Ownership, asymmetric information, and quality of care for the elderly: Evidence from US nursing homes during the COVID-19 pandemic

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Abstract

A common cause of market failures is asymmetric information. For this reason, the reliance on market incentives and signals requires that quality of goods and services is properly observable and verifiable. This requirement is hard to meet in the case of credence goods, including most social services. In such environment, nonprofit providers can offer additional quality assurance compared to for-profit entities. When quality becomes better observable and verifiable, and hence could earn a market premium, market incentives are closer aligned with social welfare, and the quality gap expected between nonprofit and for-profit provision is likely to narrow. We explore this conjecture theoretically and empirically, using in the empirical part the case of US nursing homes during the COVID-19 pandemic.

The pandemic supplied new tangible and publicly observable nursing home performance measures such as infection and death rates among residents. These measures could serve as care quality indicators, revealing aspects and attributes of the nursing home care that remained hidden before the pandemic. The data reveal significant initial gaps between for-profit and nonprofit nursing homes in COVID-19 infection rates. However, in the ensuing catching-up process triggered by increased transparency, these gaps steadily declined, eventually leading to statistical parity between two types of ownership. We explore the role of local market structure in the adjustment of nursing home industry to the pandemic; retroactively evaluate the reliability of the official ranking system in predicting nursing homes' performance; and look for evidence of sustainable learning-by-doing effect of the pandemic.

1 Introduction

Market incentives are expected to deliver economic efficiency unless market fails. A common cause of market failures is asymmetric information, and hence the reliance on market incentives and signals requires that quality of goods and services is properly observable and verifiable. This requirement is hard to meet in the case of credence goods, including most social services, which is a well-known reason for caution when for-profit firms provide such services. Market incentives could prod for-profits to cut costs without regard for quality when unobservable quality reduction is not penalized by the market (Hart et al., 1997). This affords a reputational advantage to nonprofit providers, whose incentives to maintain quality are intrinsic, rather than shaped by a potentially socially misleading market incentives (Rose-Ackerman, 1996; Glaeser and Shleifer, 2001).

When quality for some reasons becomes better observable and verifiable and hence could earn a market premium, market incentives are closer aligned with social welfare, and the quality gap expected between nonprofit and for-profit provision is likely to narrow. In such environment, one can with greater confidence rely on market forces in social service delivery to lower costs and meet growing demand without the risk of socially suboptimal quality reduction. We explore this conjecture theoretically and empirically, using in the empirical part the case of US nursing homes during the COVID-19 pandemic.

Nursing homes are specialized facilities, which provide professional care for elderly individuals who typically suffer from physical and/or mental impairments and cannot deal with their everyday needs or rely on relatives' support. This is a growing social service industry, propelled by changes in modern society, demographic trends, and advances of medicine. The cost of professional care for the elderly is to various extent covered by public insurance programs, but in most countries, including the US, care providers are mainly private, either nonprofit or for-profit.

The shares of nonprofit, for-profit, and public (usually municipal) facilities in the nursing home market vary among countries and subnational units, reflecting cultural and political preferences, tradition, regulatory environments, etc. Nonprofits, with their emphasis on compassion and mission to serve the society, seem to be a good fit for providing care for the elderly. However, historically there were for-profit nursing homes as well (prevailing in the US), and their share grew recently in part due to capacity limitations of the nonprofit sector preventing it from meeting surging demand. Another important rationale for involving for-profits is the efficiency consideration – for-profit providers, driven by market incentives, are expected to better control the growing costs of care for the elderly, potentially making the service more affordable.

However, markets for health care in general (Arrow, 1963) and for elderly care in particular (Hansmann, 1980) are prone to failures due to significant informational asymmetry between service providers and con-

sumers. Health services are predominantly credence goods for the patients, who cannot properly assess their quality, necessity, and efficacy. This general informational asymmetry is further exacerbated in nursing homes, where patients are often not payers or decision-makers, and their physical and cognitive frailty limits the communication and complaint ability even when quality shortfalls are apparent to service recipients (Weisbrod, 1988). When quality of service is not properly observable to those who procure it, contracting for such service is problematic and quality would have only mild, if any, impact on the service fee. As argued above, in such environment one could expect ceteris paribus higher quality of services at nonprofit nursing homes than at for-profit ones.

This conjecture has been stated and tested in previous literature (see, e.g., a survey in Bos et al. 2016), where it found some empirical support. However, the evidence has not been conclusive, in part due to possible misspecifications of econometric models, as pointed out by Grabowski and Hirth (2003), but perhaps more importantly due to an inherent contradiction present in such attempts. Indeed, the very inability to externally verify quality, which in the first instance makes one to expect a quality gap between for-profit and nonprofit provision of care for the elderly, precludes straightforward identification and measurement of such a gap using publicly observable data.

To alleviate care quality concerns and protect nursing home patients, governments around the world deploy various regulations and reporting requirements based on observable outcome and quality proxies, imperfect as those may be. However, the impact of such measures has been mild at best (see e.g. Grabowski and Town 2011), which was made abundantly clear during the COVID-19 pandemic – regulations on the books did not protect nursing home patients from staggering infection rates and massive loss of life. Many long-term care facilities turned into pandemic hotspots, where the numbers of infected and deceased were far in excess of the infection and mortality rates in the same age cohorts outside of nursing homes.[1] Breakdowns of care quality, possibly in pursuit of financial gains, made nursing homes particularly vulnerable to the coronavirus. Insufficient number and qualification of nursing home personnel, substandard hygiene, inadequate stocks of protective equipment, overcrowding, and other heretofore concealed deficiencies resulted in high infection and mortality rates during the pandemic. Thereby, the pandemic had temporarily reduced the informational asymmetry in the care for the elderly by making at least some quality shortfalls palpable, publicly observable and, even if indirectly, objectively measurable.[2]

Increased transparency of the quality of care in the nursing home sector during the COVID-19 pan-

[1] In the US, by August 15, 2021 COVID-19 death rate in nursing homes was 23 times higher than the same rate for the population 65 and older not residing in nursing homes (Cronin and Evans, 2022)

[2] In Warren Buffet's metaphor for an exogenous shock exposing substandard performance, "You only learn who has been swimming naked when the tide goes out." (https://www.berkshirehathaway.com/letters/2007ltr.pdf) In the case of nursing homes, "the pandemic has lifted the veil of what has been an invisible social ill for decades" (National Academies of Sciences, Engineering, and Medicine 2022, p. 1)

demic opened new analytical opportunities by making available new objective performance measures such as COVID-19 infection and mortality figures. Several studies (reviewed in Bach-Mortensen et al. 2021; Kruse et al. 2021) detected higher COVID-19 incidences and mortality at for-profit facilities. However, the observed differences between COVID-19 outcomes at for-profit and nonprofit nursing homes were not as strong and robust as some might have expected, which calls for an explanation.

In this paper, we argue that COVID-19 not only exposed quality shortfalls hidden before the pandemic from public eyes — a "gotcha" effect caused by a sudden exogenous shock, – but was also a game changer in the nursing home industry by way of reducing, at least for the time being, the informational asymmetry that apparently caused quality problems. Greater transparency transformed the market environment and the incentives in the nursing home sector. We contend that for-profit nursing homes were caught off guard by COVID-19 and initially failed their patients, often dramatically, whereas nonprofit nursing homes were relatively safer places in terms of keeping COVID-19 at bay. However, once new quality indicators had become publicly observable and, therefore, relevant for financial outcomes, for-profit nursing homes were prompted to take necessary remedial measures. Against the backdrop of the pandemic, the same high-powered market incentives that earlier pushed for-profit nursing homes to cut corners with respect to unobservable aspects of quality, worked during the pandemic to improve the now observable quality indicators. This transformation revealed the potential of for-profits to offer quality care under reduced informational asymmetry.

We offer a stylized theoretical model explaining the behavior of nonprofit and for-profit providers of a social service, operating under variable degrees of informational asymmetry. A comparative statics analysis describes responses of both types of providers to changes in the elasticity of financial reward to service quality. The model generates testable hypotheses, which are brought to data on the performance of US nursing homes during the pandemic. Our main source of information is the database assembled by the US Government's Centers for Medicare and Medicaid Services (CMS), to which US nursing homes were required to report on a weekly basis. We use the database to create a panel covering approximately 9,300 nursing homes over the observation period from late May 2020 through the end of 2021. This enables us to go beyond taking a snapshot of US nursing homes industry at some point during the COVID-19 pandemic and to study the dynamics of the industry's response and adjustment to the new level of transparency.

Econometric analysis employing different versions of the difference-in-difference approach reveals significant gaps between for-profit and nonprofit nursing homes in COVID-19 infection rates and, of a somewhat lower magnitude, in COVID-19 death rates early on in the pandemic. However, in the ensuing catching-up process triggered by increased transparency, these gaps steadily declined, eventually leading to statistical parity between two types of ownership. Such dynamics show that the market incentives to deliver quality service, unleashed by greater transparency during the pandemic, were on par or in some aspects even stronger

than non-market incentives to maintain quality in the nonprofit provision. It is noteworthy that death rates from all causes, including COVID-19, at the outset of the pandemic were statistically indistinguishable between for-profit and nonprofit nursing homes, but soon thereafter and through the rest of our observation period, for-profits surpassed nonprofits in saving residents' lives.

We also study factors that affect nursing homes' responses to increased transparency, with particular focus on the role of competition in the care for the elderly – a topic that received significant attention in the literature (see e.g. Starkey et al. 2005; Grabowski and Town 2011; Yang et al. 2022). Predictably, competition noticeably accelerates quality improvement in the for-profit segment relative to nonprofits, especially in the middle of the 83 weeks observation period, after for-profit nursing homes had had time to respond to the heretofore absent competitive pressure to improve quality, and before they have reached their production possibility frontier. We also present evidence of a yardstick competition effect of nonprofit nursing homes on the for-profit segment. Nonprofit institutions served as local standard-bearers by better protecting their patients from COVID-19 at the outset of the pandemic; in the absence of such a yardstick effect, competition and transparency alone might not trigger immediate corrective measures by for-profit providers, which could for some time "sit on their hands" in a war of attrition-type waiting game.[3]

We also perform a test of the reliability of the official Five-Star nursing home ranking system as a quality of care measure by comparing nursing home rankings with COVID-19 outcomes. We observe a highly significant and robust *positive* correlation between nursing home rankings and COVID-19 infection rates, especially among for-profit nursing homes, suggesting that official rankings could be misleading at least with regard to quality components that affected the pandemic outcomes.

Finally, we investigate whether the improvement in the performance of nursing homes was only a temporary response to the exigencies of the COVID-19 pandemic or a longer-term sustainable correction. While more time and data are needed to answer this important question, we present preliminary evidence pointing to a lasting learning-by-doing effect, which had left nursing homes, especially for-profit ones, "burned" by the COVID-19 initial onslaught, better prepared to handle subsequent waves of the pandemic.

The paper contributes to several strands of the literature, including those on the impact of the COVID-19 pandemic and on nursing homes operation and performance. More generally, it sheds new light on the role of ownership, asymmetric information, and competition in the outsourcing of public goods and services to for-profit providers. Improved transparency, even brought about by extraordinary means, better aligns market incentives with social welfare and closes the quality gap that might otherwise exist between nonprofit and for-profit provision. This is an important lesson of the COVID-19 pandemic, which has revealed the

[3]This is another version of the positive spillover effect from nonprofit to for-profit nursing homes, earlier described in Grabowski and Hirth (2003). In our analysis, such spillover occurs in nursing homes' responses to improved transparency whereas in Grabowski and Hirth (2003) it operates under persistent informational asymmetry.

potential of for-profit provision of care for the elderly (and perhaps similar some other similar social services) when informational asymmetry is alleviated. However, even when markets are competitive and informational asymmetry reduced, nonprofit providers still have a role to play, being catalysts of quality improvement and maintenance in the for-profit segment.

The paper proceeds as follows. In Section 2, we review the literature on social service outsourcing to private providers, for-profit and nonprofit, with a focus on care for the elderly. Section 3 presents a theoretical model, which compares performance of for-profit and nonprofit providers depending on the available quality premiums. Section 4 provides background information on nursing homes in the US, including the impact of the COVID-19 pandemic. In Section 5, we describe the data and outline empirical strategies. Main empirical results are presented in Section 6. Section 7 concludes.

2 Economics of social service delivery

While governments to various extent assume responsibility for social service delivery, such services are commonly provided by nongovernmental entities. Direct (in-house) social service delivery by government agencies could be inefficient and inflexible due to bureaucratic rigidity and well-known difficulties to set proper performance incentives in government hierarchies (Wilson, 1991; Prendergast, 2003; Dewatripont et al., 1999). Private sector, with its advantages of decentralized decision-making, market incentives, and competition offers an appealing alternative which calls for outsourcing of social service delivery to commercial for-profit firms.

This approach has clear limitations, since markets for social services are prone to failures due to various external effects and asymmetric information. External effects of health, education, etc., can be handled by public subsidies and transfers, but the informational asymmetry problem is harder to resolve. Often recipients of a social service cannot properly observe and verify its quality (especially in health care (Arrow, 1963) and to some extent in education), which makes such services credence goods. In many instances (daycares, nursing homes, mental health institutions, etc.), service recipients are not those who pay for it and/or choose providers, and therefore lack "market voice" even when they observe quality and find it inadequate (Frank and Salkever, 1994). Voluntary quality disclosure by all providers known as 'unraveling' is rarely observed in social service provision due to verification difficulties, market power, heterogeneous preferences, multidimensional quality, regulated prices, and other factors (Dranove and Jin, 2010). Mandatory certification and quality disclosure ('report cards') have their own limitations and more often than not do not provide comprehensive, reliable, and actionable quality information (ibid; see also Section 4).

Informational asymmetry opens room for moral hazard when a profit-driven service provider sacrifices

unobservable aspects of service quality to cut cost with no effect for revenue. This business behavior arises, for example, when third parties, such as social welfare programs and insurance companies, pay for a social service on a pre-set fee basis, and service quality cannot be authenticated by customers, insurers, and regulators, and, therefore, is not contractible. In such case, priority is given to cost reduction, "provided that quality does not suffer 'too much'" (Weisbrod 1991, p. 537). As a result, high-powered market incentives are typically misaligned with social welfare by asymmetric information.

Hart et al. (1997) studied this predicament in the property rights and incomplete contract framework, whereby a profit-seeking service provider under contract with the government could implement innovations affecting service cost and/or quality. When quality is unobservable and hence non-contractible, its reduction would not breach a service contract and carry a market penalty. Therefore, a for-profit provider will pursue cost cutting too aggressively, with collateral damage to quality far in excess of cost savings.[4]

Another quality vulnerability of profit-driven social service provision could be due to misallocation of efforts and other inputs between quality ingredients. A service provider facing a multi-tasking problem (Holmstrom and Milgrom, 1991) allocates efforts and other resources between quality components depending on how they affect service fee, rather than overall quality. Financial reward could misrepresent quality when informational asymmetry is uneven across quality ingredients, some of which are less observable (or costlier to monitor) than others. This leads to underinvestment in the former and overinvestment in the latter (Weisbrod 1991; see also Feng Lu 2012). In such cases, in-house provision by a government agency, inefficient as it may be, could be the second-best option. Ironically, for-profit firms could cause problems precisely due to their trademark propensity to innovate, which is misdirected by informational asymmetry.

However, for-profits are not the only alternative to government provision of social services – a yet another option is to involve nonprofit providers. Nonprofits, by their definition and legal statute, do not distribute profit; instead, their raison d'être is to serve a social purpose and fulfil a mission ('ideological commitment', see Rose-Ackerman 1990). Nonprofits are less likely to take advantage of informational asymmetry for two related reasons: (i) their incentive to cut cost, possibly to the detriment of quality, is not as strong as for-profits', and (ii) they internalize quality as a part of their mission and strive to maintain or improve quality even if it earns little or no market reward. Therefore, in resolving the cost vs. quality tradeoff, nonprofits put greater emphasis on the latter, and hence nonprofit status of a service provider could give some additional quality assurance (serve as a "trust signal"). This conjecture was initially formulated by Arrow (1963) with regard to medical services, and subsequently extended by Hansmann (1980) onto the nonprofit sector in general.

[4]This effect could be more pronounced in the case of private equity ownership of for-profit providers, when the incentives for short-term profit maximization are particularly strong (Gupta et al., 2021)

Nonprofits could be seen as a property rights solution to the quality problem arising under asymmetric information. Chou (2002) used proxies of informational asymmetry specific to nursing homes[5] to show that when such informational asymmetry is present, the nonprofit status significantly reduces death rates and adverse health outcomes in comparison to for-profits, but in its absence, the difference becomes statistically insignificant.

Greater trust in nonprofits makes them an attractive alternative to the government in social service delivery. For-profits and nonprofits usually share the market for social services in proportions that vary across nations and subnational jurisdictions and from one type of service to another (Rose-Ackerman, 1996). Nonprofits are subject to tighter capacity constraints due to their inability to raise equity financing and reliance on pro-social motivation (Rose-Ackerman, 1990), and because they often serve as niche providers, meeting special needs in social services left unattended both by for-profits and by governments (Weisbrod, 1988).

The borderline between for-profits and nonprofits is not watertight – both deliver services and raise revenues[6], possibly in excess of costs. While for-profits can distribute a surplus to owners, nonprofits are bound by the non-distribution constraint and should treat a surplus as retained earnings to fund future activities. In practice, there could be ways around the non-distribution constraint (e.g. by paying inflated salaries, providing valuable perquisites, etc.), which allows to disguise essentially for-profit activities as nominally nonprofit ones. An opportunistic for-profit entrepreneur can rationally select nonprofit status to take advantage of tax benefits conferred to nonprofits and especially of greater trust in nonprofits among consumers and third parties paying for the service (Hansmann, 1996). Such mimicry could explain why empirical studies (reviewed, e.g., in Grabowski and Hirth 2003, see also Molinuevo et al. 2017) do not consistently demonstrate quality advantage of nonprofit providers of care for the elderly.

Glaeser and Shleifer (2001) assume that actual quality of service is completely unobservable, but expected quality affects provider's revenue. In this case, all (identical) providers will opt to be either nonprofit or for-profit, depending on the importance of quality for consumers. It is also possible that the two ownership types share the market. This can happen when providers are heterogeneous (e.g., in their altruism and/or ability to bypass the non-distribution constraint) or there is variation of tastes for quality between consumers. Hirth (1999) explains coexistence of for-profit and nonprofit providers by uneven ability of customers to authenticate service quality, in which case uninformed customers in search of quality assurance turn to

[5]These proxies are the decline of residents' cognitive abilities and lack of visitation by relatives; it was argued earlier in the paper that such factors limit residents' ability to reveal service failures to those who select providers and pay for their services.

[6]While many nonprofits are funded by grants and donations, even more are "commercial nonprofits" (Hansmann, 1980) which sell their services (see also Rose-Ackerman 1990). This further blurs the divide between for-profit and nonprofit segments. The difference, in a nutshell, is between ends and means: for nonprofits, a service (or quality thereof) is the "end", whereas revenue is a means to this end; whereas in the case of for-profits ends and means are in reverse.

nonprofit providers (see also Spector et al. 1998), whereas informed customers obtain the service from for-profit providers and pay, in a vertically differentiated market, quality-reflecting prices. In such equilibria, nonprofits, apart from offering higher quality, produce an external effect (empirically confirmed on US nursing home data in Grabowski and Hirth 2003) on the for-profit segment by increasing the level of quality awareness among for-profits' customers and, therefore, reducing the room for opportunistic behavior in the for-profit segment.[7] If the non-distribution constraint is not properly enforced, a hybrid equilibrium obtains, where some providers driven by profit motive take advantage of the favorable collective image of nonprofits, in which case quality signal of the nonprofit status dissipates.

An important argument for social service delivery by private providers, both for-profit and nonprofit, is competition, which is expected to reduce cost, improve quality, and, more generally, increase social welfare. Indeed, when information is symmetric and absent government intervention, competition between for-profit providers at every quality level results in efficient vertically differentiated market (Hart et al., 1997). However, under asymmetric information, competition does not necessarily solve the quality problem, because unnoticed and hence unrewarded by the market quality improvement (at higher cost) would put a service provider at a competitive disadvantage. Heavy presence of governments (as donors, contractors, and regulators), considered as alternative to competition in quality assurance, further diminishes the role of competition in social service markets (Starkey et al., 2005; Hackmann, 2019). Furthermore, social service markets are often localized (geographically differentiated), which gives providers significant market power protected by entry barriers such as government certification requirement.

The vast literature on the impact of competition on the quality of health care, surveyed in Gaynor and Town (2011), and in the nursing homes sector in Yang et al. (2022), produces an unsurprisingly mixed picture with no robust and consistent effects observed across specifications, countries of the world, and measurement approaches. While in some studies covered by the above surveys competition improves quality, in others it has an adverse effect, and in yet others such effect is non-monotonic or altogether absent. It is noteworthy, however, that competition increases quality payoff to transparency-enhancing measures (Grabowski and Town, 2011; Zhao, 2016). Similarly, some studies reviewed in Yang et al. (2022) show that the impact of competition on quality is conditional on public reporting of quality information, implying complementarity between the two.

The literature reviewed above implies that market incentives could be an asset or a liability in social service delivery depending on how well they align with social welfare, and such alignment in its turn de-

[7] In the same vein, Neumayr and Meichenitsch (2011; see also Molinuevo et al. 2017) observe a 'radiation effect' of the nonprofit segment, which exerts competitive pressure on for-profit providers to reach the same standards of care. This mechanism, however, could be questioned inasmuch as quality is unobservable, but we describe a similar effect later in the paper, when the COVID-19 pandemic lessened informational asymmetry.

pends on whether quality is properly observable and contractible. Informational asymmetry underpins the relationship between two main outcomes of social service provision – service quality and financial reward, to which for-profit and nonprofit providers assign different weights. When informational asymmetry varies between services, or for a given service in response to regulations or exogenous shocks, it becomes a 'sorting factor' in providers' choices and affects relative quality and social efficiency between for-profit and nonprofit delivery modes. Intuitively, greater transparency improves equilibrium quality of service obtained from for-profit providers in relation to nonprofit ones. In the next section, we offer a theoretical model and perform a comparative statics analysis, which makes this intuition more precise.

3 The model

The following theory builds on Hart et al. (1997). We assume that a service provider selects a technology based on two main outcomes, both measured in monetary terms: private reward r to the provider, calculated as gross revenues reduced by the operating costs, and public benefits (quality) Q of the delivered service. Private reward could reflect public benefit inasmuch as the quality is externally observable and verifiable, and, therefore, affects price, sales etc. However when the service is a credence good, this link is weak or altogether absent. To increase private reward, the provider could also reduce operating cost and/or enhance observable service attributes, considered as quality proxies and as such affecting revenue whether or not these attributes reveal actual quality or its essential ingredients (Dranove and Jin, 2010). A technology that delivers a certain combination of public benefit and private reward requires effort ("innovation", as in Hart et al. 1997), which carries (intangible) costs to the service provider.[8]

For-profit and nonprofit providers put different valuations on private financial rewards and public benefits. For a for-profit provider, private reward is the sole driver of production decisions, and the incentives for greater quality arise only to the extent that quality affects the financial bottom line. For a nonprofit provider, we assume (as is common in the third sector literature) that nonprofits are driven by a sense of mission and hence have some intrinsic incentive to provide quality service in addition to or instead of the purely financial incentives. As for the latter, the non-distribution constraint technically speaking precludes nonprofits from claiming the financial private reward. However, we allow, as, e.g., in Hirth (1999) and Glaeser and Shleifer (2001), that a nonprofit provider can to some degree get around such constraint and appropriate a portion of the private reward (or carry it forward to fund future operations).

[8]This intangible individually borne cost serves as a common anchor for both types of ownership, as opposed to the tangible service delivery cost, which enters into the innovation selection differently depending on the ownership type, as explained below.

3.1 Model setup

Consider a production unit that provides a public service of quality Q, measured by the contribution of the service to social welfare. As in (Hart et al., 1997), we assume that there is a basic level of service, which the provider can alter by implementing innovations affecting two main outputs: service quality and net financial reward. At the basic level, service quality is Q_0, production cost C_0, and service price P_0 (for simplicity assume $P_0 = C_0$).

There are two types of innovations: $q \geq 0$ and $r \geq 0$, the first increases quality from its basic level to $Q = Q_0 + q$, and the second increases net financial reward of the provider by r with no impact on quality (by lowering the production cost at the same quality level or by investing in service attributes affecting financial reward, but not reflecting true quality). Quality improvement q earns a financial premium ϵq, for some $\epsilon \in [0, 1]$. Coefficient ϵ is an inverse measure of informational asymmetry; when quality information is fully asymmetric (i.e., the service is a credence good), $\epsilon = 0$. Overall, net private reward to the provider is $R = \epsilon q + r$.

To develop and implement innovations q,r delivering outcomes Q,R, the provider incurs intangible cost $C(q, r)$, reflecting the invested effort, time, entrepreneurial energy, etc. The cost function $C(q, r)$ is smooth, strictly convex, monotonically increasing in its arguments, and such that

$$C_{qr}(q, r) > 0. \tag{1}$$

Condition (1) reflects the plausible assumption that lower quality leaves more room for quality-neutral innovations that increase private reward, e.g., by cutting corners in aggressive cost reduction. More generally, $C_{qr}(q, r) > 0$ when quality- and profit-enhancing innovations crowd out each other by competing for the same limited pool of entrepreneurial energy and similar multi-purpose resources; for this reason, we will hereafter refer to (1) as the common-pool condition.

This general model includes a specification, considered in Hart et al. (1997), where innovations either improve quality or reduce the production cost (at the expense of lower quality), in which case r is cost reduction. Rather than assuming, as in the above paper, that cost reduction has an immediate adverse effect on quality, we employ a more flexible framework whereby q and r components are initially decoupled from each other and various combinations of q, r are attainable, each at its own intangible cost of generating the necessary innovations. In this framework, production cost could be lowered without a collateral damage to quality, but due to the common-pool condition, maintaining quality while cutting production cost would be more difficult for the provider in comparison to sacrificing quality along the way[9]. Therefore, overall choice

[9]This general formulation includes as a special case the model considered in Hart et al. (1997). In that model, $C = e + i$,

of the provider still involves the quality vs. cost tradeoff.

In another specification, less discussed in the literature, private reward can be increased by investments into observable attributes that are taken by the market as quality proxies (and thereby affect provider's remuneration), but in fact could significantly deviate from the actual quality. A wedge between latent quality and its observable surrogates could be due to the omission or misrepresentation of some essential quality ingredients in "report cards"; to ad hoc aggregation procedures used to obtain overall rankings, scores, etc.; to manipulation by disclosed data; and to other similar reasons. If the private reward $R = \epsilon q + r$ depends on such observables, the ϵq part rises to the extent that the observables reflect actual quality, whereas the residual r is the net revenue increase earned by quality-unrelated investments into the observables. For example, provider's response to the information disclosure requirements could be to "[reallocate] efforts across dimensions of quality, with potentially no net benefits for consumers" (Dranove and Jin 2010, p. 955). In this specification, the conflict between social and private interest, which arises due to informational asymmetry, is particularly stark, since privately rewarding innovations brings no societal benefits whatsoever, being pure rent-seeking.[10]

Notice that in all such cases the potential conflict between investments q and r into public benefits and private rewards arises not because innovations r directly reduce quality, but because due to the common-pool condition quality can be strategically sacrificed to facilitate and simplify quality-unrelated increase of private reward. The extent to which this temptation affects providers' choices depends on whether the provider operates as a for-profit or nonprofit entity.

3.2 Providers' choice

For-profit provider selects the technology to maximize net revenue, reduced by the intangible cost of innovation: $U_{fp}(q, r) = \epsilon q + r - C(q, r)$, and the choice q_{fp}, r_{fp} satisfies the following FOC (assume for simplicity interior optima):

$$C_q(q_{fp}, r_{fp}) = \epsilon, C_r(q_{fp}, r_{fp}) = 1. \tag{2}$$

Nonprofit providers, according to Hansmann (1987) (see also Glaeser and Shleifer 2001) have weaker financial incentives (since they cannot fully appropriate an operating surplus), but at the same time inter-

where e is the cost to the provider of generating an innovation that cuts operating costs by $c(e)$ and reduces quality by $b(e)$, whereas i is the cost of generating an innovation that increases quality by $\beta(i)$ without affecting operating costs. All of the above functions are monotonic and $c(e)$ and $\beta(i)$ are concave, whereas $b(e)$ is convex. In this case $r = c(e)$,$q = \beta(i) - b(e)$, and $C(q, r) = c^{-1}(r) + \beta^{-1}(q + b(c^{-1}(r)))$. One can easily verify that this function is convex and monotonic and satisfies the common-pool condition.

[10] Both versions can be combined by allowing innovations that achieve quality improvement q, operational cost reduction r_1, and net gains r_2 from privately remunerative but quality-neutral observables, with the intangible cost of the above innovations $\tilde{C}(q, r_1, r_2)$. This modification also falls into the above general setting, with the reduced-form cost function $C(q, r) \equiv \min_{r_1+r_2=r} \tilde{C}(q, r_1, r_2)$.

nalize to some extent quality improvement, beyond what is captured by the service fee, due to a "warm glow" effect (sense of mission, purpose, ideological commitment, etc.)[11]. The utility function of such provider is as follows: $U_{np} = \alpha(\epsilon q + r) + \beta q - C(q, r)$, and the selected combination q_{np}, s_{np} satisfies the following FOC:

$$C_q(q_{np}, r_{np}) = \alpha\epsilon + \beta, C_r(q_{np}, r_{np}) = \alpha. \tag{3}$$

Here $\alpha < 1$ is the share of the surplus that a nonprofit operator can still keep, notwithstanding the non-distribution constraint (through higher salaries, perks, etc.)[12], and $\beta < 1$ is a "warm glow" effect, measured by the degree to which a nonprofit provider internalizes quality improvement (we assume, as in Glaeser and Shleifer (2001), partial internalization).

Choices made by for-profit and nonprofit providers could be compared not only to each other, but also against the normative benchmark maximizing net social welfare gains. When private reward r represents reduction of production cost, social welfare gains are as follows: $SW = q + r - C(q, r)$, and socially optimal innovations q^*,r^* obtain from the following first-order conditions (still assuming interior optimum):

$$C_q(q^*, r^*) = 1, C_r(q^*, r^*) = 1. \tag{4}$$

When private reward r is earned by socially unproductive investments into quality-neutral observable attributes, socially optimal level of such innovation is zero, while quality innovations still satisfy the condition $C_q(q^*, r^*) = 1$, with $r^* = 0$. For simplicity, in the comparisons of provider's choices with social optimum we will be assuming that private reward-increasing innovations cut production cost and social optimum is described by conditions (4).

Notice that the first-best and the choices of for-profit and non-for-profit providers can all be obtained as optimal production decisions of an imaginary for-profit firm that produces two innovation outcomes, q and r, with the cost function $C(q, r)$, and sells these outcomes at some prices p_q and p_r. Supply decisions of such firm $q = q(p_q, p_r)$ and $r = r(p_q, p_r)$ maximize its profit $\Pi = qp_q + rp_r - C(q, r)$ and generate the above described allocations for the following "price" combinations:

- first-best allocation: $p_q = p_r = 1$
- for-profit allocation: $p_q = \epsilon, p_r = 1$

[11] It is assumed that a for-profit provider feels no "warm glow." In reality, for-profits could still be to some degree motivated by professional ethos, compassion, and corporate social responsibility, which creates warm glow-like incentives to maintain quality beyond what the market requires, acknowledges, and rewards. Vice versa, as mentioned in the previous section, service providers with weak or absent "warm glow" can strategically select a nonprofit status to take advantage of better collective reputation of the nonprofit group. The model can be modified to capture such effects.

[12] Other than sidestepping the non-distribution constraint, a nonprofit provider can be motivated to generate a carry-forward financial surplus to fund future activities. The model could be modified into a multi-period version to yield conclusions and hypotheses similar to those presented below.

- nonprofit allocation: $p_q = \alpha\epsilon + \beta, p_r = \alpha$.

Lemma. *Each outcome $q = q(p_q, p_r)$,$r = r(p_q, p_r)$ increases in its own price and decreases in the cross-price.*

Proof. Function $\Pi(q, r; p_q, p_r) = qp_q + rp_r - C(q, r)$ is supermodular in $q, -r$ (due to the common-pool condition) and for a given p_r has increasing differences in $(q, -r)$ with respect to p_q, and therefore due to Topkis's Theorem (Topkis, 1998) $q(p_q, p_r)$ and $r(p_q, p_r)$ are respectively increasing and decreasing functions of p_q. Similar arguments show that these functions are respectively decreasing and increasing in p_r. □

3.3 Outcome comparisons

In general, neither nonprofit nor for-profit delivers first best. For-profits respond to the "correct" price of cost reduction, but if $\epsilon < 1$, undervalue quality improvement. This leads to overinvestment in the former and underinvestment in the latter as a joint outcome of full-scale financial incentives and weaker market discipline to maintain quality.

Proposition 1. *For $\epsilon < 1$, the for-profit provider cuts cost in excess of what is socially optimal, and under-provides quality improvements.*

Proof. Since $p_q = \epsilon < 1$, $p_r = 1$, the result immediately follows from the Lemma. □

Intuitively, for-profits undervalue quality, which leads to suboptimal quality investments. In their turn, low quality due to the common-pool condition facilitates excessive cost-reduction and pushes it above the socially optimal level. Figure 1a provides a diagrammatic illustration.

Nonprofits in general undervalue both outcomes. However, when service fees are mildly responsive to quality, which corresponds to high level of informational asymmetry, nonprofits have stronger incentives for quality improvements, but still below the social valuation of quality.

Proposition 2. *If $\alpha\epsilon + \beta < 1$, nonprofit provider delivers less than socially optimal levels of cost reduction or quality improvement, or both.*

Proof. One has $q^* + r^* - C(q^*, r^*) > q_{np} + r_{np} - C(q_{np}, r_{np})$; $(\alpha\epsilon + \beta)q_{np} + \alpha r_{np} - C(q_{np}, r_{np}) > (\alpha\epsilon + \beta)q^* + \alpha r^* - C(q^*, r^*)$. Adding these two inequalities gives $(1 - (\alpha\epsilon + \beta))(q^* - q_{np}) + (1 - \alpha)(r^* - r_{np}) > 0$. Since both α and $\alpha\epsilon + \beta$ are less than unity, at least one of the differences $q^* - q_{np}$ and $r^* - r_{np}$ must be positive (see also Figure 1b). □

Warm glow β is the main driver of quality provision by nonprofits. The add-on of market incentives is diminished by the "double jeopardy" of the ownership status, which implies the non-distribution constraint, and by informational asymmetry, which makes financial reward inelastic to quality. However, even if the

combined effect of warm glow and market falls short of the social valuation of quality, nonprofit providers could still achieve and even surpass the socially optimal level of quality. Such outcome is possible since low investment in cost reduction (reflecting nonprofits' weak financial incentives) due to the common-pool condition reduce the marginal cost to the provider of quality innovations, making such innovations easier to develop and implement. Put differently, being less concerned about financial outcomes, nonprofits can draw from a broader pool of quality-enhancing innovations, which compensates for the relative weakness of incentives to increase quality. Formally, if r_{np} is small enough so that $C_q(q^*, r_{np}) < \alpha\epsilon + \beta$, then $q_{np} > q^*$.

Proposition 3. *If $(1-\alpha)\epsilon < \beta$, for-profit provider increases private reward more than nonprofit and delivers lower quality than nonprofit.*

Proof. Consider three sets of "prices" p_q, p_r: $(\alpha\epsilon + \beta, \alpha)$; (ϵ, α); and $(\epsilon, 1)$. The first set yields the nonprofit provision, and the third – the for-profit one. According to the Lemma, q decreases and r increases when moving from the first to second set and from the second to the third (Figure 1c). □

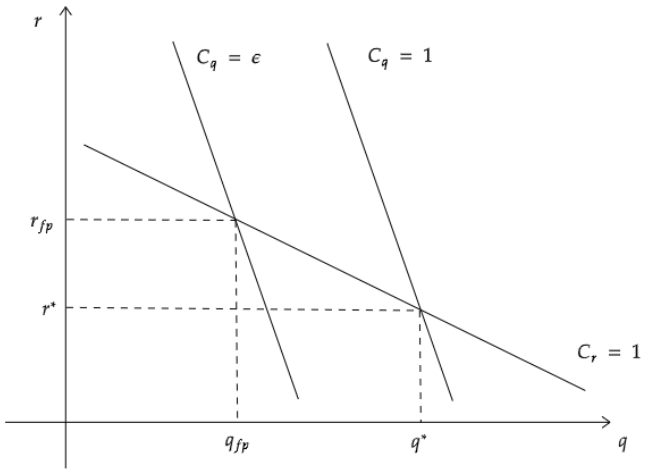
Intuitively, for-profit providers always value private reward more than nonprofits, and if in addition, quality improvements are valued by for-profits and nonprofits in the reverse order (when warm glow is strong and/or service fee is only weakly connected to quality due to informational asymmetry), then nonprofits deliver higher quality and lower private rewards than for-profits.

From the social welfare perspective, none of the two options, for-profit or nonprofit, is unconditionally superior to the other. Which of them delivers the second best, depends on the feasibility of different types of innovations and on the ability to reflect quality in the service fee. We begin with the role of "innovation technology" presented by the cost function $C(q, r)$. If there is only a narrow room for quality improvement relative to cost reduction or, which is the same, quality improvement innovations are very costly to design and implement, the matter is decided by the providers' incentives to reduce cost. This gives the advantage to for-profits, where such incentives are socially optimal, as opposed to nonprofits.[13]

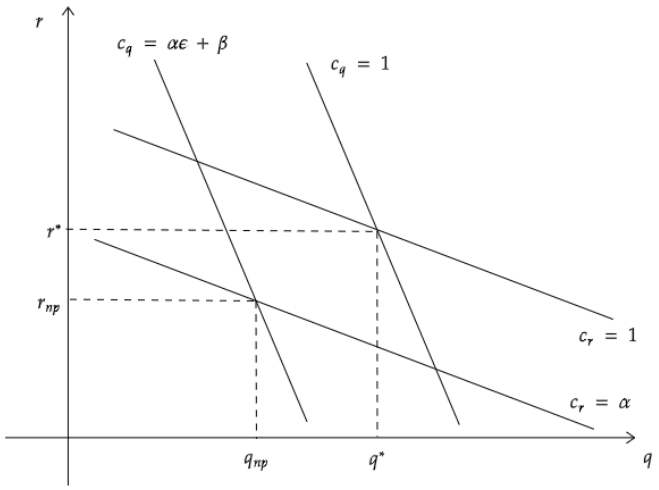
Proposition 4. *Consider the following parametric family of cost functions: $C(q, r; \sigma) = C^{(0)}(\sigma q, r)$, for $\sigma > 0$. Then for σ high enough, for-profit provision delivers greater social welfare than nonprofit one.*

Proof. At the limit when $\sigma \to \infty$, there are zero quality innovations in the social optimum and both in the nonprofit's and for-profit's selections. The investments in cost reduction made by for-profits are socially optimal, satisfying the equation $C_r^{(0)}(0, r) = 1$, whereas in the case of nonprofits such investments satisfy the equation $C_r^{(0)}(0, r) = \alpha < 1$, and are thus suboptimal. This means that innovations implemented by

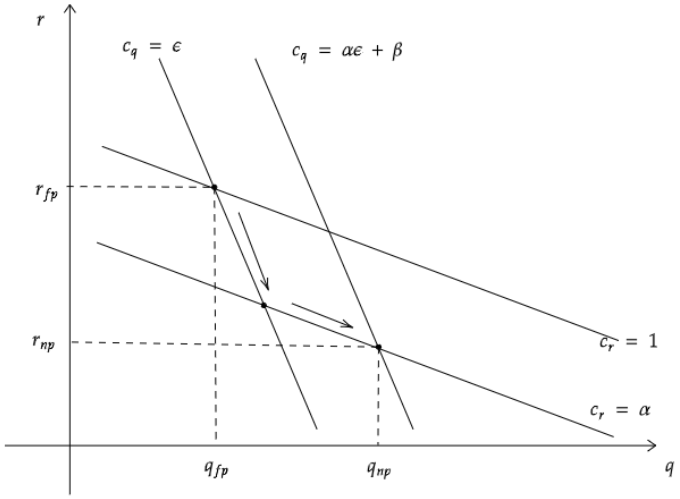
[13] Hart et al. (1997) similarly conclude that when cost reduction does not cause significant collateral damage to quality, outsourcing of a social service to for-profits is preferable to in-house public provision. Quality can be protected when it is sufficiently observable and hence contractible. In this paper, we explore the role of informational asymmetry (Proposition 6) separately from innovation technologies.



(a) For-profit vs social optimum



(b) nonprofit vs social optimum



(c) For-profit vs nonprofit

Figure 1: Diagrammatic illustrations of propositions

for-profits approximate social optimum, whereas nonprofits' innovations are suboptimal, and therefore the former deliver second best for sufficiently high σ. □

Vice versa, when opportunities for cost reduction are limited but substantial quality improvements are possible, nonprofit providers deliver the second best.

Proposition 5. *Assume a parametric family of cost functions $C(q, r; \sigma) = C^{(0)}(q, \sigma r)$ for $\sigma > 0$, and let $\epsilon < \alpha\epsilon + \beta < 1$. Then for σ high enough, nonprofit provision delivers greater social welfare than nonprofit one.*

Proof. Observe, similarly to Proposition 4, that at the limit when $\sigma \to \infty$, there are zero innovations in cost reduction in all three cases – social optimum, provision by nonprofits, and provision by for-profits. Innovations in quality improvement in these cases satisfy the following FOC: $C_q^{(0)}(q^*, 0) = 1$; $C_q^{(0)}(q_{np}, 0) = \alpha\epsilon+\beta$; $C_q^{(0)}(q_{fp}, 0) = \epsilon$. Since $C^{(0)}$ is convex, one has $q_{fp} < q_{np} < q^*$, and social welfare gains $q - C^{(0)}(q, 0)$ are increasing in $q \in [0, q^*]$, which puts the nonprofit provision in the second best position relative to provision by for-profits. □

We now turn to comparative statics with regard to the private reward's reflection of quality (via a quality premium component). Recall that the main issue with for-profit provision is a relatively weak financial incentive to deliver higher quality service. In the case of negligible quality premium, i.e., when quality is unobservable, market incentives prompt for-profit providers to sacrifice quality in order to expand opportunities for quality-unrelated profit increase. If quality earns a greater premium to the provider, it alleviates this problem, as the same market incentives now work to facilitate quality improvement.

Proposition 6. *For a for-profit provider, an increase in ϵ leads to greater quality q and lower investments in the quality-unrelated component r of private reward. Social welfare in the case of for-profit provision monotonically increases in ϵ, reaching the first-best level for $\epsilon = 1$.*

Proof. Denote $q_{fp} = q(\epsilon), r_{fp} = r(\epsilon)$ for-profit's quality and reward-enhancing innovations satisfying FOC (2). Due to the Lemma, $q(\epsilon)$ and $r(\epsilon)$ are, respectively, increasing and decreasing functions of ϵ, which proves that when quality earns a higher financial premium, for-profits invest more in quality and less in quality-unrelated private reward. To show that social welfare $SW(\epsilon) = q(\epsilon) + r(\epsilon) - C(q(\epsilon), r(\epsilon))$ rises in ϵ, notice that due to (2),

$$SW'(\varepsilon) = (1 - C_q(q(\varepsilon), r(\varepsilon)))\, q'(\varepsilon) + (1 - C_r(q(\varepsilon), r(\varepsilon)))\, r'(\varepsilon) = (1 - \varepsilon)q'(\varepsilon) > 0.$$

When $\epsilon = 1$, conditions (3) and (4) are identical, and for-profit's choice is first best optimal. □

Greater sensitivity of private reward to service quality could affect the performance of nonprofit providers as well, inasmuch as such providers care about their financial bottom line ($\alpha > 0$). Since the quality "price" $p_q = \alpha\epsilon + \beta$ increases in ϵ while the cost reduction "price" $p_r = \alpha$ remains unchanged, an increase in ϵ, according to the Lemma 1, further increases quality and causes even less of cost reduction. However, in contrast with for-profits, improvement of social welfare in the nonprofit case cannot be assured even if quality valuation by nonprofits gets closer to its valuation by the society, because quality improvement is accompanied by a further decrease in cost reduction, possibly already below the socially optimal level r^*– see Proposition 2. This is an example of the "second best" principle (Lipsey and Lancaster, 1956), whereby reducing one distortion in the presence of others does not necessarily improve social welfare. There is no such caveat in the case of for-profit, which have the "correct" incentive to cut costs, and therefore bringing the provider's valuation of quality closer to the society's valuation unconditionally increases social welfare.

For-profits respond to greater elasticity in private reward to quality more vigorously, than nonprofits, where such response is dampened by the non-distribution constraint ($\alpha\epsilon$ instead of ϵ). This makes one to expect that quality increase caused by rising ϵ will be steeper in the case of for-profits than nonprofits, reducing the quality gap between the two, especially when the non-distribution constraint is sufficiently binding (α close to zero). In such "catching-up" process, once ϵ exceeds the threshold $\beta/(1-\alpha)$, the assumption of Proposition 3 is no longer satisfied, and it is possible that for-profits get ahead of nonprofits in terms of service quality. Such reversal reflects a "glass ceiling" for quality improvement by nonprofits in response to a rise in ϵ: nonprofit provider's valuation of quality never exceeds $\alpha + \beta$, which could be far below 1.

Based on the above, if the private reward does not sufficiently reflect quality ($(1-\alpha)\epsilon < \beta$), as per Proposition 3, one can expect higher quality from nonprofit providers than from for-profit ones. This prediction holds for both specifications of the theory, i.e., when private reward increases by cutting production cost or by quality-neutral investments into observable attributes perceived as quality proxies. Proposition 3, furthermore, makes one to expect more aggressive cost-cutting by for-profit providers, than by nonprofit ones, and/or greater quality-unrelated investments by for-profits into observables serving as quality proxies.

However, if the private reward to the providers becomes more sensitive to quality due to reduced informational asymmetry, then according to Proposition 6 the quality advantage of nonprofits diminishes, even making it possible for for-profits to get ahead of nonprofits in the service quality.

An opportunity to test such predictions is presented by the US nursing home industry, where both for-profit and nonprofit institutions co-exist in comparable shares, and where a major exogenous shock of the COVID-19 pandemic laid bare heretofore unobservable aspects of care quality, with far-reaching implications for the relative performance of for-profit and nonprofit providers.

4 US nursing homes: organization, trends and issues

Nursing homes in the US are the centerpiece of the nation's acute and long-term care system. They provide room and board, personal care and assistance with everyday activities, outpatient treatment, medications, monitoring of health conditions, hold social events and recreational activities, etc. In 2018, there were around 15,600 nursing homes in the country, with the gross capacity of more than 1,650,000 certified beds, serving over 1,300,000 residents (Sengupta et al., 2022). According to Brown and Finkelstein (2008), the probability that a 65 years old American is or will become at some point a resident of a nursing home is about 1/3, making nursing home residency a social and demographic mainstream in the US. In 2019, total US nursing homes expenditures were \$127.2 billion[14], or 0.8% of the GDP.

Most of US nursing homes are privately owned (70% in 2018), while less than a quarter (23% in 2018) operate as nonprofits (Sengupta et al., 2022). The 3.04 for-profit to nonprofit ratio in the US nursing homes sector is high by international standards[15] and well above the ratio for US hospitals (0.74 in 2022)[16]. The prevalence of for-profit nursing homes in the US reflects market trends and the de-facto public policy preference for private ownership, although the law does not discriminate between nonprofit and for-profit providers (Pradhan and Weech-Maldonado, 2011)[17].

While nearly all nursing homes in the US are non-government (either for-profit or nonprofit), federal and state governments are heavily involved in funding the residents and regulating the nursing homes sector. Public funding of nursing home residents is available through the federal Medicare and Medicaid programs. The Medicare funds temporary nursing home rehabilitation after medical treatment, while the Medicaid supports permanent stay at nursing homes of eligible elderly individuals. Administration of Medicaid and disbursement of federal funds are managed by states, which set eligibility criteria and specify covered services and amounts of coverage under a preset fee-for-service "prospective payment" system. To receive Medicare and/or Medicaid funding, nursing homes must be federally certified by the Centers for Medicare and Medicaid Services (CMS). Over 95% of nursing homes are Medicaid-certified, and nearly two-thirds of nursing home residents are Medicaid-funded (Yang et al., 2022). According to Lin (2015), Medicaid funding covers about half of the total US nursing home costs.[18]

Medicaid-certified nursing homes could accept both Medicaid-funded residents and those paying privately (usually at significantly higher prices.) By law, nursing homes are required to offer same quality of service to

[14] https://www.statista.com/statistics/184780/us-nursing-home-expenditures-since-1960/

[15] In many European countries (Grabowski, 2008; Molinuevo et al., 2017) there are fewer for-profit than nonprofit nursing homes, except the UK, where the ratio is even higher than in the US.

[16] https://aspe.hhs.gov/sites/default/files/documents/582de65f285646af741e14f82b6df1f6/hospital-ownership-data-brief.pdf

[17] For further details about the organization and operational environment of the US nursing home industry see National Academies of Sciences, Engineering, and Medicine 2022

[18] The second most significant (after Medicaid) source of funding of nursing home residency are private insurance and family support (Chou, 2002).

both private-pay and Medicaid-funded residents, making the former more lucrative for revenue and profit-motivated organizations. States regulate entry of new providers into the nursing home sector by issuing certificate-of-need (CON) and through periodic construction moratoriums. These supply restrictions caused excess demand for nursing home beds, especially among Medicaid-funded residents (Yang et al., 2022), but partial removal of the entry barriers eased the capacity bottleneck (Grabowski, 2008).

Overall, Medicaid funding has been a major boost for the US nursing home industry, prompting its rapid growth and consolidation from the original "mom and pop" stage. Initially, Medicaid was reimbursing "reasonable costs" of providers, and private capital responded enthusiastically to such "soft budget constraint." To control spiraling costs, Medicaid switched to the present "prospective payment" system based on provided services rather than incurred expenditures. This strengthened the incentives to cut costs, especially in the for-profit segment, and combined with tightened regulation put the nursing home sector in financial distress. Poorly performing nursing homes and chains were en masse taken over by private equity funds (Pradhan and Weech-Maldonado, 2011). The latter sought quick return to capital and exerted strong pressure on nursing homes to generate sufficient cash flow, which made aggressive cost reduction the dominant business strategy. Although private equity investors subsequently divested of some of their acquisitions, such strategy remained deeply entrenched across the for-profit segment of the nursing home industry.

Concerns that care quality could suffer from cost reduction under the veil of informational asymmetry made the nursing home market one of the most heavily regulated in the US.[19] The CMS, in addition to nursing home certification, monitors and inspects certified institutions. Inspection results (which could trigger stiff penalties, in extreme cases facility closures) are made public since 1998 as part of CMS's "Nursing Home Compare" report card initiative. Government regulations also include restrictions on using physical and medical restraint, minimal staffing standards, etc.

To gauge nursing home performance, regulators, customers, and other stakeholders rely on a set of observable indicators expected to be associated with various aspects and facets of service quality. Such indicators are usually organized in three categories (see e.g., Hillmer et al. 2005): structure (e.g., staffing measures – quantity, quality, and retention of personnel); process (inappropriate use of restraints and/or psychoactive medications such as sedatives; breach of hygienic standards; rates of catheterization and tube feeding; etc.), and outcome (mortality; infections; pressure ulcers; dehydration; hospitalization; etc.). These are rather disparate characteristics, sometimes barely correlated even within a particular category (Zhao, 2016). Since 2002, some of these characteristics are made public in the Nursing Home Quality Initiative (NHQI) in order to increase consumers' awareness and to strengthen the incentives in the industry to maintain

[19] Competition, as an alternative to government regulation, in the case of nursing homes plays a limited role due to the general reasons mentioned in Section 2 as well as high psychological and physical health costs of relocation of elderly patients between nursing homes (Grabowski and Castle, 2004), making care for the elderly to a significant extent a locally captive market.

otherwise unobservable care quality (Grabowski and Town, 2011). According to Feng Lu (2012), this posed a multitasking problem (Holmstrom and Milgrom, 1991) for nursing home operators, who responded to NHQI by reallocating their efforts across quality dimensions to improve reportable ones at the expense of those which remained undisclosed, where the performance noticeably deteriorated.[20] Some of the reportable information is technical in its nature, while certain attributes essential for residents' well-being are omitted (McGarry and Grabowski, 2021).

Since 2008, CMS aggregates partial measures in the quarterly updated Five-Star rating of nursing homes, which is widely used as an overall quality index. Derivation of Five-Star quality rating is cumbersome and subject to periodic modification. It combines three types of information – outcomes of health inspections; staffing data; and various health outcome and wellbeing measures. The rating is expected to provide "valuable and comprehensive information to consumers based on the best data available" (Design for Care Compare Nursing Home Five-Star Rating System: Technical Users' Guide, 2023). However, the complex calibration and aggregation rules appear to be ad hoc and not necessarily reflecting actual contributions of various quality aspects to the overall quality of care.

While some authors held sanguine views of the US nursing home system,[21] there is substantial evidence in the literature that care quality at many institutions, to the extent it can be externally verified, remained inadequate, notwithstanding the massive multi-level regulatory effort. According to Pradhan and Weech-Maldonado (2011), nursing home inspections systematically revealed substandard quality, almost all of them ending in citations for deficiencies, and residents were not properly protected from neglect and even gross abuse. In Lin's (2015, p. 1261) conclusion, based on US government official sources, "poor quality of patient care plagues the [US] nursing home industry," and stepped up regulatory scrutiny after the turn of the millennium failed to properly address this persistent problem.

Inefficiency of regulation could be due to its vagueness, inconsistent and lax oversight, "unfunded mandates" (requirements exceeding nursing homes' means), etc. Regulation could also be misaligned with care quality, diverting scarce resources away from residents' welfare to meeting regulatory requirements (McGarry and Grabowski, 2021). Regulation of entry by state-issued certificates of needs stifled quality-improving innovations and condoned nursing homes' focus on the compliance with minimum standards (op. cit.). Hackmann (2019) traces quality deficiency to cost-saving strategies, including insufficient personnel, especially those with professional qualification and skills, such as licensed nurses. Low wages caused chronic short-

[20] Ody-Brasier and Sharkey (2019) similarly demonstrated that nursing homes which reported higher staffing level after the inclusion of the number of nursing hours in the Five-Star rating, did not demonstrate improved performance on bedsores – one of the key patient outcomes.

[21] "[In the US nursing home system] the public sector provides regulation and payment [and] the private sector provides buildings and services. In the context of strict regulation, the system works. It has created great capacity and, where regulation is properly conducted, delivers a reasonable level of quality." (Kaffenberger 2001, p. 46).

age of personnel in the US nursing home industry, widespread job dissatisfaction, and high labor turnover. Nursing home employees commonly combined jobs at multiple facilities to make ends meet (Denny-Brown et al., 2020). While low compensation is often ascribed to inadequate Medicaid reimbursement rates, nursing home operators have considerable leeway within the reimbursement limits and do not give priority to paying adequate wages over other expenditure items (Gupta et al., 2021).

Theoretical reasoning presented in the preceding sections implies that for-profit nursing homes should be expected to offer *ceteris paribus* lower quality of care than nonprofit ones, especially under the pressure of flat government-imposed reimbursement rates, generally considered low and leaving little room for profit (see, e.g., Hackmann 2019; McGarry and Grabowski 2021). Such expectations are generally confirmed by multiple comparative analyses of the US for-profit and nonprofit providers' performance. A review of several dozen papers covering the 2004-2014 period (Bos et al., 2016) reveals that more often than not, nonprofit nursing homes fared better on various aspects of care quality, although such demonstrated advantage of nonprofit providers was not consistent across studies, samples, and quality dimensions.[22] At the same time, and also as expected, for-profit nursing homes demonstrated better financial performance, and therefore were resolving the tradeoff between care quality and financial results in favor of the latter.[23] The problem is further aggravated by nontransparent structure of ownership of for-profit institutions, which allowed tunneling of profit (disguised as cost) through inflated rental payments and compensation for management services to related third parties (Gandhi and Olenski, 2024). Notice that the same scheme is available to nonprofits in disguise to sidestep the non-distribution constraint.

COVID-19 pandemic was a seismic shock for the US nursing home sector in the US and in many other countries around the world. The population of nursing homes was more vulnerable to the pandemic due to advanced age, aggravating health problems (comorbidities), and congregated living, making the pandemic a "perfect storm" (Ouslander and Grabowski, 2020). Up to 50% of all COVID-19-related deaths in the US in the first few months of the pandemic were among nursing home and assisted living patients (op. cit.), although for the entire 2020 the figure was about 30% (Bjoerkheim and Tabarrok, 2022), and by August 2021 it dropped further down to 21% (Cronin and Evans, 2022). By the end of 2020, the COVID-19 death

[22] An earlier literature review by Hillmer et al. (2005) arrived at similar conclusions, which are thus consistent across time. Grabowski and Castle (2004) show that the nonprofit status is a highly significant predictor of persistently (observed over a ten years observation period) high quality of nursing home services, whereas the for-profit nursing home is more likely to be a persistently low quality one. The impact of ownership on nursing homes performance in other countries is inconclusive (Broms et al., 2020). Notice, however, that Bergman et al. (2016) observed that entry of for-profits reduces mortality at Swedish nursing homes.

[23] This effect is particularly visible in the case of private equity ownership of US nursing homes. Private equity funds epitomize short-term profit maximization motive, and their ownership of nursing homes adversely affects residents' survival rates and some other essential health and welfare outcomes. Care quality suffers not only due to aggressive cost-cutting, but also as a result of shifting resources away from patient care to monitoring fees, interest and lease payments (Gupta et al. 2021; see also Pradhan and Weech-Maldonado 2011; Braun et al. 2020). Stevenson et al. (2023) use a difference-in-difference approach to show that private equity investments in nursing home led to substantial decrease in staffing level, and worsening of health deficiency scores.

rate in the US nursing homes was 24 times higher than the national average among people 65 and over living outside nursing homes (Cronin and Evans, 2022).

Compact living and higher individual vulnerability produced a 'binary explosive', detonated by the pandemic. In the epidemiological Exposure, Susceptibility and Recovery triad (see, e.g., Noppert et al. 2022), exposure to the coronavirus was more likely to cause an infection of a clinically vulnerable (due to advanced age and generally poor health) resident, quickly spreading across the institution among similarly susceptible and closely interacting individuals. Self-isolation and other shelter-in-place and physical distancing preventive measures were less effective, if not at all impractical, especially in nursing homes with multiple occupancy rooms, and also because a significant number of high-risk patients were served by the same support staff, who became infection spreaders.

Vulnerability of the US nursing home industry to COVID-19 was aggravated by the general weaknesses and failures of the system offering poor quality of care, so that the pandemic was "a crisis on top of a crisis" (McGarry and Grabowski, 2021). This metaphor suggests that an external shock of the pandemic amplified and revealed some of the chronic failures and deficiencies heretofore concealed under the veil of informational asymmetry.[24] To the extent that such deficiencies were uneven across the nursing home industry, the dramatic variations in COVID-19 outcomes (Cronin and Evans, 2022), controlling for other confounding variables (prominent among them community spread of the pandemic; see, e.g., McGarry and Grabowski 2021), could provide objective evidence-based quality of care measures. The availability of such measures temporarily reduced informational asymmetry plaguing the industry and offered an opportunity to crosscheck the earlier available quality indicators.

In a number of studies (surveyed in Konetzka et al. 2021; see also Bjoerkheim and Tabarrok 2022) the Five-Star rating showed no correlation with COVID-19 outcomes, leading some authors to conclude that "the virus [was] blind to the quality of the nursing home" (Ouslander and Grabowski 2020, p. 2154). Cronin and Evans (2022) present a more nuanced picture, whereby higher-rating nursing homes had, as one would expect, lower COVID-19 mortality. At the same time, nursing home rating had no significant impact on keeping an institution COVID-free. However, quality rating was a predictor of the ability to control the spread of infection within a nursing home by more strictly adhering to government (CDC's) guidelines, and by increasing the odds of survival of an infected resident by better monitoring and vigorous treatment. On the darker side of the picture, Five-Star rating was strongly *positively* correlated with the non-COVID-19 death rate and with the overall death rate from all causes, including the coronavirus. This could be due to "collateral damage" of strict isolation (required by government guidelines), which is shown to have a grave

[24] "[The COVID-19 pandemic] merely shed light on the national failure to fully support the care of older adults" (McGarry and Grabowski 2021, p. 138). Those same [quality of care] shortcomings rendered nursing homes ... unprepared to respond to the COVID-19 pandemic" (National Academies of Sciences, Engineering, and Medicine 2022, p. 3).

impact on physical and mental health of the residents. Apparently, such damage, measured in non-COVID-19 loss of life, exceeded in the highly rated nursing homes the benefits of containing the spread of the virus. This could be an illustration of misguided incentives in a multitasking environment, whereby an excessive focus on officially established performance measures and guidelines stifles innovations and flexibility and diverts an organization from its mission.[25]

These arguments and evidence suggest that the Five-Star rating did not reflect some salient care quality ingredients essential for residents' welfare. They also indicate that COVID-19 mortality should be treated with caution in assessing nursing homes' performance during the pandemic,[26] and that the overall mortality and COVID-19 infection rates are more suitable for such role.

The literature points to a number of possible "transmission mechanisms" linking quality shortfalls (or their flipside – aggressive cost cutting) to the COVID-19 infection and nursing home mortality during the pandemic. A review of 348 publications addressing these issues (Giri et al., 2021) lists a number of contributing factors, including personnel (insufficient number and skills; low pay), physical characteristics (space and occupancy), patients characteristics (malnutrition, mental state, comorbidities), and availability of personal protective equipment (PPE). The pandemic exacerbated chronic shortage of personnel in the nursing home industry (Denny-Brown et al., 2020), which compromised hygienic standards. Left to themselves, nursing home patients were unable to maintain self-isolation and had to leave their rooms for daily chores. Furthermore, low pay forced many support personnel to combine jobs at several institutions, leading to a prairie fire-type spread of infection across the industry. Tight and clustered indoor spaces and the use of large older buildings (to achieve the economy of scale) with shared rooms and bathrooms (McGarry and Grabowski 2021) lowered capital and operational costs. While under normal circumstances the concomitant reduction of residents' quality of life was tolerated, during the pandemic such practices turned nursing homes into COVID-19 hotspots. Poor care adversely affected physical and mental conditions of residents, reducing their ability to fight infection. A shortage of PPE revealed general neglect of safety standards, which left residents and personnel at greater risk of contracting the virus. These potential transmission (no pun intended) mechanisms suggest that COVID-19 outcomes at nursing homes could indeed be indicative of some essential ingredients of care quality.

[25]It should be noted that Cronin and Evans's (2022) results are obtained by normalizing cumulative outcomes over a period of time by the number of all beds in a nursing home. This normalization approach may produce biased results because according to our data (see the next section), during the pandemic, the number of all beds was often very different from the number of occupied beds presumably due to a high number of death and hospitalizations, which left some beds unoccupied for significant periods of time. The mean coefficient of variation of weekly occupied beds for nursing homes with 20 or more beds is slightly over 0.1 and the mean difference between all beds and occupied beds was over 30, which is a significant number, given that the mean size of a nursing home in our sample is about 112 beds.

[26]Determination of the cause of death could differ from one nursing home to another and over time. There is a difference between a person dying from COVID-19 and dying from other reasons while being infected with COVID-19, which further complicates attribution of death to the coronavirus.

The availability of new outcome (and possibly quality) measures triggered a series of studies of the impact of ownership status on the nursing homes' resilience to COVID-19. Kruse et al. (2021) in a rapid literature review summarized 18 studies (14 of them – on US data), some of which pointed out to an unadjusted positive association between for-profit status and COVID-19 infection and mortality. After controlling for some confounding variables, such as facility size and condition, congestion, chain membership, etc., the residual contribution of for-profit ownership status became, more often than not, statistically insignificant. However, some of these could be "bad controls", which in their turn are affected by ownership status, and if so, the above studies by and large upheld the expectation that ceteris paribus nonprofit nursing homes better protected their residents from COVID-19 than for-profit ones. Another literature review (Bach-Mortensen et al., 2021) covering 32 studies, 25 of them on the US, arrived at very similar conclusions: the for-profit status was associated with higher rates of COVID-19 infections and deaths, and this impact was mediated by the same set of facility characteristics. At the same time, Braun et al. (2020) observed no difference in COVID-19 cases and deaths between nursing homes owned by private equity funds (expected to be particularly prone to quality failures) and other private (for-profit and nonprofit) nursing homes in the US.

The alleged failure of the for-profit segment, dominant in the US, to offer quality care, revealed by the litmus test of the COVID-19 pandemic, reignited the debates as to whether for-profit firms could be trusted with the care of the elderly. Suggested policy implications were to "(a) disincentivize for-profit ownership structures or favor nonprofit or publicly owned nursing homes, or (b) improve the regulation of the underlying factors that appear to influence COVID-19 outcomes and in most cases quality of care more widely" (Kruse et al. 2021, p. 216). Disfavoring for-profit providers, presently serving more than 2/3 of the US market, might be impractical, which makes the first option problematic. As for the second one, industry experience does not bode well for its efficacy. Prior to the pandemic, heavy regulation of the nursing home industry failed to improve chronically low quality of service at for-profit institutions shielded by asymmetric information (Grabowski and Castle, 2004).[27] The recent regulatory response to the pandemic, both federal[28] and states', did not fare much better – it was often delayed, not supported by adequate resources, and at times misguided (e.g., as per aforementioned Cronin and Evans' (2022) finding that excessive emphasis on residents' isolation from each other and from relatives and friends steeply increased nursing home death rates).

There could be, however, a yet another way out of the low-quality equilibrium in the for-profit segment, largely left unnoticed in the massive literature on COVID-19 and its aftermath in the US nursing home industry. By revealing heretofore hidden quality shortfalls, COVID-19 shock reduced informational asym-

[27] This and other empirical studies using pre-pandemic data to lay blame for poor quality on asymmetric information rely on various proxies and partial measures of the conjectured cause and effect. For example, in Grabowski and Castle (2004) care quality is gauged by the prevalence of pressure ulcers, use of physical restraint, feeding tubes and catheters, whereas informational asymmetry is reflected in the share of nonprofit nursing homes, in accordance with Grabowski and Hirth (2003).

[28] https://stacks.cdc.gov/view/cdc/88410

metry – the main culprit for chronically low quality and thus might have turned for-profits' reliance on market incentives from a liability into a valuable asset.

During the pandemic, nursing homes found themselves in a spotlight and under increased pressure from main stakeholders – customers, investors, regulators, media, and society – to improve their, presently better observable, performance. This focus was sharpened by dramatic media reports, blaming lack of performance, transparency, and oversight for the massive infection and loss of life at US nursing homes (Miller et al., 2021). The ability of nursing home residents to "vote with their feet" remained limited, as it was before the pandemic (Grabowski and Castle, 2004), so instead of muted "exit," in Hirschman's (1970) famous metaphor, the injured parties used their "voice" to demand better treatment. Nursing homes were targeted with many hundreds of lawsuits (some of them class action) for alleged negligence and wrongful death,[29] prompting some states to give nursing homes legal immunity to prevent an industry collapse (National Academies of Sciences, Engineering, and Medicine 2022). Apart from legal liability, the pandemic severely damaged the collective reputation of the nursing home industry, causing "a growing reluctance of older adults and their family members to use nursing homes" (McGarry and Grabowski 2021, p. 152). The pandemic also caused stepped up regulatory oversight, including weekly reporting requirements imposed by CMS and CDC, penalties for COVID-19 infections and deaths, and rewards for keeping residents safe (Konetzka et al., 2021). CMS-commissioned report on safety and quality in nursing homes demanded greater transparency and accountability and person-driven and person-centered care.[30]

COVID-19 had had a detrimental effect on nursing homes' image (Ouslander and Grabowski, 2020); median occupancy rate in US nursing homes dropped from its pre-pandemic level of 85% to its lowest level of 69% in January 2021 (Medicare Payment Advisory Commission, 2024). It became imperative for individual institutions to break out of the badly tarnished collective reputation by restoring trust in their ability to deliver quality service. In the new market environment, care quality, observable via COVID-19 outcomes, earned a market premium. This incentivized for-profit providers to seek better balance between cutting cost and delivering quality care. Given far greater importance of financial outcomes for the for-profit providers, one could expect their catching up with nonprofits and perhaps even exceeding them in terms of care quality. It remains an empirical question whether such newly unlocked *market* incentives to provide quality care in the for-profit segment ensured parity between for-profit providers and nonprofit ones (relying on *non-market* incentives), or perhaps even gave the former a competitive edge in service quality.

In the rest of the paper, we present evidence of such catching-up process. In doing so, we depart from the rest of the literature, which relies mostly on cross-sectional nursing homes data to obtain a snapshot of

[29] See e.g. https://www.wsj.com/articles/nursing-homes-face-growing-number-of-lawsuits-from-covid-19-fallout-11649507400
[30] https://www.cms.gov/files/document/covid-final-nh-commission-report.pdf

the industry caught off-guard by the pandemic. Instead, we make use of nursing homes' weekly reporting to CDC to form a panel dataset to study how the industry (and especially its for-profit segment) evolved during the pandemic. In addition to observing the disappearing quality gap between the nonprofit and for-profit segments, we re-visit the impact of competition in the nursing home industry against the backdrop of reduced informational asymmetry. We also present evidence of the lasting impact of the initial COVID-19 shock on nursing homes performance.

5 Hypotheses and data

The COVID-19 pandemic supplied new tangible and publicly observable nursing home performance measures, i.e., infection and death rates among residents. Such measures could serve as care quality indexes,[31] revealing aspects and attributes of the nursing home care that remained hidden before the pandemic. As argued above, this opened up two related but distinct opportunities for empirical studies of the US nursing homes. First, the pandemic suddenly illuminated the nursing home landscape, exposing heretofore hidden shortfalls and thus offering a glimpse into the pre-pandemic patterns and practices affecting care quality.[32] This enabled an indirect retroactive comparison of care quality in nonprofit and for-profit institutions under normal times by identifying a performance gap (in terms of COVID-19 outcomes) between the two groups early on in the pandemic, when nursing homes did not have time to adjust their operations (save some stopgap emergency measures) to the new realities. Second, the increased transparency changed the market environment of nursing homes and affected the incentives of their operators, triggering a process of adjustment to the new realities. Observation of COVID-19 outcomes at for-profit and nonprofit nursing homes over the duration of the pandemic shows how the performance gap between the two groups evolved over time and what factors influenced this adjustment process.

Of the three pandemic outcomes commonly used in the nursing home literature – COVID-19 infection and mortality rates, and the overall mortality rate from all causes – we consider the first as the most reliable and informative care quality index. Indeed, as explained in the previous section, COVID-19 infection rate reflects cost-saving operational practices and patterns, which are likely to have an adverse impact on quality. Two other measures to some extent replicate (include) the first one and besides could be subject to additional noise as care quality indexes. Thus, attribution of a death to COVID-19 could sometimes be a matter of judgement involving a selection between the primary or contributory role of the coronavirus infection,

[31] "An organization's capacity to perform well in the face of adversity may be an important dimension of its quality' (Cronin and Evans 2022, p. 4).

[32] As an executive of a US social service agency put it, "Let's don't [sic] waste a good pandemic ... [COVID-19] has shined a burning light on the weaknesses of the way we've done things."
https://www.healthaffairs.org/doi/10.1377/hlthaff.2021.00081

especially in the presence of comorbidities, which could lead to inconsistencies across nursing homes and over time.[33] Furthermore, the survival of a COVID-infected nursing home patient depended not only on the care at the nursing home but also on subsequent hospital treatment (in the event of hospitalization). Finally, there is a resource allocation problem between maintaining general care quality and thus reducing infection rates, and maximizing the recovery odds of those already infected. In this tradeoff, nursing homes, especially for-profit ones, could have prioritized the second task, to avoid further reputational damage and perhaps to retain a revenue-generating client.[34] The overall death rate is not biased by attribution and diagnostic problems, and is in itself an important care outcome, which reflects the balance between COVID-19 containment and the overall wellbeing of nursing home patients. However, this measure could also be affected by the pragmatic reallocation of efforts and resources from overall care to the survival of those infected with coronavirus. For the above reasons, we use in the empirical part of the paper the COVID-19 infection rate and the overall mortality rate as, respectively, primary and secondary quality indexes, and add COVID-19 mortality rate mainly for reference purposes.

The theory presented in Section 3 and the discussion of the US nursing homes industry prior to and during the pandemic in Section 4 generate a set of research questions and hypotheses set forth below.

Since many care quality ingredients that proved essential for the protection of patients from the coronavirus were unobservable before the pandemic, for-profit nursing homes should be expected, as per Proposition 3, to be offering less of such ingredients than nonprofit ones. This quality gap should have been evident at the outset of the pandemic, when nursing homes were "caught by surprise" and before they had time to adjust to the new realities. Hence, early on in the pandemic, COVID-19 infection rates at for-profit institutions is expected to be higher than at nonprofits ones, which is our *Hypothesis 1*.

Increased visibility of care quality, and hence its higher relevance for the financial performance, should have subsequently prompted for-profit nursing homes to improve quality, as per Proposition 6, triggering a catching up process between two types of institutions. In such process, the for-profit vs. nonprofit difference between COVID-19 infection rates should be diminishing over time, which is *Hypothesis 2*. Our theory makes no predictions as to whether the convergence of COVID-19 infection rates at for-profit and nonprofit nursing homes eventually leads to parity between two types of institutions, or even a reversal of their positions. This question is answered empirically.

We should observe a similar reduction over time of the overall mortality at for-profit nursing homes in comparison to the nonprofit benchmark (*Hypothesis 2A*), insofar as overall mortality reflects improved

[33] See Fihel et al. (2024) on massive misspecification of COVID-19 deaths during the pandemic.

[34] Recall that according to Cronin and Evans (2022), higher-ranked nursing homes, presumably more conscious about their public image, fared no better than others in protecting the facility from the coronavirus, but once COVID-19 made it in, were able to keep COVID-19 deaths down by better dealing with the infection.

protection from the COVID-19 infection. However, there are no predictions as to whether overall mortality is lower at for-profit or nonprofit nursing homes, since there are two opposite effects: on the one hand, we expect higher infection rates at for-profits, at least in the earlier part of the pandemic, but on the other hand, for-profits might have stronger market-driven incentives to save lives of their residents, including COVID-infected ones.[35] Joint outcome of these effects is a priori unclear and is explored empirically.

Our theory implies that for-profit nursing homes have the incentive to over-invest in observable quality proxies to the detriment of unobservable quality ingredients and possibly of the overall quality of care. Therefore, across the for-profit nursing homes segment, higher ranking should be associated with higher COVID-19 infection rates (signaling lower unobservable quality), which is *Hypothesis 3*.

Two conjectures suggested by our theory concern the impact of local market structure[36] on the adjustment of for-profit nursing homes to increased transparency brought about by the pandemic. The first conjecture is about the role of competition, which is shown in the earlier literature (e.g., Grabowski and Town 2011; Zhao 2016; Yang et al. 2021) to complement transparency in improving care quality at nursing homes. According to Proposition 6, for-profit nursing homes raise quality when the latter becomes more relevant for their financial performance. Greater transparency brought about by the pandemic is a necessary condition for such effect, but not a sufficient one, e.g., when nursing homes have significant market power. Even if local markets are competitive, quality response to increased transparency could be delayed by residual informational asymmetry, when the performance of nursing homes is affected, in addition to care quality, by locally correlated shocks of magnitude known to nursing homes but not directly observable by outsiders. In this case, poor COVID-19 outcomes could be blamed on exceptionally unfavorable external conditions, and this excuse enables for-profit nursing homes to maintain low care quality without financial penalty.[37] It could take time to disrupt such low-level equilibria, in which case we should expect competition to have only mild, if any, impact on the reduction of COVID-19 infections in the earlier periods of the pandemic. This impact becomes tangible once some nursing homes, which offer higher quality of care, achieve better results and set performance yardsticks for the local market, in which case yardstick competition kicks in, prompting others to follow suit. Once this catching-up process is complete and for-profit nursing homes reach their production possibility frontiers in terms of quality improvement, the impact of competition should subside. This makes one to expect over the duration of the pandemic a U-shaped response to competition of for-profit nursing homes infection rates, which is our *Hypothesis 4*.

While it could take time for yardstick competition to kick-in within the for-profit segment of a local

[35] Besides, according to Gupta et al. (2021), there is less room to cut cost when caring for sicker patients with straightforward medical needs.

[36] Recall that markets for nursing home services are usually confined within narrow geographic boundaries.

[37] Such rent from incomplete information arises when observable outcomes reflect effort and external shock, which are not observable separately; see, e.g., Ferejohn (1986) and Persson et al. (1997).

market, nonprofit nursing homes in the same local area, presumed to offer higher care quality at the outset of the pandemic, provide immediately available performance yardsticks, and therefore their presence should prompt for-profits to reduce quality gap without a delay. Once nonprofits have performed such role, their impact on the for-profit part of the local market should be declining. This leads to *Hypothesis 5*: the share of nonprofit nursing homes in the local market should have a significant negative impact on COVID-19 infections in the for-profit segment early on in the pandemic, and such spillover effect (similar to the one observed in Grabowski and Hirth (2003)) should be diminishing with the passage of time.

Finally, we address the question as to whether quality improvement in the for-profit segment, expected according to Hypothesis 2, is a limited time response to extraordinary circumstances, in which case quality would sink back under the restored veil of informational asymmetry once the pandemic has subsided, or it will sustain past the pandemic's onslaught. There are two possible mechanisms for a longer-term effect of the pandemic. First, it has raised public attention to the nursing home industry and created a tighter system of regulatory scrutiny with an emphasis on transparency, accountability, and oversight. Such a system is expected to maintain the relevance of care quality for financial outcomes, in which case, in accordance to Proposition 6, quality (at least as measured by the newly observable indicators) will stay above its pre-pandemic level. Second, the changes in nursing home operation and management brought about by some external causes in the early period of the pandemic become entrenched (through learning-by-doing and other means) and sustained after the end of such impact.[38]

While more time is needed to answer the above question, the available evidence could shed some light on this important matter. Namely, we could look for indications of nursing homes' learning-by-doing in terms of their ability to cope with subsequent waves of the pandemic. An improvement of this ability over time in the industry at large and especially in its for-profit segment is our *Hypothesis 6*. We would further expect that the degree of such improvement would be positively associated with the severity of the initial shock of the pandemic (*Hypothesis 7*).

The main source of information to test the above hypotheses is the CMS Nursing Home dataset from May 2020 through December 2021, i.e., covering 84 weeks.[39] As part of COVID-19 emergency measures, US nursing homes were required since May 17, 2020 to report to CMS (via the Center for Disease Control and Prevention's National Health Care Safety Network) on a weekly basis several dozen of COVID-19-related metrics. We merge these data with another CMS resource, "Provider Information"[40] with nursing

[38] E.g., as mentioned in the previous section, aggressive cost-cutting practices at for-profit nursing homes, brought about by private equity ownership, were sustained after the divestiture by private equity funds of their nursing home holdings.

[39] https://data.cms.gov/covid-19/covid-19-nursing-home-data. Because for the week ending May 24, 2020, some of the nursing home reported cumulative data from January 1, 2020, we do not use health outcome measures for that week. However, we do use the number of occupied beds in that week in order to scale the health outcomes for the following week.

[40] https://data.cms.gov/provider-data/dataset/4pq5-n9py

homes' characteristics such as size, ownership status, funding, quality rankings etc. Importantly, the newly established CMS reporting requirements include COVID-19 infections and deaths, as well as deaths from all causes. This newly introduced reporting system has replaced the annual and quarterly nursing home reports submitted to CMS as per the pre-pandemic certification and reporting requirements. Weekly reporting, instead of quarterly one (used in earlier nursing home studies surveyed in Section 4), has vastly expanded analytical opportunities, by providing a granular micro-level view of the US nursing home industry over the span of the pandemic.

We retain for our analysis only the observations that passed the CMS quality check and furthermore exclude from our panel the nursing homes that had fewer than 80 weeks' worth of quality observations during the chosen 84 week period. Given the focus of our analysis on the comparison between for-profit and nonprofit nursing homes, we keep observations only from the counties where both ownership types were present. This leaves us with 9472 nursing homes and a total of about 725,457 observations in our baseline regressions.

Three health outcomes – infection rate among the residents of nursing home, mortality of the residents attributed to COVID-19, and overall mortality of the residents – are calculated as percentages of the previous week's occupied beds in the nursing home.[41]

Our main variable of interest is the ownership type of the nursing home, for-profit or nonprofit. We use several control variables, reflecting nursing home (NH) characteristics potentially relevant to the quality of its services. Specifically, we control for the size of NH as proxied by the log of the number of all beds, the average number of licensed staff hours per resident over the entire period of our data, the overall rating assigned annually by the CMS Five Star system, the number of complaints per occupied bed, the log of the total amount of fines imposed on the NH, and a dummy variable for Medicaid acceptance by the NH. In addition, we include lagged infection rates in some of the death rates regressions.

Some measures in our analysis reflect the local background of nursing home (NH) operations. One such measure is the COVID-19 infection rate in the surrounding locality, and two others – competition among nursing homes in the local market and the share of nonprofit providers in this market. There are two general approaches to define local nursing home markets in the literature: using counties as localities, and using a certain distance radius, such as 15 miles, 25 km or 25 miles. These options have their pros and cons (for a discussion see Grabowski 2008; Zhao 2016 and a survey in Yang et al. 2022). We use both, depending on the available information. Thus, we calculate the local market competition measure as (1-HHI), where HHI is the Herfindahl-Hirschman index based on the number of beds in the nursing homes within the 25-mile radius.

[41] The results reported in the next section are similar if we use the current week's number of occupied beds or the average of the current and previous week's number of occupied beds.

We similarly calculate the share of nonprofit nursing homes within the same radius. We do not have the data to calculate infection rates for the same 25-mile radius areas. Instead, use such rates for counties where nursing homes are located, available from the New York Times database.[42] The database stores weekly cumulative infection totals for counties, and we obtain weekly new infection data by subtracting the New York Times' number for the previous week from the current week's number.

The descriptive statistics is presented in the Table 1.[43]

	Mean	SD	N
Infection rate per previous week occupied beds, %	0.74	3.81	1,041,057.00
COVID death rate per previous week occupied beds, %	0.14	0.99	1,041,057.00
Death rate per previous week occupied beds, %	0.68	2.12	1,041,057.00
type (=1 if For-profit)	0.69	0.46	13,179.00
County infection rate, %	0.21	0.25	211,291.00
Log of number of beds	4.51	0.55	15,147.00
Total Number of Occupied Beds	73.62	44.47	1,057,959.00
Licensed staff hours	120.44	73.44	15,941.00
Overall Rating	3.23	1.42	16,403.00
Complaints per occupied bed	0.05	0.12	1,053,983.00
Medicaid (= 1 if accept)	0.96	0.20	16,647.00
competition index: 1 - HHI	0.90	0.15	1,066,595.00
Share of non-profit beds in radius	0.30	0.21	1,066,259.00

Table 1: Descriptive statistics

6 Empirical strategy and estimation results

Our empirical strategy employs various fixed effects regressions with COVID-19 outcomes as the main dependent variables and nursing home's ownership type as the main explanatory variable of interest. We control for a rich set of confounding factors and use various combinations of week, nursing home, and county fixed effects. We make use of a quasi-experimental environment provided by the COVID-19 pandemic, where nursing homes' exposure to the coronavirus exhibited exogenous and largely random variations between localities and over time. Given the variations, we study the impact on the US nursing home industry of a common exogenous shock, i.e., the availability of new publicly observable and closely watched performance measures – the rates of infection and mortality among the residents.

[42] https://raw.githubusercontent.com/nytimes/covid-19-data/master/us-counties.csv

[43] For precise definitions of all non-self-explanatory variables see CMS dataset dictionary at `https://data.cms.gov/sites/default/files/2023-08/COVID-19%20Nursing%20Home%20Data%20Dictionary.pdf`

6.1 Exploratory analysis: baseline regression

We first estimate the following baseline regression, to gauge the impact of ownership type on the overall performance of a nursing home, averaged over the observation period:

$$y_{it} = \beta_0 + \beta_1 t + \beta_2 \text{Type}_i + \beta_3 \text{C\_Inf}_{ct} + \gamma X_{it} + \mu_c + \varepsilon_{it}, \tag{5}$$

where i is the nursing home index, t – week number, starting with the week ending on May 31, 2020, y_{it} stands for one of our three measures of nursing home pandemic outcomes, Type_i is a dummy variable which equals 1 for for-profit nursing home and zero otherwise, C_Inf_{ct} is infection rate in the nursing home's county c in week t (in the regression of COVID-19 infection rates; for the regressions of death rates we include instead the two week lagged variable C_Inf_{ct-2}), X_{it} is a vector of controls representing individual characteristics of the nursing home and its locality, and ϵ_{it} are errors clustered by county. In most regressions, the nursing home characteristics include the logarithm of the number of beds in the home; the average annual number of licensed staffing hours per resident per day; the overall Five Stars quality rating of the nursing home; the number of complaints filed per occupied bed; a dummy variable for accepting Medicaid residents; the local competition measure (based on Herfindahl-Hirschman index) in the 25-mile radius around nursing home i; and the share of nonprofit nursing homes in the same radius. The baseline regression includes county fixed effect μ_c. We also include week fixed effects in most regressions, in which case we obviously drop the t variable. In another version of the nursing home death rates regression, we include as an additional control the infection rates at the same nursing home lagged two weeks. This inclusion conditions death rates on COVID-19 infections and thus reflects the quality and efficacy of care for infected residents at the nursing home.

	(1) Infection rate per previous week occupied beds, %	(2) COVID death rate per previous week occupied beds, %	(3) COVID death rate per previous week occupied beds, %	(4) Death rate per previous week occupied beds, %	(5) Death rate per previous week occupied beds, %
type (=1 if For-profit)	0.105***	-0.00173	-0.0115***	-0.105***	-0.116***
	[0.0124]	[0.00465]	[0.00420]	[0.0196]	[0.0194]
Week number	-0.0172***	-0.00393***	-0.00228***	-0.00541***	-0.00360***
	[0.000362]	[0.000104]	[0.0000698]	[0.000334]	[0.000318]
Lagged NH infection rate			0.0973***		0.106***
			[0.00211]		[0.00228]
Lagged county infection rate		0.731***	0.346***	0.922***	0.501***
		[0.0229]	[0.0143]	[0.0301]	[0.0225]
Log of number of beds	0.0766***	0.0169**	0.00889	-0.00935	-0.0184
	[0.0187]	[0.00682]	[0.00599]	[0.0425]	[0.0424]
Licensed staff hours	-0.000387***	-0.000119***	-0.0000838***	-0.0000605	-0.0000265
	[0.0000923]	[0.0000351]	[0.0000315]	[0.000172]	[0.000169]
Overall Rating	0.0149***	0.00670***	0.00423***	0.0508***	0.0477***
	[0.00488]	[0.00164]	[0.00149]	[0.00542]	[0.00529]
competition index: 1 - HHI	-0.0275	-0.0212	-0.0208	-0.165	-0.164
	[0.106]	[0.0335]	[0.0279]	[0.126]	[0.127]
Share of non-profit beds in radius	-0.127	-0.0585*	-0.0491*	-0.416**	-0.406**
	[0.0809]	[0.0312]	[0.0282]	[0.184]	[0.183]
Observations	725457	707863	706048	707863	706048

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2A: Baseline regressions of pandemic outcomes, county fixed effects.

	(1) Infection rate per previous week occupied beds, %	(2) COVID death rate per previous week occupied beds, %	(3) COVID death rate per previous week occupied beds, %	(4) Death rate per previous week occupied beds, %	(5) Death rate per previous week occupied beds, %
type (=1 if For-profit)	0.105***	-0.00167	-0.0113***	-0.105***	-0.116***
	[0.0125]	[0.00465]	[0.00420]	[0.0196]	[0.0194]
Lagged NH infection rate			0.0960***		0.104***
			[0.00208]		[0.00223]
Lagged county infection rate		0.530***	0.251***	0.631***	0.327***
		[0.0247]	[0.0180]	[0.0324]	[0.0263]
Log of number of beds	0.0748***	0.0165**	0.00878	-0.00984	-0.0185
	[0.0188]	[0.00683]	[0.00601]	[0.0425]	[0.0424]
Licensed staff hours	-0.000376***	-0.000117***	-0.0000829***	-0.0000576	-0.0000254
	[0.0000929]	[0.0000351]	[0.0000316]	[0.000172]	[0.000169]
Overall Rating	0.0145***	0.00659***	0.00421***	0.0507***	0.0477***
	[0.00488]	[0.00164]	[0.00149]	[0.00542]	[0.00529]
competition index: 1 - HHI	-0.0546	-0.0252	-0.0231	-0.170	-0.167
	[0.108]	[0.0337]	[0.0280]	[0.126]	[0.127]
Share of non-profit beds in radius	-0.112	-0.0577*	-0.0478*	-0.415**	-0.405**
	[0.0805]	[0.0313]	[0.0283]	[0.184]	[0.183]
Observations	725457	707863	706048	707863	706048

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 2B: Baseline regressions of pandemic outcomes, county and week fixed effects.

The results of regressions (1) are shown in Table 2A; Table 2B presents estimations of a modified regression model with week fixed effects. We observe higher rates of COVID-19 infections in for-profit nursing homes than in nonprofit ones (columns (1) and (2) in both tables), and the difference is significant both numerically[44] and statistically (at less than 1% level). This finding agrees with numerous media reports and some earlier pilot studies. They are also consistent with Hypotheses 1 and possibly 2 (initially higher infection rate at for-profits, gradually declining over the duration of pandemic), but do not provide direct support for these hypotheses, which would require a more sophisticated regression model presented below.

Somewhat unexpectedly, for-profits featured significantly lower death rates from all causes, than non-profits, and this finding persists across different specifications (columns (4) and (5) in both tables). This result, while at odds with the public perception of for-profit nursing homes as particularly deadly for their residents during the pandemic, could be explained by for-profits incentives to save lives, as argued earlier.

Noteworthy controls are week number (in the model without week fixed effects), countywide infection rate, and Five Star ranking, which turn out significant and have the same signs across all specifications. Week number's coefficients are all negative and significant at 1% level, which shows that nursing homes were gradually improving their ability to deal with the pandemic. This is the first piece of evidence of the *adjustment and learning effect*, variously demonstrated in the regressions that will follow. Predictably, and in agreement with earlier studies (e.g. reviewed in Konetzka et al. 2021), county infection rate, representing an exogenous "treatment" of nursing homes by the pandemic, has a highly significant adverse impact on nursing homes' health outcomes. The lagged infection rate at a nursing home increases death rates at the same nursing home.

One of the most counterintuitive findings is that nursing homes' Five Star ranking exhibits a statistically significant positive correlation with infection and mortality rates in all specifications.[45] At this point, it is unclear whether this effect originates in the for-profit segment, as per Hypothesis 3, and we defer this question to regression models presented below. However, even the relatively crude baseline model demonstrates an evident failure of the Five Star ranking to reflect care quality ingredients essential to nursing homes' resilience in the face of the pandemic.

We also note that there are no qualitative differences between the results with only county fixed effects, and with county and week fixed effects.

[44] According to the regression results, for-profits experienced 0.118 percentage points per week more infections than nonprofits, which is substantial, given the overall average weekly infection rate of about 0.72%. The regression result is also consistent with the simple differences of averages (0.76% vs. 0.62%) calculated without any controls.

[45] This finding is in agreement with Cronin and Evans (2022), who found a statistically significant positive correlation between 5-star rating and mortality from all causes at US nursing homes, albeit over a different observation period, from January 1, 2020 through April 25, 2021. According to the same source, 5-star rating was negatively correlated with COVID-19 mortality early on in the pandemic, but no such effect was observed after September 2020.

6.2 Adjustment process

We now turn to an extension of the baseline model (5), which enables tracing an adjustment process in the nursing home industry triggered by the pandemic, and identification of factors that affect such adjustment. To this end, we modify the baseline model as follows. First, since the adjustment might be non-linear in time, we include in the regression both the linear and quadratic terms of week number. Second, we interact the ownership dummy with these terms, to observe the evolving performance difference between for-profit and nonprofit nursing homes. And third, we interact the ownership dummy with our control variables to establish their role in the for-profit nursing home performance, and also include the interaction of week number with the county infection rate. These modifications lead to the following model:[46]

$$\begin{aligned} y_{it} = \beta_0 + \beta_1 t + \beta_2 \text{Type}_i + \beta_3 t \times \text{Type}_i + \beta_4 t^2 + \beta_5 t^2 \times \text{Type}_i + \beta_6 \text{C\_Inf}_{ct} + \beta_7 t \times \text{C\_Inf}_{ct} + \\ \beta_8 \text{C\_Inf}_{ct} \times \text{Type}_i + \sum_j \gamma_j X_{jit} + \sum_j \kappa_j X_{jit} \times \text{Type}_i + \mu_c + \varepsilon_{it}. \end{aligned} \tag{6}$$

The estimation results of the above model are presented in Table 3. In Table 4, we show the results of modified model (6), where week fixed effects are added (and terms $\beta_1 t$ and $\beta_4 t^2$ are accordingly removed). Of particular interest are the marginal effects of Type_i dummy as a function of the week number, calculated as

$$\frac{\partial y_{it}}{\partial \text{Type}_i} = \beta_2 + \beta_3 t + \beta_5 t^2 + \beta_8 \text{C\_Inf}_{ct} + \sum_j \gamma_j X_{jit}. \tag{7}$$

The estimates of (6) and (7) represent the main results of our paper. In what follows, marginal effect (7) curves are derived from the models with the full set (county and week) fixed effects (Table 4; dropping week fixed effects yields nearly identical dynamic patterns).

[46] When week fixed effects are included, we take out the week number and week number squared terms. Similarly to the baseline model, in the nursing home death rates regression, we include the infection rates at the nursing home two weeks earlier and interact this rate with the ownership dummy.

Table 3: Extended regressions of pandemic outcomes, county fixed effects

	(1) Infection rate per previous week occupied beds, %	(2) COVID death rate per previous week occupied beds, %	(3) COVID death rate per previous week occupied beds, %	(4) Death rate per previous week occupied beds, %	(5) Death rate per previous week occupied beds, %
type (=1 if For-profit)	0.763***	0.108	0.0337	-0.0475	-0.132
	[0.227]	[0.0754]	[0.0669]	[0.360]	[0.359]
Week number × type (=1 if For-profit)	-0.0112***	-0.00218***	-0.00112*	-0.00521***	-0.00401**
	[0.00191]	[0.000695]	[0.000597]	[0.00191]	[0.00187]
Week number	-0.0153***	-0.00403***	-0.00206***	-0.00562***	-0.00346**
	[0.00155]	[0.000615]	[0.000532]	[0.00154]	[0.00149]
Week number ^{2}	0.000204***	0.0000482***	0.0000254***	0.0000692***	0.0000439***
	[0.0000215]	[0.00000709]	[0.00000582]	[0.0000158]	[0.0000150]
Week number ^{2} × type (=1 if For-profit)	0.0000838***	0.0000225***	0.0000126**	0.0000381**	0.0000275
	[0.0000227]	[0.00000738]	[0.00000626]	[0.0000179]	[0.0000173]
Lagged NH infection rate			0.133***		0.141***
			[0.00489]		[0.00557]
Week × Lagged NH infection rate			-0.000724***		-0.000770***
			[0.0000806]		[0.0000942]
Lagged NH infection rate × type			-0.0200***		-0.0188***
			[0.00403]		[0.00479]
Lagged county infection rate		1.807***	0.949***	2.150***	1.223***
		[0.0649]	[0.0455]	[0.0906]	[0.0764]
Week × Lagged county infection rate		-0.0233***	-0.0126***	-0.0269***	-0.0152***
		[0.000932]	[0.000629]	[0.00138]	[0.00114]
Lagged county infection rate × type		-0.0850**	-0.0564**	-0.0700	-0.0519
		[0.0355]	[0.0266]	[0.0542]	[0.0484]

Continued on next page

Table 3 – continued from previous page

	(1) Infection rate per previous week occupied beds, %	(2) COVID death rate per previous week occupied beds, %	(3) COVID death rate per previous week occupied beds, %	(4) Death rate per previous week occupied beds, %	(5) Death rate per previous week occupied beds, %
Log of number of beds	0.119***	0.0167*	0.00232	-0.0716	-0.0879
	[0.0217]	[0.00929]	[0.00873]	[0.0813]	[0.0813]
Log of number of beds × type	-0.0926**	-0.00200	0.00878	0.103	0.115
	[0.0414]	[0.0126]	[0.0113]	[0.0797]	[0.0794]
Licensed staff hours	-0.000672***	-0.000117***	-0.0000440	-0.000113	-0.0000340
	[0.000123]	[0.0000453]	[0.0000407]	[0.000281]	[0.000280]
Licensed staff hours × type	0.000638***	0.00000843	-0.0000679	0.000257	0.000161
	[0.000231]	[0.0000750]	[0.0000685]	[0.000327]	[0.000323]
Overall Rating	-0.00860	0.00374	0.00404	0.0504***	0.0507***
	[0.00769]	[0.00320]	[0.00296]	[0.0123]	[0.0121]
Overall Rating × type	0.0304***	0.00416	0.000984	0.00167	-0.00236
	[0.00878]	[0.00349]	[0.00320]	[0.0127]	[0.0124]
competition index: 1 - HHI	0.124	0.0215	0.00393	0.0738	0.0537
	[0.130]	[0.0481]	[0.0435]	[0.191]	[0.191]
competition index: 1 - HHI × type	-0.285**	-0.0840	-0.0575	-0.475	-0.444
	[0.131]	[0.0534]	[0.0483]	[0.339]	[0.339]
Share of non-profit beds in radius	-0.0493	-0.0367	-0.0371	-0.335*	-0.338*
	[0.0996]	[0.0414]	[0.0378]	[0.194]	[0.192]
Share of non-profit beds in radius × type	-0.0295	0.00727	0.0129	0.0651	0.0744
	[0.0777]	[0.0279]	[0.0248]	[0.125]	[0.123]
Observations	725457	707863	706048	707863	706048

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Extended regression of pandemic outcome, county and week fixed effects

	(1) Infection rate per previous week occupied beds, %	(2) COVID death rate per previous week occupied beds, %	(3) COVID death rate per previous week occupied beds, %	(4) Death rate per previous week occupied beds, %	(5) Death rate per previous week occupied beds, %
type (=1 if For-profit)	0.778***	0.110	0.0349	-0.0454	-0.130
	[0.227]	[0.0755]	[0.0669]	[0.360]	[0.359]
Week number × type	-0.0116***	-0.00230***	-0.00121**	-0.00536***	-0.00412**
	[0.00190]	[0.000691]	[0.000596]	[0.00191]	[0.00187]
Week number × Week number × type	0.0000890***	0.0000241***	0.0000137**	0.0000401**	0.0000290*
	[0.0000225]	[0.00000734]	[0.00000624]	[0.0000179]	[0.0000173]
Lagged NH infection rate			0.132***		0.141***
			[0.00488]		[0.00554]
Week number × Lagged NH infection rate			-0.000733***		-0.000801***
			[0.0000803]		[0.0000938]
type × Lagged NH infection rate			-0.0200***		-0.0189***
			[0.00402]		[0.00478]
Lagged county infection rate		1.432***	0.748***	1.580***	0.843***
		[0.0748]	[0.0555]	[0.102]	[0.0877]
Week number × Lagged county infection rate		-0.0183***	-0.00982***	-0.0195***	-0.0102***
		[0.00102]	[0.000748]	[0.00151]	[0.00130]
Lagged county infection rate × type		-0.0824**	-0.0512*	-0.0719	-0.0510
		[0.0351]	[0.0267]	[0.0537]	[0.0483]
Log of number of beds	0.117***	0.0164*	0.00221	-0.0720	-0.0881
	[0.0217]	[0.00930]	[0.00874]	[0.0813]	[0.0813]
Log of number of beds × type	-0.0917**	-0.00184	0.00879	0.103	0.115
	[0.0415]	[0.0126]	[0.0113]	[0.0797]	[0.0794]

Continued on next page

Table 4 – continued from previous page

	(1) Infection rate per previous week occupied beds, %	(2) COVID death rate per previous week occupied beds, %	(3) COVID death rate per previous week occupied beds, %	(4) Death rate per previous week occupied beds, %	(5) Death rate per previous week occupied beds, %
Licensed staff hours	-0.000664***	-0.000116**	-0.0000436	-0.000111	-0.0000332
	[0.000122]	[0.0000452]	[0.0000407]	[0.000281]	[0.000280]
Licensed staff hours × type	0.000635***	0.00000814	-0.0000675	0.000256	0.000162
	[0.000231]	[0.0000750]	[0.0000685]	[0.000327]	[0.000323]
Overall Rating	-0.00919	0.00362	0.00397	0.0502***	0.0506***
	[0.00770]	[0.00320]	[0.00297]	[0.0123]	[0.0121]
Overall Rating × type	0.0310***	0.00427	0.00106	0.00183	-0.00222
	[0.00879]	[0.00350]	[0.00320]	[0.0127]	[0.0125]
competition index: 1 - HHI	0.117	0.0208	0.00362	0.0735	0.0538
	[0.131]	[0.0482]	[0.0435]	[0.191]	[0.191]
competition index: 1 - HHI × type	-0.298**	-0.0852	-0.0585	-0.476	-0.445
	[0.131]	[0.0534]	[0.0484]	[0.339]	[0.340]
Share of non-profit beds in radius	-0.0310	-0.0347	-0.0351	-0.334*	-0.337*
	[0.0984]	[0.0415]	[0.0379]	[0.194]	[0.192]
Share of non-profit beds in radius × type	-0.0311	0.00685	0.0125	0.0648	0.0741
	[0.0777]	[0.0279]	[0.0248]	[0.125]	[0.123]
Observations	725457	707863	706048	707863	706048

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

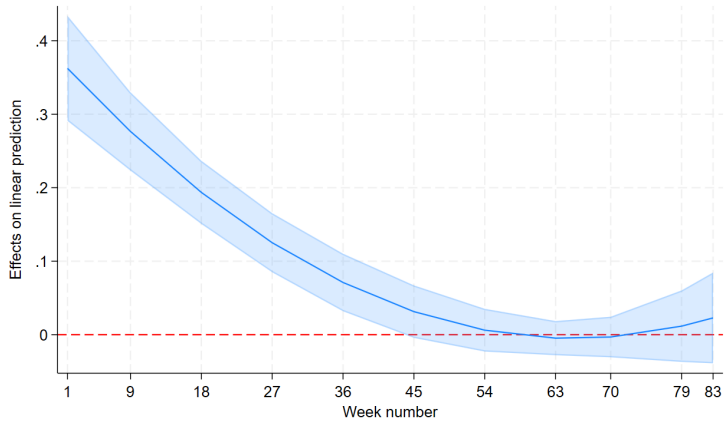


Figure 2: Dynamics of the infection rate gap (with county and week fixed effects)

Figure 2, which is based on Column (1) of Table 4, shows how the difference between COVID-19 infection rates in for-profit and nonprofit segments changed over the observation period. It fully confirms Hypotheses 1 and 2: initially there is a sizeable statistically significant gap between two types of nursing homes, reflecting lower care quality at for-profit ones at the outset of the pandemic; this gap, however, declines over time, leading to a statistical parity from week 54 onwards.[47]

The second most important outcome in our pecking order is overall mortality. Estimations of this specification of model (6) are presented in Column (4) and (5), Table 4, with corresponding marginal effect curve (7) (calculated for Column (4)) shown in Figure 3. The results confirm Hypothesis 2A: mortality from all causes, including COVID-19, at for-profit nursing homes in comparison to nonprofit ones, decreases over time. While this trend is broadly similar to the trend in COVID-19 infection rates, the important difference between these two outcomes is that in the latter case, for-profit nursing homes initially performed significantly worse than nonprofit ones, but later on reached parity with nonprofits, whereas for overall mortality, there was initial parity, followed by for-profit's leadership in saving residents' lives.[48] We also find direct support for the conjecture that for-profits ensure better survival odds of those infected with COVID-19: the interactions of the ownership dummy with the nursing home infection rates lagged by two weeks (column (5) in Tables 3 and 4) are negative and significant at 1%.

As argued in the previous section, COVID-19 mortality rate is less reliable as a quality of care indicator.

[47] A "look under the hood" to find out what exactly for-profit nursing homes did to deal with performance issues early on in the pandemic is beyond the scope of this paper. A likely adjustment strategy was to increase the numbers and quality of care providers, which was complicated by the acute staffing shortage experienced by the US nursing home industry during the pandemic (see e.g. Joshi 2023). Observe in this regard that according to our dataset, for-profit nursing homes appear to be able to better deal with the personnel shortage experienced by the industry than nonprofit ones. We defer an in-depth analysis of this phenomenon to a separate paper.

[48] Figures 2 and 3 show that on average over the observation period, for-profits performed worse than nonprofits in protecting residents from COVID-19 infection, but did a better job in terms of preventing deaths from all causes. This agrees with the estimations of benchmark model (5) presented earlier.

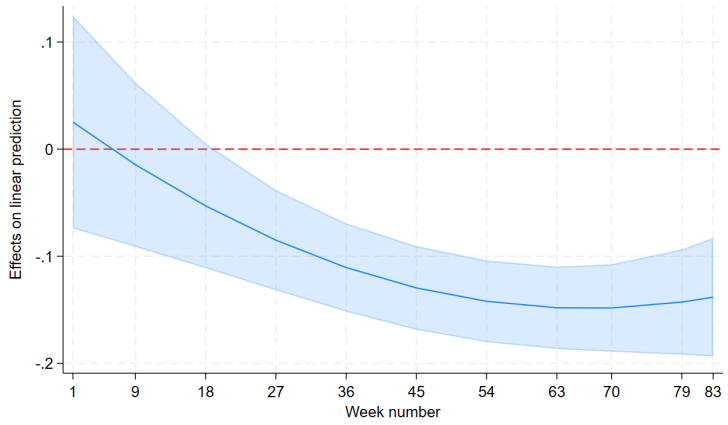


Figure 3: Dynamics of the death rate gap (with county and week fixed effects)

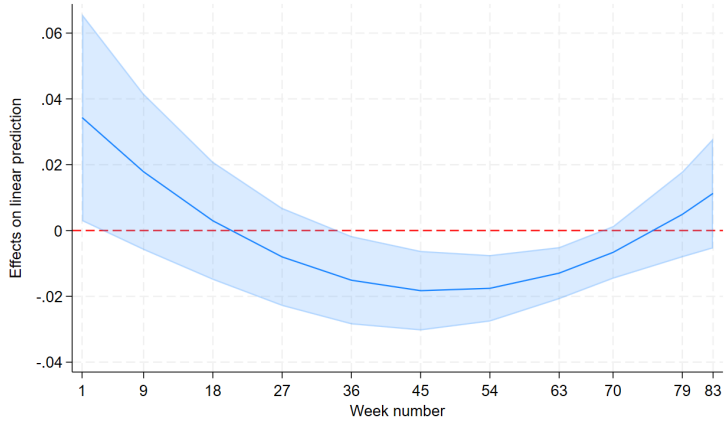


Figure 4: Dynamics of the COVID-19 death rate gap (with county and week fixed effects)

For this metric, model (6), with the inclusion of week number fixed effects, produces a U-shaped marginal effect curve (Figure 4), whereby initially for-profits exhibit higher COVID-19 mortality than nonprofits (although at a rather low statistical significance), then catch up (as in the case of COVID-19 infection rate) and even get ahead (as in the case of the overall mortality), but at the end of the observation period the two types of nursing homes become statistically indistinguishable, again as in the case of infections.

In yet another robustness check, we modify model (6) by replacing county fixed effects with nursing home fixed effects to capture possible time-invariant unique characteristics of nursing homes that are not reflected by our explanatory variables. Obviously, we should exclude the ownership dummy Type_i from these modifications, but we retain the interaction of this dummy with the week number and week number squared as well as with time-variable factors such as county infection rates. The marginal effects of ownership type for all three health outcomes exhibit trends qualitatively similar to those obtained from the original version with county fixed effects. We illustrate this by presenting the marginal effect curve for COVID-19 infection

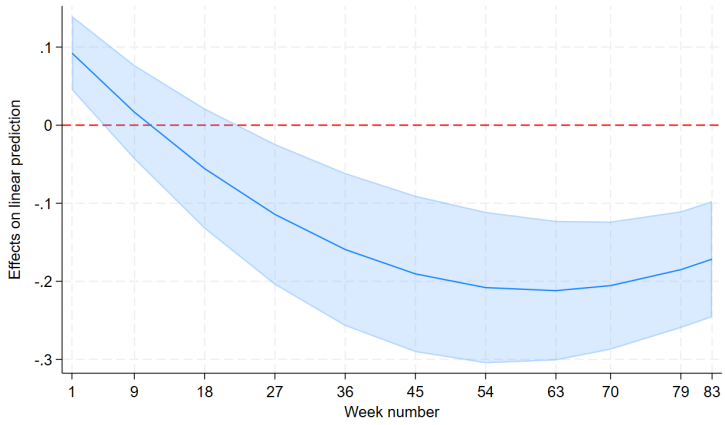


Figure 5: Dynamics of the infection rate gap (with nursing home and week fixed effects)

rate, calculated according to (7) without β_2 term (Figure 5).[49]

6.3 Misleading stars

Recall that in the baseline model (5), all three pandemic outcomes that we follow – COVID-19 infection rate and the death rates from COVID-19 and from all causes – exhibited strong positive correlation with Five Stars ranks[50] of nursing homes, contrary to what one would expect from a quality measure. Model (6) allocates these effects between the for-profit and nonprofit segments of the nursing home industry.

For COVID-19 infection rates estimations with both sets of fixed effects – county only, and county and week – the interaction of Five Star rank and nursing home ownership type is positive and highly significant, both statistically (at 1%) and numerically. In the same estimations, Five Star rank itself, turns negative, three times smaller in magnitude than the interaction term, and loses significance (Column (1), Tables 3 and 4). This means that positive correlation between the Five Star ranking and COVID-19 infection rate only occurs in the for-profit segment, in agreement with Hypothesis 3, and is absent in the nonprofit one. We arrive to the same conclusion by estimating baseline model (5) separately for the for-profit and nonprofit subsamples and calculating the marginal effects of Five Star rank for the infection rates in both subsamples – these effects are positive and significant in the former, and insignificant in the latter (Figure 6). Our theory predicts a negative association between observable quality proxies (such as Five Star ranking) and hidden quality components (revealed by the pandemic) due to stronger emphasis on financial performance, expected from for-profit providers. Viewed that way, the nonprofit segment provides a placebo test, and the

[49] Since the ownership dummy is subsumed by nursing home fixed effects, equation (7) without β_2 leaves the performance gap between two types of ownership unspecified at any *given* time, but correctly reproduces the dynamics of this gap, i.e., its variations with the passage of time. Accordingly, the nursing home fixed effect model is unsuitable for testing Hypothesis 1, but confirms Hypothesis 2.

[50] https://www.cms.gov/medicare/health-safety-standards/certification-compliance/five-star-quality-rating-system

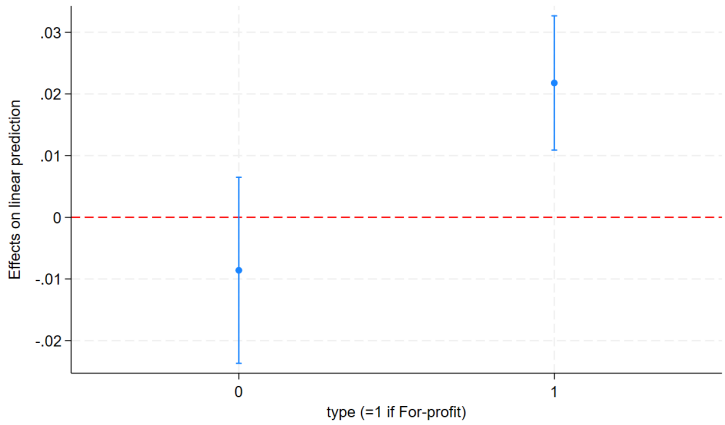


Figure 6: Marginal effects of Five Star ranking on COVID-19 infection rate in the nonprofit ("0") and for-profit ("1") segments

absence of statistically significant correlation between Five Star rating and COVID-19 infection rate within that segment supports our reasoning.

We do not observe a similarly clear-cut distinction between for-profit and nonprofit segments in the regressions for two other outcomes: death rates from COVID-19 and from all causes. In those estimations, Five Star rating has a positive and significant coefficient across the full sample, and its interactions with nursing home ownership type turn insignificant. This difference is unsurprising, given the expressed reservations about using the mortality rates, especially the COVID-19 one, as proxies for otherwise unobservable care quality aspects. The demonstrated ability of for-profit nursing homes to improve the survival odds of COVID-19-infected residents could mitigate the lack of care quality sacrificed for better ranking prior to the pandemic.

6.4 Impact of market structure

To explore the impact of market structure on the pandemic-caused adjustment process in the for-profit segment, we estimate regression (6) for the for-profit part of the full panel, paying particular attention to the marginal effects of the local competition measure and the share of nonprofits in the local market.[51] Estimation results are presented in Table 5 and the marginal effect curves for the two variables of interest are shown in Figures 7 and 8.

These results are in close agreement with Hypotheses 4 and 5. The marginal effects curve for competition (Figure 7) comes out U-shaped as expected. It shows no significant impact of local competition on COVID-

[51]Recall that we define local market as contained within a 25 miles radius around a nursing home and that competition is measured by 1 – HHI, where HHI is the Herfindahl-Hirschman index. We separately calculate such measures for for-profit nursing homes in the 25 miles radius and for all nursing homes in the same radius. Both versions are highly (more than 0.9) correlated with each other and produce nearly identical results; in what follows we use the latter measure.

19 infection rate early on in the pandemic, then competition significantly improves the performance in the for-profit segment, and subsequently this impact diminishes towards the end of the observation period, when for-profit nursing homes have reached production frontier and no further improvements are possible, at least in the short-run.

The marginal effects of the nonprofits share in the local market on the for-profit nursing homes infection rate is initially significant and negative, gradually declining over the first 25 weeks and turning insignificant for most of the remainder of the observation period (Figure 8). This is consistent with the role of nonprofit nursing homes as providing performance benchmarks early on in the pandemic and unlocking a catching-up process in the for-profit segment.[52]

[52] Arguably, such unlocking effect should also take some time to take place, but since our observation period starts several weeks after the pandemic began, we observe this effect fully pronounced – statistically and numerically – from the very beginning of the observation period. Notice that this spillover effect from nonprofit into for-profit segment is specific to the adjustment process to greater transparency brought about by the COVID-19 pandemic and is different from another spillover mechanism, described in Grabowski and Hirth (2003), which is based on residents' selection of nursing homes and as such not restricted to a particular period of time.

Table 5: Impact of competition and nonprofit share on for-profit segment

	(1) Infection rate per previous week occupied beds, %	(2) COVID death rate per previous week occupied beds, %	(3) COVID death rate per previous week occupied beds, %	(4) Death rate per previous week occupied beds, %	(5) Death rate per previous week occupied beds, %
Week number	-0.0200***	-0.00406***	-0.00183**	-0.0175*	-0.0152
	[0.00305]	[0.000901]	[0.000721]	[0.0104]	[0.0105]
Week number × type	-0.0103***	-0.00197***	-0.00107*	-0.00567***	-0.00467**
	[0.00189]	[0.000659]	[0.000561]	[0.00200]	[0.00196]
Week number^2	0.000203***	0.0000490***	0.0000269***	0.0000651***	0.0000404***
	[0.0000212]	[0.00000688]	[0.00000559]	[0.0000150]	[0.0000142]
Week number^2 × type	0.0000845***	0.0000209***	0.0000113*	0.0000419**	0.0000318*
	[0.0000223]	[0.00000709]	[0.00000596]	[0.0000174]	[0.0000167]
Lagged NH infection rate			0.130***		0.139***
			[0.00485]		[0.00562]
Week × Lagged NH infection rate			-0.000678***		-0.000769***
			[0.0000788]		[0.0000944]
type × Lagged NH infection rate			-0.0203***		-0.0200***
			[0.00399]		[0.00463]
Lagged county infection rate		1.801***	0.962***	2.132***	1.228***
		[0.0637]	[0.0452]	[0.0835]	[0.0701]
Week × Lagged county infection rate		-0.0232***	-0.0127***	-0.0259***	-0.0145***
		[0.000934]	[0.000631]	[0.00124]	[0.00103]

Continued on next page

Table 5 – continued from previous page

	(1) Infection rate per previous week occupied beds, %	(2) COVID death rate per previous week occupied beds, %	(3) COVID death rate per previous week occupied beds, %	(4) Death rate per previous week occupied beds, %	(5) Death rate per previous week occupied beds, %
type × Lagged county infection rate		-0.0942***	-0.0624**	-0.103**	-0.0794*
		[0.0363]	[0.0273]	[0.0515]	[0.0455]
competition index: 1 - HHI × Week	0.00215	-0.0000972	-0.0000945	0.0129	0.0131
	[0.00270]	[0.000804]	[0.000657]	[0.0118]	[0.0118]
Share of non-profit beds × Week	0.00754***	0.0000347	-0.000801*	0.000226	-0.000712
	[0.00170]	[0.000508]	[0.000416]	[0.00208]	[0.00205]
Observations	762908	744399	742355	744399	742355

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

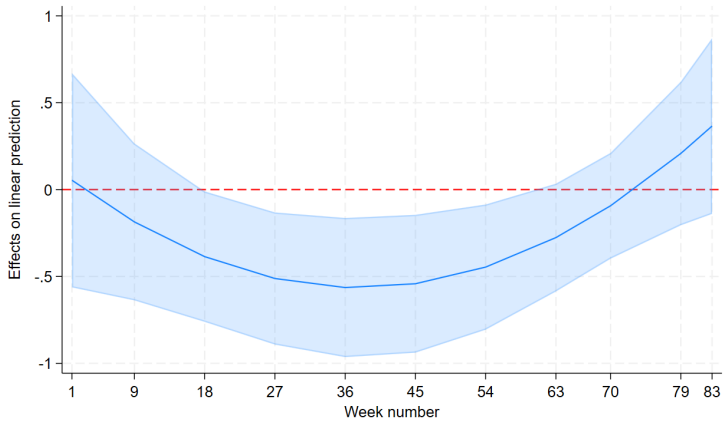


Figure 7: Marginal effect of competition on infection rate

The above effects are specific to the for-profit segment and their incentives, and should not be observed in the nonprofit part of the industry, which once again provides a placebo test for our hypotheses. In such a test, we estimate regression (6) for the residual subsample of nonprofit nursing homes. The estimation results (not presented here) show that the impact of competition on the performance of nonprofit nursing homes is insignificant over the first half of the observation period and becomes mildly adverse in the second half.[53] The impact of the nonprofits' market share on their performance is predictably insignificant over the observation period.

6.5 Sustainability and learning-by-doing

After the initial shock of the pandemic, the US nursing home industry was improving its ability to protect residents from the coronavirus, as evidenced by the estimations of the baseline model, where the coefficient of week number is significant and negative in all specifications.

Estimations of model (6) show that this trend was largely driven by the accelerated improvement of care quality in the for-profit segment, which was catching up with the nonprofit one. However, the industry at large was also better prepared for the subsequent waves of the pandemic, as shown by negative and highly statistically significant coefficients of the interaction of week number and county infection rate $t \times$ C_Inf in model (6) (Table 3). The infection rate in the surrounding community was a consistently strong predictor of a nursing home's pandemic outcomes in multiple studies, including ours, but community risk alone, salient as it was, did not explain the uneven pandemic outcomes at nursing homes. The passage of time was another

[53] A possible explanation of this pattern is as follows. For-profit nursing homes strived to expand their labor force as part of the adjustment process, and while doing so, they were putting pressure on the nonprofit segment, competing for the same production input. The strength of such pressure grew in the competitiveness of the local nursing home market (recall that according to Footnote 47, for-profit nursing homes appeared to be more successful in dealing with staff shortages plaguing the industry than nonprofit ones).

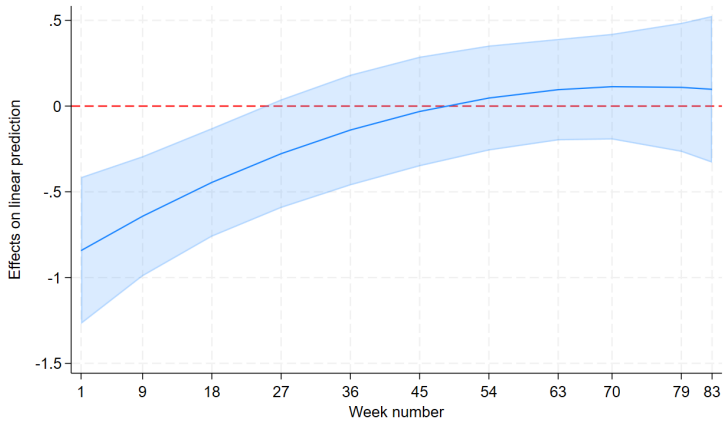


Figure 8: Marginal effect of nonprofit share on infection rate

contributing factor, in large part due to the vaccination rollout in early 2021, which prioritized nursing home population.

However, even against this generally positive backdrop, for-profit nursing homes appear to have displayed greater ability to learn-by-doing. This can be observed by introducing a triple interaction term $t \times \text{Type}_i \times \text{C\_Inf}$ of week number, private ownership dummy, and county infection rate, in the infection rate regression (6). The coefficient of this term turns out negative and significant at the 5% level. This finding agrees with Hypothesis 6.

To present further evidence of learning-by-doing in the US nursing home industry, we take advantage of a quasi-experimental environment, in which nursing homes were subjected to largely random "treatments" by the pandemic. One could expect that a stronger wake-up call experienced by a nursing home early on in the pandemic had caused a deeper and longer-lasting adjustment, leaving the nursing home better prepared to the waves to follow.

To find evidence of such effect, we perform the following version of a difference-in-difference test. We divide the observation period into two parts, first from week 1 to 49, and the second – from week 50 through 84. For each nursing home i in our sample, we calculate its exposure to the pandemic in the first part, max_inf1_i, as the maximal weekly infection rate over the week 1 to 49 period. Next, for the second part (weeks 50 through 84), we estimate, separately for the for-profit and nonprofit subsamples, regression model (5), in which we additionally include as independent variables max_inf1_i and the interaction $\text{max\_inf1}_i \times \text{C\_Inf}$.

Estimation results, presented in Table 6, show that the county infection rate remains a significant (at 1%) contributing factor to the nursing home infection rate. However, the impact of this factor is significantly (also at 1% level) mitigated by the nursing home's prior exposure to the pandemic, making badly "burned" nursing homes better insulated afterwards from the surrounding community infection. This learning-by-

doing effect conforms to Hypothesis 7. Both the for-profit and nonprofit segments present evidence of such learning-by-doing, but the impact of interaction $\text{max\_inf1}_i \times \text{C\_Inf}$ for the former is twice as large as for the latter, implying that for-profit nursing homes are better at learning from their earlier failures. This is yet another evidence of the adjustment process in the for-profit segment, triggered by the pandemic.

Table 6: Evidence of learning-by-doing: Impact of peak infection in earlier period of the pandemic

	(1) Infection rate per previous week occupied beds, %	(2) Infection rate per previous week occupied beds, %	(3) Infection rate per previous week occupied beds, %	(4) Infection rate per previous week occupied beds, %
type (=1 if For-profit)	1.598***	1.646***	1.807***	1.687***
	[0.443]	[0.442]	[0.440]	[0.450]
type × Number of a week	-0.0519***	-0.0522***	-0.0523***	-0.0506***
	[0.0134]	[0.0134]	[0.0134]	[0.0137]
type × Number of a week × Number of a week	0.000412***	0.000414***	0.000414***	0.000401***
	[0.000102]	[0.000102]	[0.000102]	[0.000105]
Max infection in NH × type			-0.00406***	-0.000844*
			[0.000452]	[0.000462]
County infection rate	1.220***	1.544***	1.211***	1.422***
	[0.0834]	[0.172]	[0.0834]	[0.114]
Max infection in NH × County infection rate				-0.0118***
				[0.00316]
County infection rate × type	0.197**	-0.0160	0.210**	0.375***
	[0.0918]	[0.179]	[0.0917]	[0.136]
Max infection in NH × County infection rate × type				-0.00611
				[0.00419]
Log of number of beds	-0.0124	-0.0125	-0.0106	-0.00891
	[0.0245]	[0.0245]	[0.0245]	[0.0247]
Log of number of beds × type	-0.0251	-0.0252	-0.0317	-0.0370
	[0.0326]	[0.0326]	[0.0333]	[0.0333]
Licensed staff hours	-0.000115	-0.000114	-0.0000923	-0.000162
	[0.000106]	[0.000106]	[0.000105]	[0.000110]

Continued on next page

Table 6 – continued from previous page

	(1) Infection rate per previous week occupied beds, %	(2) Infection rate per previous week occupied beds, %	(3) Infection rate per previous week occupied beds, %	(4) Infection rate per previous week occupied beds, %
Licensed staff hours × type	0.000140	0.000140	-0.0000330	0.0000702
	[0.000168]	[0.000167]	[0.000171]	[0.000173]
Overall Rating	-0.0000335	0.000122	0.00103	-0.00114
	[0.00678]	[0.00679]	[0.00679]	[0.00676]
Overall Rating × type	0.00528	0.00505	0.00303	0.00520
	[0.00822]	[0.00822]	[0.00826]	[0.00823]
competition index: 1 - HHI	-0.0921	-0.0902	-0.0793	-0.0859
	[0.126]	[0.126]	[0.119]	[0.119]
competition index: 1 - HHI × type	0.0203	0.0205	-0.0471	-0.0410
	[0.140]	[0.141]	[0.131]	[0.131]
Share of non-profit beds in radius	-0.192*	-0.191*	-0.176*	-0.169
	[0.109]	[0.109]	[0.106]	[0.106]
Share of non-profit beds in radius × type	0.115*	0.115*	0.107	0.0994
	[0.0672]	[0.0671]	[0.0667]	[0.0669]
Observations	305775	305775	305760	305760

Standard errors in brackets

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

7 Concluding remarks

For-profit nursing homes were often the chosen scapegoats in deliberations over the COVID-19 debacle in the nursing home industry. Suggested policy implications ranged from tighter regulation to eradication of for-profit segment of this social service. Our analysis highlights a different and heretofore insufficiently acknowledged pandemic lesson: the revealed potential of for-profit nursing homes to deliver quality care under a new set of incentives better aligned with social needs by enhanced transparency. While the pandemic did expose a dramatic failure of for-profit nursing homes to protect their residents (revealing a long-suspected but hard-to-prove lack of care quality), it also demonstrated the remarkable resilience and responsiveness of privately owned nursing homes, which enabled them to close the newly observable quality gap with nonprofit institutions in terms of coronavirus infections and even outperform the nonprofits in saving residents' lives.

The value of the pandemic experience for the future of the nursing home industry, and especially its for-profit segment, is subject to a major caveat: whether the jolt of the pandemic will have a sustained effect once quality shortfalls are no longer signaled by COVID-19 infections and deaths. While this paper presents some evidence of learning-by-doing triggered by the pandemic, improved managerial and operational practices are unlikely to sustain on their own unless the nursing homes' market environment becomes more transparent, renders a premium for quality care, and carries a punishment for substandard services.

Pre-pandemic industry regulation, still extant, did not meet such requirements. This includes official quality report cards and Five Star rankings, which send misleading signals at least on some vital aspects of care quality, as shown in the paper. Here, too, the pandemic experience, and particularly vast arrays of data accumulated in the US and elsewhere in the world, could be invaluable in allowing a retrospective statistical analysis of reporting and monitoring systems against tangible and measurable care outcomes.[54] Such analysis could inform ongoing and future efforts to improve the efficacy of regulation and enhance industry's transparency to customers, regulators, and other stakeholders.

However, government regulation has its clear limits in ensuring care quality that is not directly observable under ordinary circumstances. Better integration of nursing homes and their openness to surrounding communities would serve the same purpose, giving grassroots civil society a role and voice in the industry's oversight and preventing adverse physical and mental health outcomes caused by excessive isolation of nursing homes, as observed at the time of the pandemic. Community involvement in the institutionalized care for the elderly would complement governments as donors and regulators, in the spirit of co-production of public hoods and services (Ostrom, 1996). Last but not least, the nonprofit part of the nursing home industry

[54] COVID-19 pandemic served a dual role of exacerbating the need in "... high-quality research ... to advance the quality of care in nursing homes" (National Academies of Sciences, Engineering, and Medicine 2022, p.3), and of supplying new empirical strategies and sources of data for such research.

will continue to play an important role due to its ability, displayed during the pandemic, to maintain and display high performance standards, which complements competition and transparency as prerequisites for care quality in the for-profit segment.

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