in the form of frequencies for ranges of values. We use the middle value for each range and the frequencies to calculate expected values for these. We then combine these data to calculate the average proportion of mortgage outstanding for homeowners in the region each year. Specifically, we calculate  $\frac{(TOPA * NTOPA)}{(NTOPA + NF)}$ , where TOPA is Total Outstanding Principal Amount, NTOPA is the Number of Households that Reported Outstanding Principal, and NF is the Number of Households with Houses owned Free and Clear of any mortgage. Since

the data on TOPA, NTOPA, and NF are by region, we ascribe the regional expected value to all states in each region.<sup>34</sup> Also, since the joint Census-Housing and Urban Development (HUD) reports are biennial, we ascribe the value to the year of, and to the year before, the report. This means that we can generate our main explanatory variable of interest below from 1984 onward.

In the end, we combine the information on the proportion of outstanding mortgage for homeowners (data in item 4 above) with the state home ownership rate (item 3) and housing value time series (combination of items 1 and 2) to calculate our measure of Collateralizable Housing Wealth for each state/year, given by:  $(1 - \text{the average proportion of mortgage still owed}) \times (\text{the home ownership rate}) \times (\text{housing value})$ .

### A.3 Other Macroeconomic Variables

Real Gross State Product (GSP) data are from the Bureau of Economic Analysis. We deflate nominal annual GSP data using the Consumer Price Index also from the Bureau of Labor Statistics, and obtain per capita GSP after dividing by population. The annual population data were downloaded from: <http://www.census.gov/popest/states/>. The interest rate data series we use is the effective Federal Funds rate annual data (downloaded from the Federal Reserve web site, at <http://www.federalreserve.gov/releases/h15/data.htm> on 03/26/2009). The data are in percent.

### A.4 Weighing Matrices

As described in the body of the paper, we create our main weighing matrix using information from the 1049 franchisors in our data that we observe at least once within 15 years after they start franchising. We use only one year of data per franchisor, namely the latest year within this 15 year period, to construct the matrix. For each state pair  $(s_1, s_2)$ , the weight is defined as  $\sum_{j \in J_{s_1}} \mathbf{1}(s_2 \text{ is the top state for chain } j) / \#(J_{s_1})$ , where  $J_{s_1}$  is the set of chains that headquarter in state  $s_1$ ,  $\#(J_{s_1})$  is the cardinality of the set  $J_{s_1}$ , and  $\mathbf{1}(s_2 \text{ is the top state for chain } j)$  is a dummy variable capturing whether chain  $j$  reports  $s_2$  as the state where they have most of their outlets. In other words, the weight is the proportion of chains headquartered in  $s_1$  that report  $s_2$  as the state where they have most of their outlets. The resulting matrix is shown below as Matrix A.

We use an alternative set of weights in our robustness analysis. Our source data identifies three (or two, or one if there are only two or one) U.S. states where the chain has the most outlets, and for each of those, it states how many outlets it has. Our alternative weighing matrix takes all this into account, namely it uses data from all top three states (as opposed to only the top one state in

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<sup>34</sup>We have investigated several other data sources that provide information on home equity and housing values, some of which include data at a more disaggregated level. However, none of them allow us to go back in time as far as 1984, like our current sources do. Moreover, these sources covered a number of major cities rather than states.

Matrix A) as well as the relative importance of these top three states, in the form of the proportion of outlets in each state relative to the total in all three (as opposed to only using a dummy to capture whether a state is *the* top state as in Matrix A). Specifically, for each chain  $j$ , we calculate  $N_{3j} = n_{1j} + n_{2j} + n_{3j}$ , where  $n_{ij}$  is the number of establishments of the chain in its top three states  $i = 1, 2$  or  $3$ . We then calculate  $p_{ij} = n_{ij}/N_{3j}$ . For each state pair  $(s_1, s_2)$ , we calculate the average proportion of establishments in origin state  $s_1$  and destination state  $s_2$  pairs across all the chains headquartered in state  $s_1$  as  $\sum_{j \in J_{s_1}} [p_{1j} \mathbf{1}(s_2 \text{ is franchisor } j\text{'s state with the most outlets}) + p_{2j} \mathbf{1}(s_2 \text{ is franchisor } j\text{'s state with the second most outlets}) + p_{3j} \mathbf{1}(s_2 \text{ is franchisor } j\text{'s state with the third most outlets})] / \#(J_{s_1})$ . Note that the sum of these average proportions across destination states  $s_2$  for each origin state  $s_1$  is again 1.

The resulting matrix is shown below as Matrix B. As can be seen from a comparison of the matrices, the matrix we rely on in our main specification (Matrix A) allocates some weight to macro conditions outside of the chain's headquarters state, but not as much as Matrix B does. The latter is a little more dispersed. Overall, the two matrices are similar. Consequently, per the descriptive statistics in Table 4 below, the macroeconomic variables are similar in the two matrices. Compared to using the macroeconomic variables of the home state only, with no weights, the mean and standard deviation of population in particular is quite different once we apply our weights. This confirms the fact that, as noted in the body of the paper, franchisors headquartered in relatively small (i.e. low population) states tend to move into other, more populated states faster than do those headquartered in larger markets. Similarly the descriptive statistics suggest that franchisors in low collateralizable housing wealth states grow into others with slightly more such wealth earlier on. It is therefore important that we use these weighing matrices as this allows variation in the economic conditions of the other relevant states to affect the decisions of chains headquartered in smaller, lower wealth states.

Table 4: Summary Statistics for Macroeconomic Variables for Different Weight Matrices: At the state/year level, for 48 states between 1984 and 2006

	Mean	Median	S.D.	Min	Max	Obs
<b>No Weights</b>						
Coll. Housing Wealth (82-84 \$10K)	3.41	3.03	1.52	1.51	14.17	1104
Population (Million)	5.46	3.83	5.83	0.52	36.12	1104
Per-Capita Gross State Product (82-84 \$10K)	1.85	1.73	0.67	1.09	7.47	1104
<b>Main Matrix (Matrix A)</b>						
Coll. Housing Wealth (82-84 \$10K)	3.62	3.34	1.31	1.83	14.17	1104
Population (Million)	8.84	8.23	5.52	0.52	31.68	1104
Per-Capita Gross State Product (82-84 \$10K)	1.89	1.79	0.63	1.22	7.47	1104
<b>Alternative Matrix (Matrix B)</b>						
Coll. Housing Wealth (82-84 \$10K)	3.61	3.28	1.17	2.11	13.21	1104
Population (Million)	8.67	8.20	4.73	1.14	28.92	1104
Per-Capita Gross State Product (82-84 \$10K)	1.89	1.80	0.54	1.26	6.60	1104





## B Details on the Parametric Model in Section 3.2

In this Appendix, we describe the parametric model for our analysis in section 3.2. In this parametric model, we assume a linear revenue function  $G(\theta, a) = \theta + \beta a$ . The profit shock  $\theta$  follows a normal distribution with mean 6 and a variance of 9. Opening an outlet in this chain requires capital  $I = 5$ . In the debt contract, the repayment  $R$  depends on the amount of money borrowed ( $I$ ) and the collateral ( $C$ ) according to the following linear function:  $R = (1 + r)I$  where  $r = 0.35 - (0.35 - 0.01)C/I$ . In other words, the interest rate is 35% when  $C = 0$  and 1% when  $C = I$ .

The franchisee's utility function is  $-e^{-\rho w}$  where  $\rho = 0.005$  is her absolute risk aversion parameter and  $w$  is her payoff. It is costly for her to exert effort. The cost is  $\Psi(a) = e^a$ .

We assume that the number of potential franchisees  $N$  follows a Poisson distribution with mean  $\bar{N}$ . The collateralizable wealth that each potential franchisee has follows a truncated normal distribution with mean  $\bar{C}$  and a variance of 1. It is truncated on the left at 0.

The expected profit from a company-owned outlet is  $\tilde{\pi}_c = E_\theta [G(\theta, a_0) \mathbf{1}(G(\theta, a_0) > 0)] - I$ . We normalize the hired manager's effort  $a_0$  to be 0 and the corresponding compensation to be 0. Thus,  $\tilde{\pi}_c = 1$  in our example.



## C Proofs for Section 3.1

In this section, we show that  $\frac{\partial^2 U}{\partial a \partial C} > 0$  at the interior solution to the franchisee's utility maximization problem. The first-order condition for the franchisee's expected utility maximization problem is

$$\begin{aligned} \frac{\partial U}{\partial a} &= \rho \int_{-\infty}^{\theta^*} -\Psi'(a) e^{-\rho[-\Psi(a)-L]} dF(\theta) \\ &+ \rho \int_{\theta^*}^{\infty} \left[ (1-s) \frac{\partial G(\theta, a)}{\partial a} - \Psi'(a) \right] e^{-\rho[C+(1-s)G(\theta, a)-R(C, I)-\Psi(a)-L]} dF(\theta) = 0. \end{aligned} \quad (\text{C.17})$$

The effect of increasing  $C$  on the marginal utility of effort is therefore

$$\begin{aligned} \frac{\partial^2 U}{\partial a \partial C} &= -\rho \Psi'(a) e^{-\rho[-\Psi(a)-L]} f(\theta^*) \frac{\partial \theta^*}{\partial C} \\ &+ \rho^2 \left( \frac{\partial R}{\partial C} - 1 \right) \int_{\theta^*}^{\infty} \left[ (1-s) \frac{\partial G(\theta, a)}{\partial a} - \Psi'(a) \right] e^{-\rho[C+(1-s)G(\theta, a)-R(C, I)-\Psi(a)-L]} dF(\theta) \\ &- \rho \left[ (1-s) \frac{\partial G(\theta^*, a)}{\partial a} - \Psi'(a) \right] e^{-\rho[C+(1-s)G(\theta^*, a)-R(C, I)-\Psi(a)-L]} f(\theta^*) \frac{\partial \theta^*}{\partial C}. \end{aligned} \quad (\text{C.18})$$

Given that  $R(C, I) - C = (1-s)G(\theta^*, a)$  according to (1), the above expression can be simplified as follows:

$$\begin{aligned} \frac{\partial^2 U}{\partial a \partial C} &= \rho^2 \left( \frac{\partial R}{\partial C} - 1 \right) \int_{\theta^*}^{\infty} \left[ (1-s) \frac{\partial G(\theta, a)}{\partial a} - \Psi'(a) \right] e^{-\rho[C+(1-s)G(\theta, a)-R(C, I)-\Psi(a)-L]} dF(\theta) \\ &- \rho (1-s) \frac{\partial G(\theta^*, a)}{\partial a} e^{-\rho[C+(1-s)G(\theta^*, a)-R(C, I)-\Psi(a)-L]} f(\theta^*) \frac{\partial \theta^*}{\partial C}. \end{aligned} \quad (\text{C.19})$$

When we plug in  $(1-s) \frac{\partial G(\theta^*, a)}{\partial a} \frac{\partial \theta^*}{\partial C} = \frac{\partial R}{\partial C} - 1$ , which is obtained by total differentiation of equation (1) with respect to  $C$ , into (C.19), we can further rewrite it as

$$\begin{aligned} \frac{\partial^2 U}{\partial a \partial C} &= \rho^2 \left( \frac{\partial R}{\partial C} - 1 \right) \int_{\theta^*}^{\infty} \left[ (1-s) \frac{\partial G(\theta, a)}{\partial a} - \Psi'(a) \right] e^{-\rho[C+(1-s)G(\theta, a)-R(C, I)-\Psi(a)-L]} dF(\theta) \\ &+ \rho \left( 1 - \frac{\partial R}{\partial C} \right) e^{-\rho[C+(1-s)G(\theta^*, a)-R(C, I)-\Psi(a)-L]} f(\theta^*). \end{aligned} \quad (\text{C.20})$$

The second term in (C.20) is positive. This term captures the effect of an increase in  $C$  on the franchisee's incentive to work hard so as to avoid defaulting. As  $C$  increases, the opportunity cost of defaulting increases. As a result, the franchisee has more incentives to decrease the probability of defaulting by working hard.

The first term captures the effect of wealth on incentives through affecting the marginal utility of wealth. Note that the first term in the first-order condition (C.17) is negative and the second term is positive. In other words, at the optimal effort level, the franchisee would have worked

too much if she knew that she would default and would have worked too little if she knew that she would not default. When collateral  $C$  increases, the repayment  $R$  decreases. As a result, her wealth when she does not default  $(C + (1 - s)G(\theta, a) - R(C, I) - \Psi(a) - L)$  increases, and her marginal utility from wealth decreases. Therefore, the marginal utility from the positive marginal payoff is decreasing in  $C$ , implying a negative effect of an increase in  $C$  on marginal utility  $\frac{\partial U}{\partial a}$ , i.e., incentives. Intuitively, less wealthy agents get more utility from an increase in wealth and therefore have more incentives to work hard to increase wealth. The magnitude of this negative effect of an increase in  $C$  on the franchisee's incentive to work is governed by  $\rho$ . Thus, when  $\rho$  is small,<sup>35</sup> the positive effect of  $C$  on incentives (i.e., higher incentives to decrease the probability of defaulting) dominates the negative effect of  $C$  on incentives (i.e., lower incentives to increase payoff for given a probability of defaulting).

## D Details on the Log-likelihood Function

In this section, we derive the log-likelihood function (16). It consists of three components: the likelihood that chain  $i$  starts franchising in year  $F_i$ ,  $p(F_i|\mathbf{u}_i)$ ; the likelihood that this chain is in the sample  $p(F_i \leq 2006|\mathbf{u}_i)$  and the likelihood of observing its growth paths of the number of company-owned and franchised outlets  $p(n_{cit}, n_{fit}; t = F_i, \dots, 2006|F_i; \mathbf{u}_i)$ .

First, the likelihood of observing  $F_i$  conditional on chain  $i$ 's unobservable component of the arrival rate and its unobservable profitability of opening a franchised outlet is

$$p(F_i|\mathbf{u}_i) = \sum_{t'=B_i}^{F_i} \left[ \prod_{t=B_i}^{t'-1} (1 - q_t) \cdot q_{t'} \cdot \prod_{t=t'}^{F_i-1} (1 - g(\mathbf{x}_{it}; \mathbf{u}_i)) \cdot g(\mathbf{x}_{iF_i}; \mathbf{u}_i) \right] \quad (\text{D.21})$$

where  $q_t$  is the probability that the chain is thinking about franchising in a specific year. As explained above,  $q_t = q_0$  when  $t = B_i$  and  $q_t = q_1$  when  $t > B_i$ . Thus, the first summand in (D.21) (when  $t' = B_i$ ) is  $q_0 \cdot \prod_{t=B_i}^{F_i-1} (1 - g(\mathbf{x}_{it}; \mathbf{u}_i)) \cdot g(\mathbf{x}_{iF_i}; \mathbf{u}_i)$ . It captures the probability that chain  $i$  is thinking of franchising from the very beginning, but chooses not to start franchising until year  $F_i$ . Similarly, the second summand in (D.21) (when  $t' = B_i + 1$ ) is  $(1 - q_0)q_1 \cdot \prod_{t=B_i+1}^{F_i-1} (1 - g(\mathbf{x}_{it}; \mathbf{u}_i)) \cdot g(\mathbf{x}_{iF_i}; \mathbf{u}_i)$ , which captures the probability that chain  $i$  starts to think of franchising one year after it starts its business, but does not start franchising until year  $F_i$ . The sum of all such terms gives us the probability of starting franchising in year  $F_i$ .

Second, the likelihood of observing chain  $i$  in the sample, which requires that  $F_i \leq 2006$ , is thus the sum of the probability that chain  $i$  starts franchising right away ( $F_i = B_i$ ), the probability that

<sup>35</sup>Specifically,  $\rho < -e^{-\rho[C+(1-s)G(\theta^*, a) - R(C, I) - \Psi(a) - L]} f(\theta^*) / \int_{-\infty}^{\theta^*} [-\Psi'(a)] e^{-\rho[-\Psi(a) - L]} dF(\theta)$ .

it starts one year later ( $F_i = B_i + 1$ ), ..., the probability that it starts in 2006, i.e.,

$$p(F_i \leq 2006 | \mathbf{u}_i) = \sum_{F=B_i}^{2006} p(F | \mathbf{u}_i).$$

Third, to derive the likelihood of observing the two growth paths ( $n_{cit}, n_{fit}; t = F_i, \dots, 2006$ ) of chain  $i$  conditional on its timing of franchising, note that the number of company-owned outlets in year  $t$  is given by equation (14), copied below:

$$n_{cit} = n_{cit-1} - \text{exits}_{cit-1} + (\text{new outlets})_{cit},$$

where  $\text{exits}_{cit-1}$  follows a binomial distribution parameterized by  $n_{cit-1}$  and  $\gamma$ , the outlet exit rate; and  $(\text{new outlets})_{cit}$  follows a Poisson distribution with mean  $m_i p_{ac}(\mathbf{x}_{it}, \mathbf{u}_i)$  or  $m_i p_{bc}(\mathbf{x}_{it}, \mathbf{u}_i)$  depending on whether the chain starts franchising before year  $t$  or not. Given that the mixture of a Poisson distribution and a binomial distribution is a Poisson distribution<sup>36</sup> and the sum of two independent Poisson random variables follows a Poisson distribution,  $n_{cit}$  follows a Poisson distribution with mean  $\sum_{k=B_i}^t m_i p_c(\mathbf{x}_{ik}, \mathbf{u}_i) (1 - \gamma)^{t-k}$ , where  $p_c(\mathbf{x}_{ik}, \mathbf{u}_i) = p_{bc}(\mathbf{x}_{ik}, \mathbf{u}_i)$  for  $k < F_i$  and  $p_c(\mathbf{x}_{ik}, \mathbf{u}_i) = p_{ac}(\mathbf{x}_{ik}, \mathbf{u}_i)$  for  $k \geq F_i$ . The likelihood of observing  $n_{cit}$  in the year the chain starts franchising (i.e. in the first year that we can observe this chain in the data) conditional on it starting franchising in year  $F_i$  is therefore

$$p_{n_{cit}|F_i}(\mathbf{u}_i) = \Pr \left( n_{cit}; \sum_{k=B_i}^t m_i p_c(\mathbf{x}_{ik}, \mathbf{u}_i) (1 - \gamma)^{t-k} \right) \text{ for } t = F_i,$$

where  $\Pr(\cdot; M)$  denotes the Poisson distribution function with mean  $M$ .

For subsequent years ( $t = F_i + 1, \dots, 2006$ ), we need to compute the likelihood of observing  $n_{cit}$  conditional on  $F_i$  as well as  $n_{cit-1}$ . According to equation (14), this conditional probability is the convolution of a binomial distribution (" $n_{cit-1} - \text{exits}_{cit-1}$ " follows a binomial distribution with parameters  $n_{cit-1}$  and  $1 - \gamma$ ) and a Poisson distribution ( $(\text{new outlets})_{cit}$  follows a Poisson distribution with mean  $m_i p_{ac}(\mathbf{x}_{it}, \mathbf{u}_i)$ ):

$$\begin{aligned} & P_{n_{cit}|n_{cit-1}, F_i}(\mathbf{u}_i) \\ &= \sum_{K=0}^{n_{cit-1}} \Pr(K | n_{cit-1}; 1 - \gamma) \Pr((\text{new outlets})_{cit} = n_{cit} - K; m_i p_{ac}(\mathbf{x}_{it}, \mathbf{u}_i)), \end{aligned}$$

where  $K$  represents the number of outlets (out of the  $n_{cit-1}$  outlets) that do not exit in year  $t - 1$ .

<sup>36</sup>If  $X$  follows a binomial distribution with parameters  $(M, p)$  and  $M$  itself follows a Poisson distribution with mean  $\bar{M}$ , then  $X$  follows a Poisson distribution with mean  $\bar{M}p$ . Note that  $n_{cit-1} - \text{exits}_{cit-1}$  in equation (14) follows a binomial distribution with parameters  $n_{cit-1}$  and  $1 - \gamma$ .

The conditional probabilities  $p_{n_{fit}|F_i}(\mathbf{u}_i)$  and  $P_{n_{fit}|n_{fit-1},F_i}(\mathbf{u}_i)$  can be computed analogously. Since Poisson events that result in company-owned and franchised outlet expansions are independent events (because Poisson events are independent), the likelihood of observing chain  $i$ 's growth path  $p(n_{cit}, n_{fit}; t = F_i, \dots, 2006 | F_i; \mathbf{u}_i)$  is the product of

$$\begin{aligned} & p_{n_{cit}|F_i}(\mathbf{u}_i), \text{ for } t = F_i; \\ & P_{n_{cit}|n_{cit-1},F_i}(\mathbf{u}_i), \text{ for } t = F_i + 1, \dots, 2006; \\ & p_{n_{fit}|F_i}(\mathbf{u}_i), \text{ for } t = F_i; \\ & P_{n_{fit}|n_{fit-1},F_i}(\mathbf{u}_i), \text{ for } t = F_i + 1, \dots, 2006. \end{aligned}$$

In our likelihood function, we also handle missing data. For example, data in 1999 and 2002 were not collected. When  $n_{cit-1}$  is not observable but  $n_{cit-2}$  is, we need to compute  $P_{n_{cit}|n_{cit-2},F_i}$ . Note that  $n_{cit} = n_{cit-2} - \text{exits}_{cit-2} + (\text{new outlets})_{cit-1} - \text{exits}_{cit-1} + (\text{new outlets})_{cit}$ , which can be rewritten as

$$\begin{aligned} & \text{outlets in } n_{cit-2} \text{ that do not exit before } t \\ & + \text{new outlets in } t-1 \text{ that do not exit before } t \\ & + \text{new outlets in } t, \end{aligned}$$

where “outlets in  $n_{cit-2}$  that do not exit before  $t$ ” follows a binomial distribution with parameters  $(n_{cit-2}, (1-\gamma)^2)$ , “new outlets in  $t-1$  that do not exit before  $t$ ” follows a Poisson distribution with mean  $m_i p_{ac}(\mathbf{x}_{it-1}, \mathbf{u}_i)(1-\gamma)$  and “new outlets in  $t$ ” follows a Poisson distribution with mean  $m_i p_{ac}(\mathbf{x}_{it}, \mathbf{u}_i)$ . Therefore,

$$\begin{aligned} & P_{n_{cit}|n_{cit-2},F_i}(\mathbf{u}_i) \\ & = \sum_{K=0}^{n_{cit-2}} \Pr(K | n_{cit-2}; (1-\gamma)^2) \Pr((\text{new outlets})_{cit} = n_{cit} - K; m_i p_{ac}(\mathbf{x}_{it-1}, \mathbf{u}_i)(1-\gamma) + m_i p_{ac}(\mathbf{x}_{it}, \mathbf{u}_i)). \end{aligned}$$

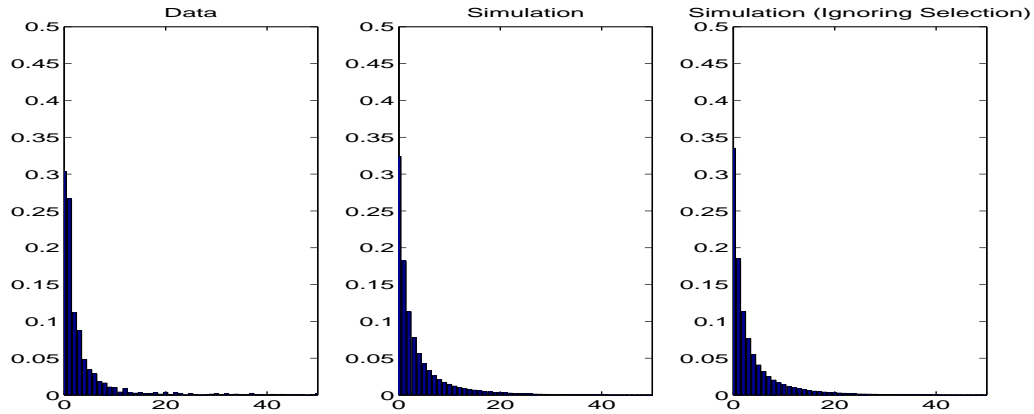
When more than one year of data is missing, we compute the corresponding conditional probability analogously. We then replace  $P_{n_{cit}|n_{cit-1},F_i}$  and  $P_{n_{fit}|n_{fit-1},F_i}$  by  $P_{n_{cit}|n_{cit-2},F_i}$  and  $P_{n_{fit}|n_{fit-2},F_i}$  when the observation of a year, by  $P_{n_{cit}|n_{cit-3},F_i}$  and  $P_{n_{fit}|n_{fit-3},F_i}$  when data of two years are missing, so on and so forth.

## E Simulated Distributions of the Number of Outlets when Selection is Ignored

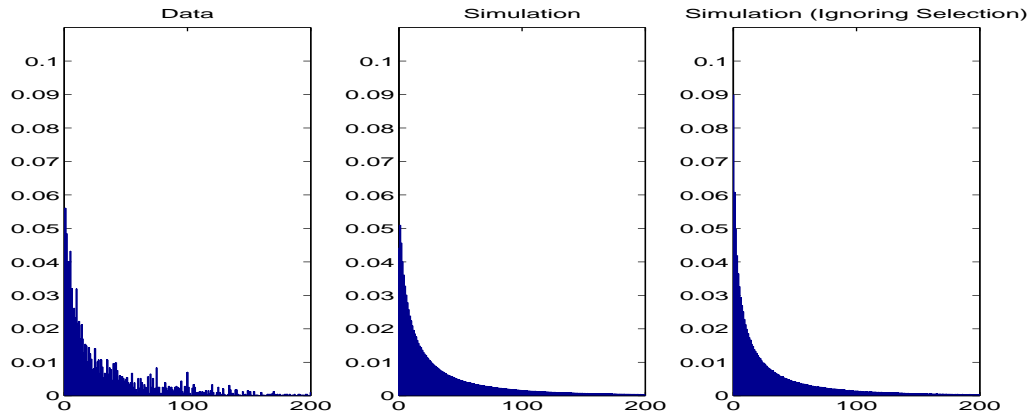
In this section, we show simulated distributions of the number of company-owned and franchised outlets when the decision on the timing of entry into franchising is ignored. Specifically, in these simulations we take the observed waiting time in the data as exogenously given. The simulated distributions are shown in the right panels of Figures 9(a) and 9(b). We include the two panels in Figure 6(b) (and 6(c)), which show the distribution in the data and the simulated distribution taking selection into account, respectively, as the left and the middle panels in Figure 9(a) (and Figure 9(b)) for comparison. When we compare the middle panel of Figure 9(a) (the simulated distribution of the number of company-owned outlets when selection is considered) and the right panel of the same figure (the simulated distribution when the timing of entry is ignored), we can see that these two distributions are very similar. This is because two effects are at play, and they presumably cancel each other out. On the one hand, chains that enter into franchising quickly tend to grow faster overall either because they are presented with more opportunities to open outlets or because outlets of these chains are more likely to be profitable. This effect is illustrated in Figure 1. On the other hand, chains that enter into franchising fast are chains for which a franchised outlet is likely to be particularly profitable relative to a company-owned outlet. This effect is suggested by Figure 2. The latter effect shifts the distribution of the number of company-owned outlets to the left, while the first effect shifts the same distribution to the right.

Figure 9: Simulated Distributions of the Number of Outlets when Selection is Ignored

(a) Number of Company-owned Outlets



(b) Number of Franchised Outlets



The second effect is also consistent with the comparison of the middle panel and the right panel of Figure 9(b) for the number of franchised outlets. The simulated distribution of the number of franchised outlets when the entry decision is taken as exogenous (in the right panel) is shifted to the left from the simulated distribution where the entry decision is endogenized (in the middle panel). This is because when we simulate the distribution in the right panel, we draw the unobservable profitability of a franchised outlet from the unconditional distribution. So even if the draw is not in favor of a chain opening a franchised outlet when an opportunity arrives, the simulated number of franchised outlets corresponding to this draw, which is most likely to be very small, is included to compute the distribution. When the timing of entry is taken into account, however, a chain with unfavorable draws is likely to delay its entry into franchising, and therefore may not be included in the computation of the conditional distribution of the number of franchised outlets.