Vertical Integration between Hospitals and Insurers*

José Ignacio Cuesta† Carlos Noton‡ Benjamín Vatter§

Abstract. The welfare effects of vertical integration are ambiguous. Cost efficiencies and the elimination of double marginalization may offset increases in market power and incentives to raise rivals' costs. To study the effects of vertical integration between insurers and hospitals, we develop a model of bargaining and competition. Integrated firms have incentives to increase hospital prices to rivals to steer demand to integrated partners. We estimate the model using administrative data on claims and plans from Chile, where vertically integrated hospitals account for half of all admissions. Our estimates imply that steering incentives are significant and that vertical integration decreases welfare.

Keywords: health care competition, insurer, hospital, vertical integration, bargaining
JEL Codes: I11, L13, L40

*This version: May 3, 2019. First version: August 23, 2017. We thank Christian Cox, David Dranove, Liran Einav, Martin Gaynor, Gautam Gowrisankaran, Igal Hendel, Ali Hortaçsu, Gastón Illanes, Elena Prager, William Rogerson, Pietro Tebaldi, and seminar participants at the 11th Workshop on Industrial Organization and Economic Theory at ISC Chile, 16th International Industrial Organization Conference, the 2018 North American Meeting of the Econometric Society at UC Davis, the First Workshop on Structural Models in Industrial Organization at Universidad Javeriana, the Workshop on Health Care and Industrial Organization in Santiago, the Applied Micro Research Seminar at the University of Chicago, Kellogg Strategy, the IO student seminar at Northwestern, Universidad Alberto Hurtado and Universidad de Chile for helpful comments and suggestions. We thank the Superintendence of Health of Chile for access to data and useful discussions, in particular Claudia Copetta, David Debrott and Eduardo Salazar. Noton acknowledges financial support from Fondecyt 1170029 and the Institute for Research in Market Imperfections and Public Policy, ICM IS130002. This research was partially supported by the computing infrastructure of the NLHPC (ECM-02). †University of Chicago. Email: jicuesta@uchicago.edu. ‡Department of Industrial Engineering, University of Chile. Email: cnoton@dii.uchile.cl. §Northwestern University. Email: benjaminvatterj@u.northwestern.edu.

1 Introduction

The recent trend towards vertical integration in health care markets has become a major concern for policymakers and researchers.[1] There has been speculation about whether vertical integration will reduce health care costs through better management and cost control, or increase market power of integrated firms and induce exclusionary practices towards rival firms (VOX, 2017). Yet, there is limited empirical work informing this debate, at least partly due to a lack of compelling settings and data (Gaynor et al., 2015). The wave of hospital mergers in the U.S. during the last two decades motivated substantial research on horizontal mergers in health care (Gaynor and Town, 2011; Dafny, 2014; Gowrisankaran et al., 2015). However, such evidence is not informative about the effects of vertical integration, since the trade-offs associated with them differ.

The effects of vertical integration on equilibrium outcomes are theoretically ambiguous. The main arguments in favor of vertical integration involve solving the double marginalization problem, and aligning incentives within the vertical chain to induce the efficient use of resources (Spengler, 1950; Williamson, 1971; Grossman and Hart, 1986). However, vertical integration also grants market power to integrated firms and may induce foreclosure, which could harm consumers (Hart and Tirole, 1990; Ordover et al., 1990). In this line, integrated firms may find it profitable to increase prices to rivals to steer consumers to their related partners. The extent to which this distortion arises in insurance and health care markets, and whether it outweighs the potential benefits of vertical integration are empirical questions that have received limited attention.

To study the equilibrium effects of vertical integration between insurers and hospitals, we develop and estimate a model for these markets. We use this model to identify incentives for integrated firms to steer demand towards partners, through which vertical integration affects equilibrium outcomes. To quantify the implications of vertical integration, we estimate the model primitives using detailed administrative data from Chile and use these estimates to study the counterfactual policy of banning vertical integration. Vertical integration induces higher negotiated hospital prices by integrated hospitals and reduces overall welfare in our setting.

The Chilean private health care market provides a unique setting for studying the effects of vertical integration. The market displays an oligopolistic structure where a small number of hospitals and insurers compete, and vertically integrated firms account for almost half of hospital admissions. Consumers choose among a variety of plans and, whenever they require health care, choose hospitals from their network and pay their share of the bill. The market features a stable set

[1] A recent event was the acquisition of Aetna by CVS in 2018. There are several examples of recent vertical mergers in the U.S.: Anthem acquired Simply Healthcare in Florida, United Health acquired DaVita and Monarch Healthcare in California, and Highmark acquired West Penn Allegheny System in Pennsylvania. Outside the U.S., Aetna acquired Indian Health Organization, and Cigna announced a similar strategy to enter the Indian and Chinese markets. Moreover, United Health recently bought the largest health care player in Brazil, Amil, and agreed to acquire Banmédica in Chile. Bossert et al. (2014) provides a discussion of increasing concentration in Latin American health care markets.

of hospitals and insurers, complete networks and limited variation in plan design, which ease the study of the effects of vertical integration. For this setting, we have access to detailed individual-level panel administrative data for 2013–2016. These data contain linked hospital claims, insurance plan choices, hospital prices, consumer out-of-pocket payments, plan premiums, and consumer demographics.

Our analysis starts by describing differences in market outcomes for integrated and non-integrated firms. The full price of admissions at an integrated hospital is 7.9% lower when the patient comes from an integrated insurer, and patients from integrated insurers pay 23% less out-of-pocket than patients from non-integrated insurers. Additionally, we show that new enrollees of integrated insurers are 10% more likely to visit hospitals integrated with that insurer, despite facing unrestricted networks. These facts suggest that vertical integration affects prices and choices in this market. However, vertical integration affects the behavior of all firms in equilibrium, which complicates the interpretation of these effects. The limitations of this analysis motivate the structural approach we adopt in the rest of the paper to evaluate the effects of vertical integration.

We develop a model that captures the main features of vertical integration in health care. The vertical structure of this market is non-standard and induces particular incentives. In a typical vertical market, downstream firms sell products acquired from upstream firms. In health care markets, consumers acquire an insurance plan that gives them an option to access upstream hospitals and purchase services directly from them at a given price schedule (Capps et al., 2003). This structure creates incentives for integrated insurers to use negotiated hospital prices to steer patients towards their integrated partners.

We model the interaction between hospitals, insurers and consumers as a four-stage game. In the first stage, hospitals and insurers engage in bilateral bargaining over hospital prices. In the second stage, insurers set premiums taking hospital prices as given. In the third stage, households choose an insurance plan. Finally, in the fourth stage, consumers' health risk is realized and, upon becoming sick, they choose a hospital within a choice set that depends on their insurance plan. This model is broadly similar to leading models in the literature (Gowrisankaran et al., 2015; Prager, 2016; Ho and Lee, 2017), but connects those to recent developments in the study of vertical markets (Lee, 2013; Crawford et al., 2018). In particular, our model accommodates vertical integration between insurers and hospitals, which allows for analyzing its effects. Integrated firms set both hospital prices and premiums to maximize their joint profits.

The main insights from our model are two mechanisms that emerge in equilibrium, which we study and quantify. Integrated firms have incentives to increase hospital prices to steer demand from rival hospitals and insurers towards their related partners. First, integrated hospitals have incentives to steer demand to their integrated insurers by negotiating higher hospital prices with rival insurers, which we call the *enrollee-steering* effect. This effect has been previously referred to as *raising your rival's cost* (Salop and Scheffman, 1983). Second, integrated insurers have incentives to steer demand to their integrated hospitals by negotiating higher prices with rival hospitals, which we call the *patient-steering* effect. To our knowledge, this effect has not been studied previously, as it stems from the aforementioned non-standard structure of the health care market. Both patient- and enrollee-steering effects can be broadly identified with partial foreclosure, as their limit case leads to downstream and upstream exclusion (Hart and Tirole, 1990).

We exploit our data and variation in vertical integration to estimate the model. First, we estimate discrete choice demand models for hospitals and plans using data on hospital and plan choices, prices, premiums, and consumer demographics. We exploit our individual-level data to control for unobservables, using rich sets of fixed effects to deal with price and premium endogeneity concerns. Our hospital demand estimates indicate that consumers are price sensitive and value the proximity of hospitals. Moreover, our plan demand estimates imply that consumers trade-off premiums and the overall quality of the network offered by insurers when choosing plans. Second, we estimate the parameters of the supply side of the model, namely marginal costs and bargaining weights. We develop a GMM estimator based on three sets of moments related to (i) optimality conditions for premium setting, (ii) firms' profitability as measured by financial statements, and (iii) orthogonality conditions between instruments and unobservable determinants of hospital costs. Using the estimated model, we show that enrollee- and patient-steering effects are empirically relevant in this setting.

Using our structural estimates, we quantify the effects of banning vertical integration on prices, market shares and welfare. Banning vertical integration increases total welfare in our setting, largely driven by a reduction in the gap between prices of integrated and non-integrated hospitals. This change in prices lowers insurer costs, which is partially passed through to consumers. The welfare effect of banning vertical integration is $146 million per year, which combines a decrease in hospital profits with increases in both insurer profits and consumer surplus. Underlying these welfare effects, we show that this policy involves substantial changes in the distribution of consumers across hospitals and insurers. This analysis does not account for potential cost efficiencies associated with vertical integration. We study a wide range of such efficiencies within integrated firms and show that while the welfare effects of banning vertical integration become smaller, they remain positive. However, vertical integration is welfare enhancing if cost efficiencies of the same magnitude within an integrated hospital were shared with rival insurers.

The strength of the steering incentives depends on consumer price sensitivity. More price sensitive consumers make this mechanism more effective and allow integrated firms to take advantage of this source of market power. However, more price sensitive consumers also make the market more competitive and induce prices to decrease. We explore the role of consumer price sensitivity for the effects of vertical integration. We find the the effect of banning vertical integration on consumer surplus depends on whether consumers are more sensitive to prices then to premiums, or the converse. When consumers respond more to hospital prices, integrated firms can steer patients by increasing prices to rival insurers which generates a consumer surplus loss. Alternatively, when consumers are more responsive to premiums then integrated insurers steer enrollees by lowering premiums, which increases consumer surplus.

Our paper contributes to three branches of the literature. First, we contribute to the empirical literature on the effects of vertical integration (Chipty, 2001; Hastings, 2004; Hortaçsu and Syverson, 2007; Atalay et al., 2014), which is still unsettled (Bresnahan and Levin, 2012). Closest to this paper is the work by Crawford et al. (2018) on vertical integration in multichannel television markets. Although our model is similar to theirs, the vertical structure of the health market we study creates new forces. We study a non-standard vertical market in which consumers interact with both upstream hospitals and downstream insurers, and it turns out that this feature has relevant implications for the effects of vertical integration. In effect, we find that demand steering incentives have significant implications on outcomes, which are not present in the vertical relationships between content providers and TV broadcasters where foreclosure is the predominant force.

Second, we contribute to the literature on competition in health care markets by providing new evidence on the effects of vertical integration. Within the vast literature on competition in health care (Gaynor and Town, 2011; Gaynor et al., 2015), the analysis of mergers focuses mostly on horizontal mergers between hospitals (Dafny, 2009; Dafny et al., 2012; Gowrisankaran et al., 2015; Lewis and Pflum, 2017; Craig et al., 2018; Dafny et al., 2018) and between insurers (Chorniy et al., 2016). Despite the increasing number of vertical mergers, work on vertical integration in health care is limited, and we contribute by expanding it. An exception is Diebel (2018), who studies the effect of vertical integration on foreclosure using the approach of Lewis and Pflum (2015).[2]

Finally, we contribute to the empirical literature on bargaining in vertical markets by studying the role of steering effects. The bargaining literature has covered a variety of research topics such as vertical integration and foreclosure (Crawford et al., 2018), horizontal mergers (Gowrisankaran et al., 2015), insurer competition (Ho and Lee, 2017), bundling (Crawford and Yurukoglu, 2012), price discrimination (Grennan, 2013), and network design and formation (Ho, 2009; Prager, 2016; Ghili, 2017; Ho and Lee, 2018; Liebman, 2018). Our paper focuses on the estimation of price distortions associated with vertical integration and their welfare implications.

Overall, we provide a theoretically grounded approach for quantifying the effects of vertical integration, that can inform antitrust analysis. We accommodate vertical integration in a bargaining framework that identifies demand steering incentives that distort negotiated hospital prices, and propose an approach to empirically assess the welfare consequences of banning vertical integration. Importantly, our approach can be used to study vertical integration in other industries where downstream consumers also interact with upstream firms. For example, our framework could be applied to analyze the role of Pharmacy Benefit Managers (PBM) in the U.S. market.

[2]Additionally, there is some literature on vertical contracting between insurers and hospitals, although it focuses mostly on the possibility of foreclosure (Gal-Or, 1997; Gal-Or, 1999).

The remainder of the paper is organized as follows. Section 2 describes the institutional framework and data from the Chilean health market, and provides descriptive evidence for the role of vertical integration. Section 3 proposes a model of competition and bargaining in health markets. Then, Section 4 discusses the identification and estimation of the parameters of the model and the main results from estimation. Section 5 develops a welfare analysis of banning vertical integration in this market. Finally, Section 6 concludes.

2 Institutions and Data

2.1 The Chilean Health Care Market

Health Insurance. The insurance system in Chile combines public and private provision.[3] The public insurer is the National Health Fund (*Fondo Nacional de Salud*, FONASA), a pay-as-you-go system financed by individual contributions and the government. The private sector has a small number of insurers (*Instituciones de Salud Previsional*, ISAPREs) that compete in a regulated environment. FONASA serves around 70% of the population and ISAPREs serve roughly 15% of it, while the remaining 15% of is either enlisted in the army or uninsured (Bitrán et al., 2010; Duarte, 2012). Insurance is mandatory for those in the labor market. Workers entering the labor force for the first time must automatically enroll in FONASA. After a month, they must actively choose to stay in FONASA or switch to a private insurer. Hence, workers, and then retirees, must contribute 7% of their taxable income to the public system or to purchase a private plan with a premium of at least that amount, with a maximum of $264 per month.[4]

Private and public plans differ in premiums, networks, coinsurance structure, coverage caps, risk pricing, and selection. In both sectors, plans offer separate coinsurance rates for inpatient and outpatient care. Unlike in the U.S., plans do not include deductibles and out-of-pocket maximums. For details on the interaction between the public and private systems, see Appendix B.1.

Private Health Insurance. Private insurers were introduced in 1981, in a context of broader privatization and market-oriented policies. Private insurers developed a variety of contracts to attract consumers, mainly from the top of the income distribution. Contracts in the private market are mostly individual arrangements among insurers and consumers. Contracts are annual, and once consumers choose one, they must remain under it for at least one year. After that period, consumers are allowed to switch to a different plan in the private or public sector. We focus on the six *open* insurers available to all workers, which account for 96% of the private market. We denote

[3] Our description of the Chilean insurance markets borrows from Duarte (2012) and Atal (2015).

[4] All monetary amounts are measured in U.S. dollars using the exchange rate on December 30, 2014.

these insurers by m_1–m_6. Insurers m_1 and m_6 are horizontally integrated, which motivates treating them as a single firm for our supply side analysis.[5]

Insurance plans are regulated and are composed of the following elements. First, they have a monthly premium that is age- and gender-specific. Second, insurers may reject consumers based on their health status, although plans have guaranteed renewability by which policyholders can always re-enroll on their plan regardless of changes in health status. Third, each plan has separate coinsurance rates for inpatient and outpatient care. Fourth, plans offer either unrestricted open networks or tiered networks.[6] Hospitals cannot deny health care to patients, and therefore all consumers have access to all hospitals, although they may have zero coverage from their plan. For further details regarding the regulation of insurance plans, see Appendix B.2.

Hospitals. The health care system combines public and private provision. The public hospital network is broader than the private one, with 185 public hospitals compared to 85 private hospitals in 2012 (Clínicas de Chile, 2012). We focus on the interaction between private insurers and private hospitals, given the private and public sectors are mostly segmented. Private insurers primarily cover admissions to private hospitals, whereas the public insurer mostly covers admissions to public hospitals. In fact, 97% of private insurer payments are to private hospitals, whereas only 3% are to public hospitals (Galetovic and Sanhueza, 2013). An important feature of this market is price transparency, as consumers are often able to obtain price quotes before choosing a hospital.

For our analysis, we focus on a particular segment of the market. Geographically, we focus on the city of Santiago, which is the largest health care market and where more than a third of private hospitals and around half of the capacity is located (Galetovic and Sanhueza, 2013). Additionally, we only consider inpatient care, which represents more than half of health care expenditure. This segment is comprised of remarkably fewer players than the outpatient care sector and therefore strategic concerns associated with vertical integration are more relevant in it. We focus on the 12 main hospitals in Santiago, and denote them by h_1–h_{12}. We discuss this selection in Section 2.2.1.

Vertical Integration. Vertically integrated firms are structured into *holdings* that control both insurers and hospitals.[7] Insurers and hospitals have strong vertical linkages: 48% of the private hospital capacity was controlled by holdings that also owned an insurer in 2012 (Galetovic and

[5]We account for the distinction between m_1 and m_6 when relevant. In particular, when estimating plan demand we allow consumers to hold different preferences for m_1 and m_6.

[6]Unrestricted network plans provide the same coverage for all hospitals. Tiered networks offer differentiated coverage across sets of private hospitals, as PPO plans in the U.S.. Few plans offer restricted networks, as HMO plans in the U.S., and they are rarely observed in the data and not offered publicly. We do not consider them in our analysis.

[7]The Chilean law forbids insurers from having ownership and control over hospitals. However, the law does not forbid a third party to own insurers and hospitals simultaneously. Hence, firms have circumvented the regulation by establishing vertical relations through holdings that own both insurers and hospitals.

Sanhueza, 2013). There are two integrated insurers, each of which is integrated with three hospitals in Santiago. In particular, insurer m_1 is integrated with hospitals h_4 , h_7 and h_{11}, whereas insurer m_3 is integrated with hospitals h_2, h_3 and h_8.[8] Importantly, vertically integrated hospitals remain open to patients from all insurers in the market.

2.2 Data

2.2.1 Administrative Records

We exploit administrative data collected by the regulator of the insurance market (*Superintendencia de Salud*, SS). Insurers must report data on individual claims. These data cover every health service provided to a private plan policyholder in 2013–2016, including financial and medical attributes along with consumer, plan and hospital identifiers. We complement these data with list prices paid by the public insurer for each service. Additionally, we access data on all private plans offered in 2013–2014. We have data on plan premiums, copayment rates, preferential networks, coverage caps, and availability in the market over time. Furthermore, we can match plans and their enrollees and observe basic demographics of policyholders and their dependents.[9]

We restrict our analysis to the 12 hospitals with highest market share, which account for 76% of the admissions in the data. The remaining hospitals are relatively small, and we group them into the outside option along with public hospitals. All these hospitals receive patients from all insurers in the market. Figure A.1 displays their locations in the market.

Admissions. We exploit administrative claims data to construct hospital admissions. Using claim dates and patient identifiers, we identify unique medical episodes of inpatient care which we label as *admissions*. The data contain detailed financial and medical information for each admission. Financial information includes the hospital charges, insurer coverage, and consumer copayment. Medical information includes the diagnosis and the list of claims for different services provided by the hospital. We code admissions to diagnoses using ICD-10 codes, resulting in medical episodes that cover 16 diagnoses groups.[10] These diagnoses account for 90% of admissions and 92% of

[8]We define vertically integrated firms as those for which the holding owns more than 50% of the hospital and more than 98% of the insurer. Information on vertical linkages is based on Copetta (2013). The case of m_2 is unclear, as the holding only controls 50% of the hospital. We do not consider this hospital-insurer pair as vertically integrated. The list of vertical linkages we provide is limited to the market we examine. Private insurers also hold vertical linkages with hospitals in other geographic markets (Tobar et al., 2012; Copetta, 2013; Galetovic and Sanhueza, 2013). We assume that geographic markets are independent and therefore focus only on linkages between insurers and hospitals in Santiago.

[9]When appropriate, we distinguish between policyholders, who choose and pay for insurance, and the full set of enrollees, which also cover policyholders' dependents.

[10]The list of diagnosis covers infections and parasites, neoplasms, blood diseases, endocrine diseases, nervous system diseases, ocular diseases, ear diseases, circulatory diseases, respiratory diseases, digestive diseases, skin diseases, musculoskeletal diseases, genitourinary diseases, pregnancy, perinatal treatments, and congenital malformation.

hospital revenue. Finally, we combine these data with plan attributes and consumer covariates, such as age, income, gender, and the number of dependents. We describe this process in detail in Appendix A. The resulting dataset contains 641,392 admissions for 2013–2016.[11]

Insurance Plans. Our administrative data on insurance plans contain detailed characteristics of 68,625 coded plans. The proliferation of plan codes is due to incentives faced by insurers due to guaranteed-renewability requirements (Atal, 2015). However, consumers face a much smaller choice set when choosing insurance. By grouping plans that are identical in financial attributes, we reduce the number of distinct plans to 4,358 over our four years of data.[12] As insurers offer different plans by gender, age, and household structure, consumers choose on average among 1,603 plans, of which only 43 have a market share above 0.5%. We provide more details on how we construct plan choice sets for demand estimation in Section 4.3.

2.2.2 Descriptive Statistics

Table 1-A describes policyholders. The average policyholder is 40 years old, has a monthly income of $1,600, and pays $160 in insurance premiums every month.[13] There is substantial variation in the household composition of policyholders, with 34% and 22% being single males and single females respectively, while the remaining 43% of the enrollees have at least one dependent.

Table 1-B displays plan attributes where the coverage rates are, on average 85% and 72% for inpatient and outpatient care. Moreover, 87% of plans have a coverage cap and 86% offer at least one preferential hospital. Table 1-C summarizes the market shares and monthly premiums.[14] We document substantial variation in premiums across insurers, with the difference between the highest and the lowest average premium being 66% of the average premium. Furthermore, we observe significant variation in premiums within an insurer, which is partly explained by the ability of insurers to adjust premiums by policyholder gender, age and number of dependents.

Table 2-A describes admissions, and shows that the average admission bill is $3,790, of which the patient pays almost a third. However, there is significant dispersion in total bill and insurer coverage. Nearly 38% of admissions are at preferential hospitals in the plan's tiered network. The average patient is 37 years old, although the data span from infants to elderly. Finally, about 70%

[11] We face limitations that preclude us from using outpatient claims data. The main issue is that those services are provided by entities typically different from hospitals (mostly physicians groups or other firms such as laboratories). Thus, tracking the identity of these providers is not feasible.

[12] We group plans by insurer, coverage rates, network structure and deciles in the base premium.

[13] This contribution is on average slightly larger than the mandatory 7%, because additional contributions are allowed.

[14] Market shares in our sample closely track national market shares. According to the regulator, insurer market shares in 2015 were 19.3% for m_1, 16.2% for m_2, 19.6% for m_3, 21.2% for m_4, 16.4% for m_5, 3.9% for m_6 and 3.3% for other insurers (Superintendencia de Salud, 2015).

of the patients have dependents, and 14% and 17% are single males and females, respectively.

Table 2-B documents hospital market shares and prices. Four hospitals have market shares between 10% and 13%, while the rest have market shares of 5% or lower. The outside option—minor private hospitals and all public ones—has a market share of 24%. There is substantial dispersion in total bill across hospitals. For example, hospitals h_1 and h_6 charge average prices more than double those charged by h_4 and h_{11}. This price dispersion is explained by differences in location, infrastructure, real and perceived quality, among others.

Finally, Table 3-A displays the breakdown of hospital admissions by insurer. Among all integrated hospitals, integrated insurers are the dominant source of admissions, representing between 40% and 70% of the hospitals' admissions. Nevertheless, all integrated hospitals receive a substantial share of patients from non-integrated insurers.

2.3 Descriptive Evidence on Vertical Integration

In this section, we provide descriptive evidence consistent with integrated firms steering demand towards their partners. We focus on how hospital prices and insurer coverage correlate with vertical integration, and on how being enrolled in an integrated insurer affects hospital choice.

2.3.1 Vertical Integration and Payments

To study how vertical integration correlates with admission payments, we exxploit within-hospital variation in admission outcomes for patients insured by integrated and non-integrated insurers. If integrated firms use prices to steer demand towards their partners, we should observe that hospital charges and patient copayments are lower for integrated admissions relative to non-integrated admissions within an integrated hospital.

The estimating equation is:

$$y_{idjh} = \beta VI_{m(j)h} + X'_{ij}\gamma + \tau_d + \eta_{m(j)} + \zeta_h + \varepsilon_{idjh} \quad (1)$$

where y_{idjh} is the outcome of interest for patient i admitted for diagnosis d under plan j in hospital h; $VI_{m(j)h}$ is an indicator of whether the insurer m and the hospital h are integrated; and X_{ij} is a vector of controls that includes patient i demographics and plan j attributes. Demographics include gender, age, income, number of dependents, an indicator for being an independent worker, and county of residence. Plan attributes include plan premium, coinsurance rate for inpatient and outpatient admissions, and indicators for whether the plan has a coverage cap and a preferential hospital. We also include prices in the public system for each admission as a proxy of costs, which we interact with hospital dummies. Moreover, we control for time-invariant heterogeneity by including diagnosis, insurer and hospital fixed effects, denoted by τ_d, $\eta_{m(j)}$ and ζ_h respectively.

Table 4 displays results for the full hospital bill, patient out-of-pocket copayment, and insurer coverage.[15] Each column shows estimates using an increasingly broader set of controls, and column (5) is our preferred specification. Estimates in Panel A show that the hospital bill is 7.9% lower for integrated admissions. Moreover, estimates in Panel B show that patient copayments are 23% lower for integrated admissions, whereas estimates in Panel C show that the amount paid by the insurer is 3.9% higher for integrated admissions.

These differences are not sufficient to determine the impact of vertical integration. On the one hand, we can rationalize this gap as an increase in integrated hospital prices to rival insurers to steer demand to their integrated insurer. On the other hand, it could be driven by cost efficiencies and the elimination of double marginalization within integrated firms. Our structural model will distinguish and quantify these two mechanisms.

2.3.2 Integrated Hospitals and Hospital Choices

Vertical integration creates incentives to steer demand towards integrated partners. To test whether the availability of integrated hospitals affects hospital choice, we study the outcomes of policyholders who switched to integrated insurers. The hospital choice set for switchers is constant over time. However, whether a hospital is integrated with a policyholder's insurer changes over time with switches. We exploit that variation to study the role of vertical integration in hospital choice.

Thus, we estimate the following event study regression for the subpopulation of switchers:

$$y_{iht} = \sum_{\tau} \beta_\tau D_{ih\tau} + \alpha_i + \delta_{ht} + \varepsilon_{iht} \tag{2}$$

where y_{iht} is an outcome for patient i in hospital h at year t. The main explanatory variables are the indicators $D_{ih\tau} = 1\{h \in \mathcal{H}_{m(is_i)}, \tau = s_i - t\}$, where $\mathcal{H}_{m(is_i)}$ is the set of hospitals integrated with the patient insurer, and s_i is the date at which patient i switched insurers. Each dummy variable indicates whether hospital h is integrated with the patient's insurer, τ periods after year t. The coefficients of interest are β_τ, which measure the effect of changing the integrated status of a hospital on the outcomes of interest τ years after the patient switched insurers. We include patient fixed effects α_i to control for differences in outcomes across patients that are constant through time (e.g., permanent differences in health), and hospital-time fixed effects δ_{ht} to control for differences in outcomes across hospitals and time that are constant across patients (e.g., seasonality in health shocks, quality differences). The coefficient for the year before the patient switches is set to zero.

[15] We use the log of the outcomes plus some fixed amount to ensure no zeros in the dependent variable, which is frequent for patient copayments. The results are similar when using the inverse hyperbolic sine transformation of the dependent variable, $y = \log(\widetilde{y} + \sqrt{\widetilde{y}^2 + 1})$, as displayed in Table A.1.

Policyholders switching to an integrated insurer are more likely to choose hospitals integrated with their insurer. Figure 1 displays results from estimating equation (2). In particular, Figure 1-a shows that when the patient switches insurers, the probability of choosing a hospital integrated with the new insurer increases by almost 10%. Moreover, Figure 1-b shows that expenditure in hospitals integrated to the new insurer increases by more than 50% relative to the year before. Both effects remain two years after the patient switches insurers.

These results should be interpreted with caution. First, patients may switch insurers precisely to improve their access to integrated hospitals. Second, the results do not imply that hospital admissions or expenditure increased, but may reflect reallocation from non-integrated to integrated hospitals. Finally, this analysis does not identify which aspect of the chosen plan affects hospital choice, which could be prices, networks, or other.

3 A Model of Bargaining between Hospitals and Insurers

We model the market as a four-stage game. First, hospital prices are set for each insurer-hospital pair in the market. If the hospital-insurer pair is integrated, the hospital prices are set by joint profit maximization, whereas if firms are not integrated, they engage in negotiation. Second, insurers determine plan premiums taking hospital prices as given. Third, households choose an insurance plan based on premiums and the expected utility from the plan network of health care services. Fourth, consumers' health risk is realized. Upon becoming sick, consumers choose a hospital given hospital characteristics and out-of-pocket payment as determined by their insurance plan.

Our model builds upon recent work in the literature (Gowrisankaran et al., 2015; Prager, 2016; Ho and Lee, 2017), though differing in two critical aspects. First, central to our analysis, we allow for vertical integration, which alters incentives in upstream and downstream equilibrium prices. Second, we assume that insurers set premiums taking hospital prices as given, which is different from Ho and Lee (2017) who assume those pricing decisions to be simultaneous.[16]

3.1 Setup

Each insurer $m \in \mathcal{M}$ offers a menu of insurance plans denoted by $\mathcal{J}_m$, where $\mathcal{M}$ is the set of insurers. Each plan $j \in \mathcal{J}_m$ charges a premium ϕ_j for a given coverage structure and a specific hospital network. Offered hospital networks are unrestricted, but plans may offer tiered networks that differ in coinsurance rates across tiers. Throughout the paper, we assume an exogenous and fixed set of available plans, keeping their coinsurance rates and network structure constant.

[16]We allow insurers to set premiums after observing hospital prices, as insurance contracts in Chile are signed throughout the year. In contrast, hospital contracts have fixed lengths and are renegotiated only once per term.

Hospitals $h \in \mathcal{H}$ provide health services. Each hospital h charges a price p_{mh} to patients enrolled with insurer m. Patient out-of-pocket payments are a fraction of the hospital price, determined by the patient's plan coverage at the hospital. Given that hospital networks are unrestricted and hospitals cannot refuse health care to patients, consumers can choose any hospital in the market regardless of their plan. We also allow hospitals to organize into systems which we denote by $s \in \mathcal{S}$, where each system s consists of a set of hospitals $\mathcal{H}_s \subset \mathcal{H}$. Hospital systems negotiate the prices of their hospitals as a single entity but are allowed to set different prices for each hospital-insurer.

3.1.1 Timing of the Game

Our model consists of a four-stage game with the following timing:

1. Hospital prices $\boldsymbol{p}$ are determined either by bilateral negotiation between insurers and hospitals or by joint profit maximization if the hospital and the insurer are integrated.
2. Profit maximization of the insurers determines the vector of plan premiums $\boldsymbol{\phi}$, taking hospital prices $\boldsymbol{p}$ as given.
3. Households choose an insurance plan j of insurer m based on premiums and the expected utility from health care services provided by the plan. Household choices determine the aggregate demand for plans, $D_j^M(\boldsymbol{\phi}, \boldsymbol{p})$.
4. Health risk is realized, and consumers choose among hospitals given their attributes and the out-of-pocket expenditure determined by their plan. Consumer choices determine aggregate demand for each hospital h by household type enrolled in each plan j, $D_{hj}^H(\boldsymbol{\phi}, \boldsymbol{p})$.

Note that the timing of the game implies that premiums are set conditional on hospital prices. This allows insurers to respond to out-of-equilibrium offers made in the bargaining stage, which disciplines equilibrium prices.

3.1.2 Hospital Profits

Hospital system $\mathcal{H}_s$ maximizes profits by setting prices with integrated insurers and negotiating prices with non-integrated insurers. Profits for the hospital system s are given by:

$$\pi_s^H(\boldsymbol{\phi}, \boldsymbol{p}) = \sum_{h \in \mathcal{H}_s} \sum_{m \in \mathcal{M}} \sum_{j \in \mathcal{J}_m} D_{hj}^H(\boldsymbol{\phi}, \boldsymbol{p})(p_{mh} - c_{mh}^H) \tag{3}$$

where $D_{hj}^H(\boldsymbol{\phi}, \boldsymbol{p})$ is health care demand, c_{mh}^H is the hospital marginal cost and p_{mh} is the price charged by hospital h to patients enrolled with insurer m. For simplicity, we assume scalar costs and prices for each hospital-insurer pair. In the empirical application, we use condition-specific weights to allow the hospital prices and costs to vary across diagnosis and consumer characteristics.

3.1.3 Insurer Profits

Insurer m maximizes expected profits by choosing plan premiums for the set of offered plans, conditional on hospital prices. Profits for the insurer m are given by:

$$\pi_m^M(\boldsymbol{\phi}, \boldsymbol{p}) = \sum_{j \in \mathcal{J}_m} D_j^M(\boldsymbol{\phi}, \boldsymbol{p})(\phi_j - c_j^M) \tag{4}$$

where ϕ_j is the premium and c_j^M is the expected marginal cost per household enrolled in plan j. We abstract from insurer administrative costs. Hence, the insurer expected marginal cost is the fraction of the hospital bill covered by the insurer.

3.1.4 Profits for Vertically Integrated Firms

We use the term holding for a firm that owns an insurer and a hospital system. These vertically integrated firms or holdings set both hospital prices and plan premiums to maximize the joint profits of their related partners. In doing so, these firms internalize the effects of changes in premiums and hospital prices in steering demand towards their affiliated insurer and hospitals.

The profits of integrated firm $a \in \mathcal{V}$ that controls hospital system $s(a)$ and insurer $m(a)$ are:

$$\pi_a^{VI}(\boldsymbol{\phi}, \boldsymbol{p}) = \pi_{s(a)}^H(\boldsymbol{\phi}, \boldsymbol{p}) + \theta_a \pi_{m(a)}^M(\boldsymbol{\phi}, \boldsymbol{p}) \tag{5}$$

where both hospital and insurer profits are as in equations (3) and (4). The VI weight θ_a scales the objective of the firm, allowing it to differently value profits from health care than those from insurance.[17] This can be justified by differences in regulation between both markets; by the internal organization of the integrated firm and ability to transfer rents across its insurer and system; or simply by the nature of the contracts written when merging. We allow the weight to differ between integrated systems, and consider $\boldsymbol{\theta} = 1$ as the special case where integrated firms value all rents equally. For ease of exposition, we present the rest of the model for this special case, and reintroduce θ when discussing the supply side estimation in Section 4.4.

3.1.5 Bargaining over Hospital Prices

We assume that hospital systems and insurers that are not integrated engage in sequential bargaining over hospital prices as in Collard-Wexler et al. (2017). Thus, the negotiated hospital price, p_{mh}, between non-integrated hospital h and a non-integrated insurer m is given by:

$$p_{mh} = \arg\max_{p_{mh}} \quad (\pi_s^H - \pi_{s \backslash m}^H)^{(1-\lambda_{ms})}(\pi_m^M - \pi_{m \backslash s}^M)^{\lambda_{ms}} \tag{6}$$

[17] Crawford et al. (2018) justify a similar weighting in their context, as a measure of the extent of the integration.

where $\pi^H_{s\backslash m}$ are the profits for hospital system s upon disagreement with insurer m, and $\pi^M_{m\backslash s}$ are the profits for insurer m upon disagreement with hospital system s. The negotiated price maximizes the Nash product that is the weighted product of the marginal gains from the relationship for each firm. Under the standard assumption of passive beliefs, we keep all other hospital prices constant at their equilibrium level (Horn and Wolinsky, 1988). The parameter $\lambda_{ms} \in (0,1)$ is the normalized bargaining weight of insurer m relative to hospital system s and measures relative bargaining skill. For instance, if λ_{ms} increases, then the split of surplus skews towards insurer m.

We generalize equation (6) to accommodate negotiations between holdings a and b, since integrated and non-integrated firms are particular cases of holdings with and without related firms. The negotiated hospital price, $p_{m(a)h(b)}$, between insurer $m(a)$ and hospital $h(b)$ is given by:

$$p_{m(a)h(b)} = \arg\max_{p_{m(a)h(b)}} (\pi^{VI}_a - \pi^{VI}_{a\backslash s(b)})^{\lambda_{m(a)s(b)}} (\pi^{VI}_b - \pi^{VI}_{b\backslash m(a)})^{(1-\lambda_{m(a)s(b)})} \tag{7}$$

where $\pi^{VI}_{a\backslash s(b)}$ are the profits of holding a upon disagreement with hospital system $s(b)$, and $\pi^{VI}_{b\backslash m(a)}$ are the profits of holding b upon disagreement with insurer $m(a)$. As before, the parameter $\lambda_{m(a)s(b)}$ is the normalized bargaining weight between insurer $m(a)$ and hospital system $s(b)$. Notice that the disagreement between two firms from different holdings does not block the agreement between the other related firms of those holdings. For instance, a disagreement between insurer $m(a)$ and hospital system $s(b)$ does not prevent an agreement between insurer $m(b)$ and hospital system $s(a)$.

Vertical Integration and Disagreement Profits. We analyze the components of disagreement profits for vertically integrated firms, as they provide relevant insights regarding the role of vertical integration in the bargaining outcomes.

Profits for holding a upon disagreement with hospital system $s(b)$ are given by:

$$\pi^{VI}_{a\backslash s(b)} = \pi^H_{s(a)\backslash s(b)}(\boldsymbol{\phi}, \boldsymbol{p}) + \pi^M_{m(a)\backslash s(b)}(\boldsymbol{\phi}, \boldsymbol{p})$$

where $\pi^H_{s(a)\backslash s(b)}(\boldsymbol{\phi}, \boldsymbol{p})$ and $\pi^M_{m(a)\backslash s(b)}(\boldsymbol{\phi}, \boldsymbol{p})$ are the hospital and insurer profits of holding a upon disagreement with hospital system $s(b)$.

The term $\pi^H_{s(a)\backslash s(b)}(\boldsymbol{\phi}, \boldsymbol{p})$ is novel and highlights that integrated holdings have incentives to steer demand towards their hospitals. Indeed, the disagreement between holding a and hospital system $s(b)$ can be beneficial to their related hospital system, $s(a)$. Thus, holding a has incentives to deter enrollees of insurer $m(a)$ from choosing hospitals in system $s(b)$. Unlike non-integrated insurers, holding a internalizes that high hospital prices to rival hospitals may steer demand towards their related hospital system. Therefore, we denote this as the *patient-steering* effect.

Disagreement profits $\pi^M_{m(a)\backslash s(b)}(\boldsymbol{\phi}, \boldsymbol{p})$ capture the standard loss in a vertical relationship when the insurer loses a hospital system from its network, making the network less valuable for enrollees.

This loss stems from the ensuing decrease in insurance demand for plans offered by insurer $m(a)$, mitigated by the ability of insurers to adjust premiums after disagreements.

Analogously, profits for holding b upon disagreement with insurer $m(a)$ are given by:

$$\pi^{VI}_{b\setminus m(a)} = \pi^{H}_{s(b)\setminus m(a)}(\boldsymbol{\phi}, \boldsymbol{p}) + \pi^{M}_{m(b)\setminus m(a)}(\boldsymbol{\phi}, \boldsymbol{p})$$

where $\pi^{H}_{s(b)\setminus m(a)}(\boldsymbol{\phi}, \boldsymbol{p})$ and $\pi^{M}_{m(b)\setminus m(a)}(\boldsymbol{\phi}, \boldsymbol{p})$ are hospital and insurer profits of holding b upon disagreement with a rival insurer $m(a)$. The usual loss from disagreement is given by $\pi^{H}_{s(b)\setminus m(a)}(\boldsymbol{\phi}, \boldsymbol{p})$, which captures the change in hospital profits when removed from insurer $m(a)$ networks. Unless enough patients leave insurer $m(a)$ following the disagreement and access hospitals in $H_{s(b)}$ through other plans, the hospital system will obtain lower profits under disagreement.

Disagreement profits $\pi^{M}_{m(b)\setminus m(a)}(\boldsymbol{\phi}, \boldsymbol{p})$ capture a novel effect of vertical integration. Under vertical integration, disagreement with rival insurer $m(a)$ may benefit the holding's insurer $m(b)$, as not having hospital system $s(b)$ in the network of $m(a)$ makes that network less valuable and increases demand for insurer $m(b)$. Unlike non-integrated insurers, holding b internalizes that high hospital prices with rival insurers worsen its rival's network and benefit their integrated insurers.[18] Therefore, we refer to this as the *enrollee-steering* effect.

3.2 Equilibrium

3.2.1 Equilibrium Negotiated Hospital Prices

Negotiated prices between non-integrated hospitals and insurers come from equation (6), and solve:

$$\frac{\partial \pi^{H}_{s}}{\partial p_{mh}}(1-\lambda_{ms}) = -\lambda_{ms}\left(\frac{\pi^{H}_{s} - \pi^{H}_{s\setminus m}}{\pi^{M}_{m} - \pi^{M}_{m\setminus s}}\right)\frac{\partial \pi^{M}_{m}}{\partial p_{mh}} \quad \forall m \in \mathcal{M}, h \in \mathcal{H} \tag{8}$$

which we generalize to accommodate different combinations of vertical structures between the two negotiating firms. In particular, let $1_{v\in\mathcal{V}}$ indicate whether an integrated holding owns firm v. Then, based on equation (7), the negotiated prices between insurer $m(a)$ and hospital $h(b)$ are:

$$\begin{aligned}\frac{\partial \pi^{H}_{s(b)}}{\partial p_{m(a)h(b)}} + 1_{b\in\mathcal{V}}\frac{\partial \pi^{M}_{m(b)}}{\partial p_{m(a)h(b)}} &= -\frac{\lambda_{m(a)h(b)}}{1-\lambda_{m(a)h(b)}}\left(\frac{\pi^{H}_{s(b)} - \pi^{H}_{s(b)\setminus m(a)} + 1_{b\in\mathcal{V}}(\pi^{M}_{m(b)} - \pi^{M}_{m(b)\setminus m(a)})}{\pi^{M}_{m(a)} - \pi^{M}_{m(a)\setminus s(b)} + 1_{a\in\mathcal{V}}(\pi^{H}_{s(a)} - \pi^{H}_{s(a)\setminus s(b)})}\right) \\ &\quad \times\left(\frac{\partial \pi^{M}_{m(a)}}{\partial p_{m(a)h(b)}} + 1_{a\in\mathcal{V}}\frac{\partial \pi^{H}_{s(a)}}{\partial p_{m(a)h(b)}}\right) \quad \forall m \in \mathcal{M}, h \in \mathcal{H}\end{aligned} \tag{9}$$

[18] The usual incentive to foreclose rivals from accessing upstream services arises when negotiated prices tend to infinity (Hart and Tirole, 1990).

which is the standard condition in the bargaining literature, extended to consider the incentives related to vertical integration between insurers and hospitals. For integrated firms, a change in hospital prices affects both hospital and insurer profits.

Negotiated prices in equation (9) can be rewritten in matrix form. After rearranging and stacking equations, the vector of negotiated prices for hospital system $s(b)$ is given by:

$$\boldsymbol{p}_{s(b)} = \boldsymbol{c}^H_{s(b)} - (\Omega_{s(b)} + \Lambda_{s(b)})^{-1}(D^H_{s(b)} + \Gamma_{s(b)}) \tag{10}$$

where $\boldsymbol{p}_{s(b)}$ contains negotiated prices between each hospital $h \in \mathcal{H}_{s(b)}$ and each insurer. On the right-hand side, $\boldsymbol{c}^H_{s(b)}$ contains hospital marginal costs for each hospital and insurer. Thus, equilibrium mark-ups over marginal cost combine several elements that we analyze in detail.[19]

First, the matrix $\Omega_{s(b)}$ captures demand price sensitivity for hospital h from enrollees of insurer m. Each entry in this matrix is given by:

$$\Omega_{s(b)[h,m]} = \sum_{j \in \mathcal{J}_m} \frac{\partial D^H_{hj}(\phi, p)}{\partial p_{m(a)h(b)}}$$

which measures standard demand responses to hospital prices across plans of insurer m. The more price sensitive hospital demand is, the lower the equilibrium mark-up in hospital price $p_{m(a)h(b)}$.

Second, the matrix $\Lambda_{s(b)}$ captures additional considerations of price sensitivity of the insurer's holding. Each entry in this matrix is:

$$\Lambda_{s(b)[h,m]} = \underbrace{\frac{\lambda_{m(a)h(b)}}{1-\lambda_{m(a)h(b)}}}_{\substack{\text{Relative} \\ \text{bargaining skill}}} \underbrace{\sum_{j \in \mathcal{J}_m} [D^H_{jh}(\phi, p) - D^H_{jh \setminus m}(\phi, p)]}_{\substack{\text{Contribution of insurer } m \\ \text{to demand for hospital } h}} \underbrace{\left(\frac{\frac{\partial \pi^M_{m(a)}}{\partial p_{m(a)h(b)}} + 1_{a \in \mathcal{V}} \frac{\partial \pi^H_{s(a)}}{\partial p_{m(a)h(b)}}}{\pi^M_{m(a)} - \pi^M_{m(a) \setminus s(b)} + 1_{a \in \mathcal{V}}(\pi^H_{s(a)} - \pi^H_{s(a) \setminus s(b)})} \right)}_{\text{Sensitivity of holding } a \text{ profits to negotiated price}}$$

where the first term depends on the relative bargaining weights, and shows that insurers with higher bargaining skill obtain lower hospital mark-ups. The second term captures the marginal contribution of insurer m to demand for hospital h. The larger the contribution of insurer m, the lower the hospital mark-up. Finally, the third term measures the sensitivity of holding a's profits to

[19] Equation (10) nests other models as particular cases. First, in the absence of vertical integration ($\mathcal{V} = \emptyset$) and when hospitals have all the bargaining power ($\lambda_{ms} = 0$), we recover the usual Nash-Bertrand conditions for hospital pricing, $\boldsymbol{p}_{s(b)} = \boldsymbol{c}^H_{s(b)} - \Omega^{-1}_{s(b)} D^H_{s(b)}$. Second, if all bargaining power is granted to insurers ($\lambda_{ms} = 1$), then hospital prices are equal to hospital marginal costs, $\boldsymbol{p}_{s(b)} = \boldsymbol{c}^H_{s(b)}$. Finally, allowing for both players to hold some bargaining power ($\lambda_{ms} \in (0, 1)$) in absence of vertical integration ($\mathcal{V} = \emptyset$), equilibrium hospital prices are set at a mark-up over marginal costs, $\boldsymbol{p}_{s(b)} = \boldsymbol{c}^H_{s(b)} - (\Omega_{s(b)} + \Lambda_{s(b)})^{-1} D^H_{s(b)}$, such that mark-ups depend on price sensitivity augmented by bargaining, similar to that in Gowrisankaran et al. (2015). An identical conclusion can be drawn from equation (8): as λ_{ms} goes to zero, optimal prices solve $\frac{\partial \pi^H_s}{\partial p_{mh}} = 0$, whereas as $(1 - \lambda_{ms})$ goes to zero, optimal prices solve $\frac{\partial \pi^M_m}{\partial p_{mh}} = 0$.

the negotiated price and captures the patient-steering effect in integrated insurers, when $a \in \mathcal{V}$.[20]

Finally, $\Gamma_{s(b)}$ captures the enrollee-steering effect in integrated hospitals, when $b \in \mathcal{V}$. This term measures the ability of hospital systems to leverage their integrated insurers for higher prices:

$$\Gamma_{s(b)[m]} = 1_{b\in\mathcal{V}}\Bigg[\underbrace{\frac{\partial \pi^M_{m(b)}}{\partial p_{m(a)h(b)}}}_{\text{Effect on integrated insurer profits}} + \underbrace{\left(\pi^M_{m(b)\setminus m(a)} - \pi^M_{m(b)}\right)}_{\text{Integrated insurer disagreement profit}} \underbrace{\frac{\lambda_{m(a)h(b)}}{1-\lambda_{m(a)h(b)}}}_{\text{Relative bargaining skill}} \underbrace{\left(\frac{-\frac{\partial \pi^M_{m(a)}}{\partial p_{m(a)h(b)}} - 1_{a\in\mathcal{V}} \frac{\partial \pi^H_{s(a)}}{\partial p_{m(a)h(b)}}}{\pi^M_{m(a)} - \pi^M_{m(a)\setminus s(b)} + 1_{a\in\mathcal{V}}(\pi^H_{s(a)} - \pi^H_{s(a)\setminus s(b)})} \right)}_{\text{Sensitivity of holding } a \text{ to negotiated price}} \Bigg]$$

where the first term measures the effect of higher hospital prices for rival insurer $m(a)$ on the integrated insurer $m(b)$. Higher hospital prices to rival insurer $m(a)$ steer demand towards the integrated insurer $m(b)$, thus increasing holding b's profits. The stronger this effect, the higher the prices $p_{m(a)h(b)}$. The second term captures the benefits of insurer $m(b)$ from the disagreement between insurer $m(a)$ and hospital $s(b)$. The larger the benefits of $m(b)$ under the disagreement with $m(a)$, the higher the prices $p_{m(a)h(b)}$. This effect is augmented by the bargaining weight of insurer $m(a)$ and the marginal loss in profit of holding a from an increase in the negotiated price. This adjustment captures the incentives to foreclose $m(a)$, which is larger when facing a counterpart with high bargaining skill, or when hospital $s(b)$ is relevant for holding a's profits. In the limit case in which the insurer $m(a)$ has all the bargaining power, this last component implies perfect foreclosure by hospital system $s(b)$ through an infinite $p_{m(a)h(b)}$.

Integrated holdings set hospital prices for their insurer and hospitals to maximize joint profits in equation (5). Although not arising from a bargaining problem, the first order condition for optimality of that problem is identical to that of a bargaining problem in which the bargaining weight λ is set to zero. This implies that equation (10) nests the optimal hospital prices of the integrated firm, and therefore we can solve for all hospital prices from a single matrix equation.

3.2.2 Premium Setting by Non-Vertically Integrated Insurers

Insurers compete in premiums taking negotiated hospital prices as given. Optimal premiums for a non-integrated insurer m are those that maximize insurer profits in equation (4). The first order

[20] The numerator is the marginal effect of an increase in hospital prices on holding a's profits. It includes not only the standard negative effect on insurer $m(a)$ but also the positive effect on the profits of affiliated hospitals $s(a)$. The more sensitive holding a's profits are to hospital prices, the lower the equilibrium mark-up charged by hospital $s(b)$ to insurer $m(a)$. The denominator is the marginal value of the relationship with system $s(b)$ to holding a's profits. As discussed above, disagreement payoffs not only include the standard negative effect of losing the patients from hospital system $s(b)$ but also the positive effect of such disagreement on the profits of its affiliated hospital system $s(a)$. The lower the marginal value of $s(b)$ to the profits of holding a, the lower the mark-ups charged by the hospital $s(b)$ to insurer $m(a)$.

condition is:

$$\phi_j^*(\boldsymbol{p}) = c_j^M - \underbrace{\frac{1}{\frac{\partial D_j^M(\boldsymbol{\phi},\boldsymbol{p})}{\partial \phi_j}}\left[D_j^M(\boldsymbol{\phi},\boldsymbol{p}) + \sum_{j' \neq j, j' \in \mathcal{J}_m} \frac{\partial D_{j'}^M(\boldsymbol{\phi},\boldsymbol{p})}{\partial \phi_j}(\phi_{j'}^* - c_{j'}^M)\right]}_{\text{Standard multiproduct insurer mark-up}} \quad \forall j \in \mathcal{J}_m \tag{11}$$

which is the standard Bertrand-Nash pricing for a multiproduct insurer that offers differentiated plans. Optimal premiums are set as a mark-up over marginal costs that depends on two terms: price sensitivity of demand for plan j to changes in its premium, and price sensitivity of demand for other plans $j' \in \mathcal{J}_m$ to changes in premium of plan j. Since plans are substitutes, the insurer internalizes substitution across its plans when optimally setting premiums.

3.2.3 Premium Setting by Vertically Integrated Insurers

Vertically integrated insurers face more complex incentives when setting premiums, as they internalize the steering effect that premiums have on their integrated hospitals. Optimal premiums in this case are given by:

$$\begin{aligned}
\phi_j^*(\boldsymbol{p}) \quad = \quad & c_j^M - \frac{1}{\frac{\partial D_j^M(\boldsymbol{\phi},\boldsymbol{p})}{\partial \phi_j}}\Bigg[\underbrace{D_j^M(\boldsymbol{\phi},\boldsymbol{p}) + \sum_{j' \neq j, j' \in \mathcal{J}_{m(a)}} \frac{\partial D_{j'}^M(\boldsymbol{\phi},\boldsymbol{p})}{\partial \phi_j}(\phi_{j'}^* - c_{j'}^M)}_{\text{Standard multiproduct insurer mark-up}} \\
& + \underbrace{\sum_{h \in \mathcal{H}_s}\left(\sum_{j' \in \mathcal{J}_{m(a)}} \frac{\partial D_{hj'}^H(\boldsymbol{\phi},\boldsymbol{p})}{\partial \phi_j}(p_{m(a)h} - c_{m(a)h}^H)\right)}_{\text{Steering from integrated insurer}} \\
& + \underbrace{\sum_{h \in \mathcal{H}_s}\left(\sum_{m' \neq m(a), m' \in \mathcal{M}} \sum_{j' \in \mathcal{J}_{m'}} \frac{\partial D_{hj'}^H(\boldsymbol{\phi},\boldsymbol{p})}{\partial \phi_j}(p_{m'h} - c_{m'h}^H)\right)}_{\text{Steering from rival insurers}}\Bigg] \quad \forall j \in \mathcal{J}_{m(a)}
\end{aligned} \tag{12}$$

Besides the standard effects shown in equation (11), the integrated insurer faces two additional effects associated to the profits of its integrated hospitals. The first term captures the effect of premiums on hospital profits coming from the enrollees of integrated plans. The second term captures the effect of premiums on hospital profits coming from the enrollees of competing plans. Therefore, integrated insurers have stronger incentives for premium competition as they account for the potential benefits of steering demand towards their integrated hospitals from the integrated insurer, but also from rival insurers.

4 Econometric Model

Our goal is to estimate the model to study equilibria under counterfactual market structures and assess the welfare effects of banning vertical integration. The parameters of interest are the preferences over insurance plans and hospitals, hospital costs, and bargaining weights. Estimation proceeds in four stages. First, we estimate negotiated prices, resource intensity weights and consumer health risk. Second and third, we estimate discrete choice models of demand for hospitals and insurance plans. Fourth, we estimate hospital marginal costs and bargaining weights.

4.1 Negotiated Prices, Resource Intensity Weights and Health Risk

Our data collects the price for each admission, along with identifiers for hospital, insurer, diagnosis and consumer. However, our model focuses on a scalar negotiated price for each insurer and hospital. This simplifying feature is common in bargaining models (Horn and Wolinsky, 1988; Gowrisankaran et al., 2015; Ho and Lee, 2017), and suggests a decomposition of observed payments into a negotiation index over which bargaining takes place, and a resource intensity weight that scales the index to match payments. For a particular admission price ρ_{ihmdt}, this decomposition is:

$$\rho_{ihmdt} = p_{hmt}\omega_{ihmdt} \tag{13}$$

which is fully generic without further restrictions. However, it clearly precludes the identification of the components of interest. Therefore, we impose restrictions on weights ω. In particular, we assume that it is common across insurers, hospitals and years, but varies with diagnosis and consumer attributes to capture heterogeneity in admission complexity. In a similar exercise, Gowrisankaran et al. (2015) used the resource intensity weights (DRG) calculated by the authorities (CMS) to reimburse hospitals in the U.S. as a proxy for ω, allowing it to vary only by diagnosis.[21] Since a standardized weight is unavailable in Chile, we estimate them from the data. By constructing detailed utilization metrics based on public system prices, we are able to separate the consumer-diagnosis component $\omega_{\kappa(i)d}$ from the negotiated price component p_{hmt}. Appendix A.2 describes this procedure and its advantages relative to estimating this equation using fixed effects.[22,23]

[21] Additionally, Ho and Lee (2017) construct negotiated price by imposing similar restrictions based on DRG weights.

[22] Using fixed effects or imposing functional forms to separate the bargaining component from the observable price is common in structural bargaining models (Cooper et al., 2018; Crawford et al., 2018).

[23] Limiting the variation of resource intensity weights has implications. First, by assuming constant weights across hospitals, they cannot differ in their relative charges across medical conditions, implying that targeted investments in treatment efficiency are only priced on average. Since the hospitals in our sample are large general hospitals, we consider this a mild assumption. Second, we assume time-invariant weights. Since we do not observe substantial technological changes in inpatient care during our period of study, we expect minor variation over time in weights. Finally, we also assume that these weights are common knowledge. This seems appropriate in a mature market like the

Table 3-B displays full admission prices in the raw data as a share of total payments, while Panel 3-C displays estimated hospital prices as a share of total payments. Controlling for demographics and diagnosis matters, but only marginally. Estimated prices fit average observed prices well for each combination of insurer-hospital-year, as shown in Figure A.3. Additionally, Table A.3 displays the estimated resource intensity weights by diagnosis and demographic group.

Finally, we also estimate consumer health risk, which is then used to compute the distribution of insurer costs, hospital revenues, and consumer expected utility. We use a frequency estimator of admission probabilities for the population of enrollees. We allow for time-invariant admission probabilities to vary across diagnoses and gender-age. Table A.4 shows the estimated probabilities.

4.2 Demand for Health Care

The next step in our analysis is health care demand. We specify a hospital choice model conditional on diagnosis and insurance plan. A consumer who faces a medical condition chooses a hospital from the hospital network available in his current plan based on the out-of-pocket cost of the treatment and the distance to the hospital. Importantly, we allow for observable heterogeneity in preferences and control for unobserved preferences for hospitals.

The utility of consumer i enrolled in insurance plan j of choosing hospital h for diagnosis d at time t is given by:

$$u^H_{ijhdt} = \alpha^H_i c_{jh} p_{ijhdt} + \beta_v v_{ih} + \delta^H_{h\kappa(i)d} + \varepsilon_{ijhdt}$$

where $\kappa(i)$ is the consumer type and $p_{ijhdt} = \omega_{\kappa(i)d} p_{mht}$ is the weighted negotiated price described in the previous section; c_{jh} is the coinsurance rate obtained by the enrollees of plan j at hospital h, and v_{ih} is the distance from the consumer residence to hospital h. Additionally, $\delta^H_{h\kappa(i)d}$ is the hospital h fixed effect for consumers of type $\kappa(i)$ under diagnosis d, which captures time-invariant unobserved hospital attributes for that specific group of patients. Finally, ε_{ijhdt} is an idiosyncratic preference shock assumed to follow an i.i.d. T1EV distribution. As described in Section 2, consumers choose among hospitals, including those of the public system. The outside option, defined as the nearest public hospital, delivers a utility given by:

$$u^H_{ij0dt} = \alpha^H_i c_{j0} p_{j0dt} + \vartheta_{l(i)} + \varepsilon^H_{ij0dt}$$

where p_{j0dt} is the price of the public option for diagnosis d at time t, and $\vartheta_{l(i)}$ is a county-fixed effect that accounts for the heterogeneity in the outside option across consumer locations.

Since we assume preference shocks are i.i.d. T1EV, the probability that consumer i enrolled in

one we study. Moreover, it allows us to label the weights as resource intensity weights, which map average hospital resource utilization for each condition and consumer type to service costs.

plan j chooses hospital h given diagnosis d is:

$$\sigma^{H}_{ijht|d} = \frac{\exp(\alpha^{H}_{i}(c_{jh}p_{ijhdt} - c_{j0}p_{j0dt}) + \beta_{v}v_{ij} + \delta^{H}_{h\kappa(i)d} - \vartheta_{l(i)})}{1 + \sum_{r\in\mathcal{H}} \exp(\alpha^{H}_{i}(c_{jr}p_{ijrdt} - c_{j0}p_{j0dt}) + \beta_{v}v_{ir} + \delta^{H}_{r\kappa(i)d} - \vartheta_{l(i)})}$$

We model observed heterogeneity in the price coefficient as:

$$\alpha^{H}_{i} = D'_{age,i}\alpha^{H}_{age} + D'_{HH,i}\alpha^{H}_{HH} + \alpha^{H}_{income}income_{i} \tag{14}$$

where $D_{age,i}$ and $D_{HH,i}$ are dummies for whether consumer i belongs to specific bins of age and household characteristics, respectively. The age bins match the definitions of $\kappa(i)$ while the household characteristics include gender, marital status, and whether she has dependents.[24]

We estimate the demand model via maximum likelihood using the detailed data on admissions described in Section 2.2.1, which includes admission medical and financial attributes, along with patient attributes. We measure the distance between households and hospitals as the linear distance between the centroid of the household's county of residence and the hospital location.

Identification. Hospital demand is identified off variation in prices and distances across consumers within and between hospitals. We face three threats to identification. First, the correlation between prices and unobservable consumer preferences for hospitals. Given that estimation requires prices for all hospitals in the choice set, we use predicted hospital prices as estimated in the previous section. By construction, these prices are free of much of the individual-specific heterogeneity that might be correlated with unobserved preferences. By adding fixed effects for hospital-diagnosis, we control for systematic tastes for particular hospitals for certain conditions. By further estimating the model by age groups, we account for the possibility that these tastes vary across consumer age groups. The remaining potentially endogenous taste variation is within hospital-diagnosis and across gender. Given our restrictions on the resource intensity weights, price variation for a given diagnosis across age and gender is independent of the hospital and the consumer insurer, which makes this form of endogeneity unlikely.[25]

The second issue is that consumer location may be based on hospital unobservables that affect consumer choice. We assume that consumer location is exogenous based on the facts that inpatient events are relatively rare, and that there is a broad set of options for outpatient care in the market. The third issue is that unobserved preferences could drive selection into plans. In our setting, all

[24] We consider single males as the baseline group. Consistent with that specification, the coefficients on the age-group dummies capture price sensitivity for single men, while the coefficients for other groups (e.g., single women or consumers with dependents) should be added to the correspondent age-group estimate.

[25] Price endogeneity at this level would require variation in preferences for a hospital-diagnosis across young females and males. Moreover, this variation should be considered by insurers and hospitals when negotiating a price that applies across diagnoses and consumers, conditional on the average young consumer preference for the hospital.

plans offer complete networks and differ only in the coinsurance rates offered across hospitals. To our knowledge, there are no other systematic differences among plans in terms of hospital access. Given this variation is observable and priced, it should not threaten our strategy.[26]

Results. Table 5-A shows the estimates of the hospital demand model, where each column includes an increasingly richer set of fixed effects $\delta^{H}_{h\kappa(i)d}$. For the rest of the paper, we use the results in columns (4) and (5), which include estimates the model separately for young and old consumers and includes hospital-diagnosis fixed effects.

Overall, we find that all consumers are price sensitive, with young, single males, and lower-income consumers being more price sensitive. Additionally, consumers value hospital location and prefer hospitals close to their residences. Note that adding richer sets of fixed effects delivers larger estimates of price sensitivity, which suggests that those fixed effects indeed capture unobserved drivers of hospital choice that are correlated with prices, such as hospital quality.[27] Table 5-B summarizes price elasticities, while Figure 2-a shows a histogram of them. The average and median price elasticities are -2.40 and -1.88, which are larger than those in the literature on the intensive margin for inpatient care in the U.S.[28]

4.3 Demand for Insurance Plans

We develop a model of insurance plan choice. Households take into account the expected utility from the plan for all household members. Therefore, households choose among available plans based on premiums, hospital networks, and the expected quality and price of health care.[29]

Using our estimates of hospital demand, we compute the expected utility from the hospital network offered by each plan, in line with Capps et al. (2003). Given the hospital demand model in Section 4.2, the expected utility of consumer i from the hospital network of plan j at time t is:

$$EU^{H}_{ijt} = \sum_{d\in\mathcal{D}} \gamma_{d\kappa(i)} \log \sum_{h\in\mathcal{H}} \exp(\alpha^{H}_{i}(c_{hj}p_{ijhdt} - c_{j0}p_{j0dt}) + \beta_v v_{ih} + \delta^{H}_{h\kappa(i)d} - \vartheta_i) \tag{15}$$

[26] The same assumption has been used extensively in the literature (e.g. Ho 2006; Ho and Lee 2017).

[27] To evaluate whether hospital fixed effects in hospital demand capture meaningful differences across hospitals, we study their correlation with observable hospital attributes. Figure A.2 shows the relationship between estimated hospital fixed effects in Column (2) of Table 5 and an objective measure of quality, which comes from the position of the hospital in the Webometrics Ranking of World Hospitals (Cybermetrics Lab, 2016). Both variables display a positive correlation, which suggests that our strategy indeed captures relevant hospital attributes that might drive choices.

[28] The utilization elasticity in the RAND experiment is -0.2 (Aron-Dine et al., 2013), whereas Prager (2018) estimates price elasticities across hospitals of between -0.03 and -0.12. This pattern may be driven by two differences that make prices more salient in Chile than in the U.S.: (i) consumers in the former share the cost of treatment at the margin, given there are no caps on out-of-pocket expenditure, and (ii) hospital prices are more transparent in Chile, because prices and insurance coverage are mostly available to consumers when choosing hospitals.

[29] We assume that household decisions equally weight the welfare of all household members.

where $\gamma_{d\kappa(i)}$ is the probability of consumer type $\kappa(i)$ of being diagnosed with condition d.

Let the utility of household-type f from choosing insurance plan j at time t be:

$$u^M_{fjt} = \alpha^M_f \phi_{fjt} + \beta_f \sum_{i \in f} EU^H_{ijt} + \delta^M_{m(j)\kappa(f)} + \varepsilon^M_{fjt} \tag{16}$$

where ϕ_{fjt} is the premium charged to household-type f if choosing plan j at time t; $\delta^M_{m(j)\kappa(f)}$ is the mean utility that household-type $\kappa(f)$ obtains from plans offered by insurer $m(j)$ other than premiums and expected health care services (e.g., insurer customer service); and ε^M_{fjt} is an idiosyncratic preference shock i.i.d. T1EV.[30] Under these assumptions, the choice probability of plan j by household-type f at time t is given by:

$$\sigma^M_{fjt} = \frac{\exp(\alpha^M_f \phi_{fjt} + \beta_f \sum_{i \in f} EU^H_{ijt} + \delta^M_{m(j)\kappa(f)})}{\sum_{k \in \mathcal{J}} \exp(\alpha^M_f \phi_{fkt} + \beta_f \sum_{i \in f} EU^H_{ikt} + \delta^M_{m(k)\kappa(f)})}$$

We estimate the model by maximum likelihood. We allow for observable heterogeneity on preferences over premiums and the expected utility of hospital networks across age, household composition and income, with a structure similar to that in our hospital demand model. As discussed in Section 2.2.1, there is a large number of plans in the market with negligible market share. To reduce the size of the choice set, we let each consumer choose among the 30 most popular plans offered in their market segment each year.[31] In total, each insurer offers up to 40 plans over all markets, each year. Appendix A.3 describes the construction of plan choice sets.

Identification. Plan demand is identified by variation in premiums and offered hospital networks across plans within an insurer and household type. However, endogeneity of premiums and networks might threaten identification. In particular, insurers could provide additional services to their clients that are not captured by plan attributes and are unobserved to us. If these services affect premium setting or the contracting phase with hospitals, it would cause an endogeneity concern. We address this by assuming that these unobserved attributes are constant over time, and add plan-level fixed effects to capture these unobservables.

Results. Table 6-A shows plan demand estimates. Columns (1)-(5) report results for premium sensitivity, whereas columns (6)-(10) report results for willingness to pay for hospital networks covered by a plan. For the rest of the paper, we use the results in columns (4), (5), (9) and (10),

[30] Recall that consumers must spend at least 7% of their taxable income (up to a cap) on insurance, as discussed in Section 2.1. This mandatory payment is not choice-specific and is therefore omitted from the equation above.

[31] We allow consumers to re-enroll in their plan even if it was no longer available, consistent with the guaranteed renewability regulation.

which estimate the model separately for young and old consumers and include plan fixed effects.

Our estimates suggest that all consumers are premium sensitive, but young single, males, with no dependents, and lower-income consumers are more price sensitive. This heterogeneity is consistent with patterns of premium sensitivity previously found in literature (e.g. Ho and Lee 2017; Tebaldi 2017). As expected, households have a preference for plans offering a higher expected utility from health care services. Table 6-B summarizes premium elasticities, and Figure 2-b shows a histogram of them. The average and median premium elasticities are -1.32 and -1.01, which are within the range of estimates in the literature.[32]

4.4 Marginal Costs and Bargaining Weights

We turn to the estimation of supply-side parameters, namely hospital marginal costs and bargaining weights. The estimation procedure builds on optimality conditions for insurer premiums and negotiated hospital prices in Section 3.2, to propose a GMM estimator of the form:

$$\min_{\lambda,\theta,c,\phi} \quad g(\boldsymbol{\lambda},\boldsymbol{\theta},\boldsymbol{c},\boldsymbol{\phi})' W^{-1} g(\boldsymbol{\lambda},\boldsymbol{\theta},\boldsymbol{c},\boldsymbol{\phi}) \tag{17}$$

$$\text{s.t} \quad \boldsymbol{c} = C(\boldsymbol{\phi},\boldsymbol{\lambda},\boldsymbol{\theta}) \tag{18}$$

$$\boldsymbol{\phi} = \boldsymbol{\phi}^*(\boldsymbol{c},\boldsymbol{\theta}) \tag{19}$$

where $\boldsymbol{c}$ and $\boldsymbol{\phi}$ are auxiliary variables that capture the equilibrium constraints (18) and (19), $g(\cdot)$ is a vector of moment conditions, and W is a weighting matrix. Ignoring the auxiliary variables, the problem is optimized over bargaining weights $\lambda_{ms} \in (0,1)$ and VI weights $\theta_m \geq 0$.

The first constraint (18) is that hospital costs, conditional on premiums and weights, must satisfy the first order condition of the Nash-in-Nash bargaining problem in equation (10). This optimality condition allows us to build moments related to marginal costs that discipline the estimator based on how $\boldsymbol{\lambda}$ and $\boldsymbol{\theta}$ determine costs. The second constraint (19) is that premiums, in equilibrium and under all pair-wise disagreements between hospitals and insurers, must satisfy the first order condition of insurer premium setting in equations (11) and (12). This condition allows us to evaluate the disagreement profit of hospitals and insurers, and to build moment conditions based on equilibrium premiums.[33]

[32] For instance, Abaluck and Gruber (2011) estimate mean elasticities around -1 for Medicare Part D; Curto et al. (2015) estimate mean elasticities around -1.1 for Medicare Advantage; Ho and Lee (2017) estimates mean elasticities between -2.95 and -1.23 for enrollees of CalPERS; and Tebaldi (2017) estimates mean elasticities between -1.2 and -0.8 for subsidized buyers of Silver plans in the California ACA exchange. Atal (2015) estimates a lower mean elasticity of -0.2 in the Chilean market.

[33] The nested fixed point for premiums problem distinguishes our estimator from that in recent work (Ho and Lee, 2017; Gowrisankaran et al., 2015). This provides us with additional identifying moments at the expense of substantial computational cost.

The first set of moment conditions matches the equilibrium and observed premiums. We impose this moment condition separately for each insurer-year, such that:

$$g^{\phi}_{mt}(\boldsymbol{\phi}) = \frac{1}{|\mathcal{J}_m|}\sum_{j\in\mathcal{J}_m}(\tilde{\phi}_{jt} - \phi_{jt}) \quad \forall m \in \mathcal{M}, t \in \mathcal{T}$$

where $\tilde{\phi}_{jt}$ are observed premiums, ϕ_{jt} are equilibrium premiums, and $\mathcal{T}$ is the set of years in our data. Note that in the absence of vertical integration, these conditions do not inform the estimates of marginal costs.[34]

The second set of moment conditions builds on firms' financial records. We construct moment conditions that match equilibrium mark-ups to observed profit to revenue ratios, displayed in Table A.5. Denoting the observed ratios $\tilde{\mu}_{lt}$, we define these conditions as:

$$\begin{aligned}
g^{\mu}_{m}(\boldsymbol{c},\boldsymbol{\phi}) &= \frac{1}{|\mathcal{T}|}\sum_{t\in\mathcal{T}}\left(\tilde{\mu}_{mt} - \frac{\sum_{j\in\mathcal{J}_m} D^M_{jt}(\boldsymbol{\phi}_t,\boldsymbol{p}_t)(\phi_{jt} - c^M_{jt})}{\sum_{j\in\mathcal{J}_m} D^M_{jt}(\boldsymbol{\phi}_t,\boldsymbol{p}_t)\phi_{jt}}\right) \quad \forall m \in \mathcal{M} \\
g^{\mu}_{h}(\boldsymbol{c},\boldsymbol{\phi}) &= \frac{1}{|\mathcal{T}|}\sum_{t\in\mathcal{T}}\left(\tilde{\mu}_{ht} - \frac{\sum_{m\in\mathcal{M}}\sum_{j\in\mathcal{J}_m} D^H_{hjt}(\boldsymbol{\phi}_t,\boldsymbol{p}_t)(p_{mht} - c^H_{mht})}{\sum_{m\in\mathcal{M}}\sum_{j\in\mathcal{J}_m} D^H_{hjt}(\boldsymbol{\phi}_t,\boldsymbol{p}_t)p_{mht}}\right) \quad \forall h \in \mathcal{H}
\end{aligned}$$

Finally, the third set of moments exploits orthogonality conditions. Consider a set of instruments $\boldsymbol{Z}$ that is independent of within hospital-year variation in marginal cost and predicts negotiated prices. In particular, $\boldsymbol{Z}$ includes four metrics of willingness to pay for hospitals by enrollees of each insurer: (i) willingness to pay for each hospital, (ii) for each hospital system, (iii) for all rival hospitals, and (iv) for all rival systems. Each metric computes willingness to pay relative to the actual network offered by each plan, as in Capps et al. (2003), and then averages by insurer. This creates four instruments that vary across hospitals, insurers and years, similar to those used in previous work (e.g., Gowrisankaran et al. 2015, Ho and Lee 2017). However, we exploit prices in the public system instead of negotiated prices to compute these metrics. This departure from the traditional BLP-style instruments (Berry et al., 1995) weakens the assumption needed to claim exogeneity, as it removes any dependence with the bargaining process between hospitals and insurers, but keeps enough hospital and consumer heterogeneity as to predict prices.[35]

To construct this final set of moments, we decompose the marginal cost of hospital h as:

$$c_{hmt} = \bar{c}_h + \bar{c}_t + \eta_{hmt}$$

[34]These conditions inform the estimator because of the pass-through of marginal costs to premiums, the strategic interaction of insurers, and how premiums affect the profits of integrated firms.

[35]Willingness to pay instruments are associated to BLP instruments, as it is considered an attribute of plans.

where $\bar{c}_h$ and $\bar{c}_t$ capture cost differences across hospitals and years.[36] The remaining variation η_{hmt} is assumed to be independent of instruments Z_{hmt}. We construct moment conditions as:

$$g_k^Z(\boldsymbol{c}) = \frac{1}{|\mathcal{H}| \times |\mathcal{M}| \times |\mathcal{T}|} \sum_{h \in \mathcal{H}} \sum_{m \in \mathcal{M}} \sum_{t \in \mathcal{T}} Z_{k,hmt} \eta_{hmt}$$

where k indexes the instruments, which include the willingness to pay metrics and hospital and year dummies, so as to match the decomposition of marginal cost. Our assumption relies on the connection between the public and private systems: public system prices correlate with hospitals' costs, but are exogenous to the contracting process between private hospitals and insurers.

We optimize the GMM objective by replacing the equilibrium constraints within the moment conditions.[37] To reduce the dimensionality of the problem and to guide our counterfactuals, we decompose bargaining weights into a convex combination of insurer and hospital components. In particular, if insurer a is negotiating with hospital b, the bargaining weight takes the form:

$$\lambda_{ab} = \alpha^{\lambda}(a,b)\lambda_a + (1 - \alpha^{\lambda}(a,b))\lambda_b \tag{20}$$

with the weight $\alpha^{\lambda}(a,b)$ being an additional parameter to be estimated, but restricted to be the same for each type of negotiation. In particular, there are four types of negotiations: non-integrated hospitals bargaining with non-integrated insurers, integrated hospitals with integrated rival insurers, integrated hospitals with non-integrated insurers, and integrated insurers with non-integrated hospitals.[38] This specification has two main advantages. First, it guides how bargaining weights adjust under counterfactual integration scenarios. Second, it reduces the number of bargaining weights to estimate from $|\mathcal{S}| \times |\mathcal{M}| - |\mathcal{V}|$ to $|\mathcal{S}| + |\mathcal{M}| + 4$, which in our case reduces the number of bargaining parameters from 38 to 17. Further details regarding the implementation and estimation of the bargaining and VI weights are provided in Appendix C.1.

Identification. We start by focusing on the identification of $\boldsymbol{\lambda}$ given $\boldsymbol{\theta}$. First, note that the unobserved hospital marginal cost $\boldsymbol{c}$ uniquely determines $\boldsymbol{\lambda}$ using the first order condition of the Nash bargaining problem in equation (10). Second, hospital financial moments directly determine hospital average marginal cost, therefore $\boldsymbol{c}$ is known up to variation within hospital-year. This

[36] We decompose marginal costs this way to reduce computational burden. Decomposing cost as $c_{hmt} = \bar{c}_{ht} + \eta_{hmt}$ instead does not affect the results to a relevant extent, but increases the time to convergence substantially.

[37] Using a constrained, derivative-free numerical optimizer, we account for the support of $(\boldsymbol{\lambda}, \boldsymbol{\theta})$. We use the COBYLA algorithm (Powell, 2007). Computing numerical gradients for this problem is prohibitively costly.

[38] As the previous literature has emphasized, accurate estimation of bargaining weights often requires additional structure. For example, cross-sectional studies such as Gowrisankaran et al. (2015) and Ho and Lee (2017) assume that bargaining weights are insurer-specific. This increases the sample size over which the same weights are valid to all negotiations in which an insurer participates in the sample year. In our estimation, we let bargaining weights to be fixed for each pair of insurer and hospital system and follow the structure of equation (20) and leverage the panel structure of our data to increase the sample size in terms of number of negotiations.

implies we can decompose hospital marginal costs into their average and unknown variation:

$$\boldsymbol{c} = \bar{\boldsymbol{c}} + \boldsymbol{\eta}$$

and we can therefore rewrite equation (10) as:

$$\boldsymbol{p} - \bar{\boldsymbol{c}} = F(\boldsymbol{p}, \boldsymbol{c}, \boldsymbol{\eta})$$

where the right hand side mark-up is a known non-linear function of prices $\boldsymbol{p}$ and within hospital-year variation in costs $\boldsymbol{\eta}$. This leads us to a non-linear instrumental variable problem (Hansen and Singleton, 1982), in which we seek to identify the residual $\boldsymbol{\eta}$, to which the regressor $\boldsymbol{p}$ is endogenous due to the bargaining process. Thus, our willingness to pay instruments using public system prices are valid, as they are correlated with negotiated prices $\boldsymbol{p}$ but uncorrelated with $\boldsymbol{\eta}$.[39] Therefore, the orthogonality condition moments identify the remaining cost variation, which in turn identifies $\boldsymbol{\lambda}$.

Finally, the VI weights $\boldsymbol{\theta}$ are identified by the premium and insurer financial moments. Given hospitals marginal costs and equilibrium premiums, the Nash-Bertrand first order condition for the premium of an integrated plan is linear in θ. Thus, we jointly solve for the VI weights and cost vector $\boldsymbol{c}$. The premium matching condition implements this constraint by requiring $\boldsymbol{\theta}$ to match predicted and observed premiums. Moreover, insurer financial moments further discipline this link by providing a different level of aggregation over which premiums must match the data. The additional information contained in these moments helps to identify bargaining and VI weights.[40]

Results. Table 7 summarizes our estimates for bargaining weights and marginal costs.[41] Table 7-A shows that, on average, negotiations weigh insurer and hospitals gains from trade equally. However, these weights vary depending on the negotiation: integrated hospitals and insurers have lower bargaining weights than non-integrated ones. One way to interpret this dispersion is by recognizing that Nash-in-Nash bargaining might overstate the ability of hospital systems to leverage their set of hospitals when negotiating. For example, if hospital systems cannot credibly threaten to remove all hospitals from the insurer's network upon disagreement, the bargaining objective will overstate the hospital system's ability to command higher prices. As the integrated firms in our setting also own horizontally integrated hospital systems, a reduction

[39] Our instrument predicts hospital costs. It varies across hospitals and insurers due to compositional changes in demand caused by the joint distribution of preferences and risk. Public system prices are good predictors of hospital costs, because they capture common cost shocks across the public and private systems (e.g., physician labor costs).

[40] As in the related literature, we cannot rule out the possibility of multiple solutions to the marginal cost equilibrium constraint (18), as $F(\cdot)$ may not be injective in $\boldsymbol{\eta}$. We explore a variety of starting values in the optimization procedure and obtain similar estimates upon convergence. Our results seem robust to the multiplicity concern, and our numerical analysis suggests that equation (18) is a contraction, at least locally to the only solution we find.

[41] Table A.6 displays results for the first stage of negotiated prices on willingness-to-pay instruments, which show that our instruments are strong predictors of negotiated prices, with an F-test of 437.

in hospital bargaining weights might be associated with this group to adjust for their increased leverage. This argument is consistent with the finding that the bargaining weight of integrated hospitals when negotiating with separately integrated insurers is less skewed, as both negotiating firms incorporate the bargaining surplus of their hospital systems. Regardless of the source of this heterogeneity, as bargaining weights are not strategic components and have no clear non-cooperative counterpart, they do not affect the interpretation of results from our counterfactuals.

Table 7-B displays estimates of hospital marginal costs, negotiated prices, and hospital mark-ups. Our estimates indicate that hospitals average mark-up is around 38%, which is mostly driven by our financial moment conditions. Interestingly, integrated hospitals charge a mark-up to their integrated insurer. Note that this does not imply a failure of vertical integration to eliminate double marginalization. Recall that this vertical market differs from those of retail goods, where consumers pay only to downstream firms. In this case, consumers pay in both upstream and downstream markets and are elastic to both hospital prices and premiums. This particularity implies that it is optimal for integrated firms to balance charges to consumers on both ends. The incentive to remove double marginalization, in this case, is reflected in the lower mark-up hospitals charge to their integrated consumers relative to those enrolled in plans of rival insurers.[42]

These results also show that integrated hospitals have lower marginal costs than their rival hospitals, but face a slightly higher cost of serving their integrated insurer. The first finding is partly driven by two high-quality and high-price hospitals among non-integrated hospitals.The second result relates to the motivation for vertical integration, which we do not model. In particular, our work is silent on the effects of vertical integration on firms' organization. Therefore, we are unable to determine whether integrated firms provide better care to patients at a higher cost, or if insurers decide to integrate precisely with hospitals with higher costs. In both cases, vertical integration might lead to changes in costs which we do not capture. To assess the robustness of our welfare calculations, our counterfactuals explore the role of cost efficiencies .[43]

Finally, the estimated VI weights θ are 0.474 and 0.206 for the two integrated firms, m_3 and m_1. These estimates imply that both firms value hospital profits more than insurer profits. This finding is consistent with a heavier regulatory burden for insurers relative to hospitals in our setting;[44] or with commitments between the insurer and the hospital at the time of the merger.

[42]The reduction is also driven by incentives to steer patients to the integrated hospital, discussed in Section 4.5.

[43]Notice that we do not identify fixed and sunk costs in the hospital industry or the insurance sector. Therefore, we cannot make statements regarding the overall profitability of the health sector. Also, fixed and sunk costs are irrelevant for the bargaining stage of the game since they are not contingent on reaching an agreement with a particular firm.

[44]As an example of the asymmetric regulation between insurers and hospitals, our rich data comes from the regulator of insurers, whereas very little data exists on the private hospitals we study. Moreover, the regulator publishes quarterly reports on insurer profits, which generate adverse reactions from consumers and calls for stronger regulations on health-insurance providers. See La Tercera (2017) for an example discussing high profits in the industry in 2016—in which profits increased by 40.6% relative to 2015—, with several quotes from senators manifesting their concern.

4.5 Patient and Enrollee Steering Effects

Our model illustrates how vertical integration affects incentives in the market through patient-steering effects and enrollee-steering effects. In this section, we quantify such incentives.

From equation (7), the bargaining surplus of an integrated insurer m with a rival hospital system $s(b)$ is $(\pi^A_m - \pi^{NA}_{m\backslash s(b)} + \pi^A_{s(m)} - \pi^{NA}_{s(m)\backslash s(b)})$, which combines the surplus it obtains from both the insurance and health care markets. The bargaining surplus of the integrated hospital system from the negotiation $(\pi^A_{s(m)} - \pi^{NA}_{s(m)\backslash s(b)})$ is non-positive, as under the event of foreclosure the integrated system would benefit from the steering of patients to its hospitals. In the extreme, if this incentive to steer dominates the gains of the insurer m from bargaining with $s(b)$, then no agreement should take place between the two players. Therefore, we can measure the patient-steering effect as:

$$\frac{\pi^A_{s(m)} - \pi^{NA}_{s(m)\backslash s(b)}}{\pi^A_m - \pi^{NA}_{m\backslash s(b)}}$$

which is the fraction of the integrated insurer bargaining surplus from the insurance market that is lost due to the vertical incentive to steer patients away from a rival hospital.[45] We measure this incentive for the two integrated insurers in our setting as its average across non-integrated rival hospitals. We find that this fraction is -22.19% for m_1 and -15.85% for m_3.

Similarly, from equation (7), the bargaining surplus of an integrated hospital system s with a rival insurer $m(b)$ is $(\pi^A_s - \pi^{NA}_{s\backslash m(b)} + \pi^A_{m(s)} - \pi^{NA}_{m(s)\backslash m(b)})$. In this case, the bargaining surplus from the insurance market $(\pi^A_{m(s)} - \pi^{NA}_{m(s)\backslash m(b)})$ is non-positive, as the integrated insurer would benefit from its hospital foreclosing rivals and leading patients to switch away from $m(b)$. Thus, the enrollee-steering effect is given by:

$$\frac{\pi^A_{m(s)} - \pi^{NA}_{m(s)\backslash m(b)}}{\pi^A_s - \pi^{NA}_{s\backslash m(b)}}$$

which is the fraction of the integrated hospital bargaining surplus lost due to the incentive to steer enrollees away from a rival insurer. We measure this incentive for the two integrated insurers in our setting as its average across non-integrated rival hospitals. We find these fractions to be -29.84% for hospitals integrated with m_1 and -1.67% for hospitals integrated with m_3.

There is substantial heterogeneity in the patient- and enrollee-steering effects, driven by the horizontal differentiation among firms. The differentiation is starker in the enrollee-steering effect as we estimate unobserved consumer preference for m_1 to be substantially larger than that of m_3. Hence, while m_1 can count on steering patients away from rivals to work in their favor, m_3

[45] This ratio relates to vertical gross upward pricing pressure indices (vGUPPIs) used in antitrust analysis (Moresi and Salop, 2013). vGUPPIs measure the potential harm of vertical integration captured by unilateral pricing incentives, which compare the value of sales diverted to the downstream merging partner to the revenue on volume lost by the upstream merging partner.

cannot do so to the same extent. Overall, the fact that incentives associated with vertical linkages are quantitatively relevant suggests that the distortions related to vertical integration might be substantial and motivates our welfare analysis of banning vertical integration in the next section.[46]

5 Equilibrium Effects of Vertical Integration

We use our estimated model to solve for equilibrium in a scenario in which integrated insurers and hospitals are broken up. Banning vertical integration induces adjustments in plan premiums and hospital negotiated prices. Consumers react to these price changes in both markets by adjusting their hospital and insurance demand. We compute hospital profits, insurer profits, and consumer surplus in both scenarios to measure the welfare effects of vertical integration in this setting.

5.1 Simulation Details

The simulation consists of solving equation (10) for negotiated prices conditional on estimated hospital costs. The procedure is as follows: for each guess of hospital prices, we find the equilibrium premiums and demands, and evaluate equation (10) until reaching a fixed point. The root of this non-linear problem yields the new equilibrium negotiated hospital prices, insurance premiums, and demands. For our main results, we hold hospital marginal costs fixed at their estimated levels. We then explore the role of potential cost efficiencies in Section 5.3.

The specification of bargaining weights as in equation (20) offers the advantage of determining the bargaining weights for integrated firms in our counterfactual scenarios. In particular, we use the mixing coefficient α^{λ} of non-integrated hospitals and insurers to compute counterfactual bargaining weights for the simulated scenarios. Hence, the ban on vertical integration alters both the gains from trade and the heterogeneity in bargaining parameters.

5.2 Main Results

Banning vertical integration would have sizable effects in the hospital market, as shown by Table 8-A. Formerly integrated hospitals decrease negotiated prices across the board: the average price to non-integrated insurers falls by 19.84%, and that to their previously affiliated insurer by 2.44%. These results are consistent with the enrollee-steering effect: integrated hospitals had an incentive to increase prices to rival insurers to steer demand to their integrated insurer, which is not the case when vertical integration is banned. As a result, the market share of hospitals integrated

[46] Importantly, the fact that these effects are larger than -100% supports the absence of foreclosure in this market. For example, if an integrated hospital system benefits more from a disagreement of its integrated insurer than the profit generated by the insurer from the agreement in question, than disagreement should happen and foreclosure take place.

at baseline coming from non-integrated insurers increases by 16.68%, whereas their market share coming from integrated insurers at baseline decreases by 18.53%.

Moreover, hospital profits decrease for both integrated and non-integrated hospitals. Non-integrated hospitals now bargain in a less distorted market with cheaper competing hospitals. As a consequence, non-integrated hospitals decrease their prices to integrated insurers by 0.88%, which is consistent with the patient-steering effect: integrated insurers had the incentive to increase prices to rival hospitals, as their integrated hospitals would recapture part of that hospital demand.

The insurance market is also affected by banning vertical integration, as shown in Table 8-B. After banning vertical integration, integrated insurers increase their premiums by 4.72% on average, while non-integrated insurers decrease theirs by 0.32%. Driven by these changes in premiums, consumers substitute towards insurers that were not integrated at baseline. Lower negotiated prices imply lower payments to hospitals increasing insurer profits.

Consumers on average benefit from banning vertical integration, as shown by Table 8-C.[47] Average consumer surplus increases by $55 per year. However, there is substantial heterogeneity, partly driven by premium sensitivity. Less premium sensitive consumers gain the most: elderly females and males increase their consumer surplus by $200 and $132 per year. On the other hand, young females and males are sufficiently price-sensitive as to lose from banning vertical integration due to increases in premiums, although their losses are small. On average, consumers are willing to pay 4% higher premiums to ban vertical integration.

5.3 Welfare Effects and Cost Efficiencies

Advocates of vertical integration often argue they induce cost efficiencies. To explore this margin, we evaluate how the welfare effects of vertical integration vary under a range of cost efficiencies, which are lost under our counterfactual ban. In practice, we consider cost efficiencies in a range of -10% to 30% relative to our estimated hospital costs, which only apply to admissions within integrated hospitals and insurers.[48] Figure 3-a shows results for this analysis.

Banning vertical integration increases overall welfare by $146 million per year, which accrue

[47]We measure consumer surplus from the insurance market, given the utility from plans captures benefits from both markets by including the expected utility of hospital networks as an attribute. In particular, we compute expected consumer surplus following Small and Rosen (1981), as:

$$CS_f = \frac{1}{\alpha_f^M} \log \sum_{k \in \mathcal{J}} \exp\left(-\alpha_f^M \phi_{fk} + \beta_f \sum_{i \in f} EU_{ik}^H + \delta_{m(k)\kappa(f)}^M \right) + \iota$$

where ι is the Euler-Mascheroni constant.

[48]To put this range in context, we use the case of childbirth, which has been exploited by other studies of efficiency in health care (e.g., Johnson and Rehavi 2016). One way through which integrated firms can affect spending is by engaging in fewer C-sections, which are often costlier than natural births. In our setting, the average C-section has a 13% higher price and a 15% higher insurer payment, both of which are within the range of cost efficiencies we study.

increases of $90.1 million in consumer surplus and $100.7 million in insurer profits, and a decrease of $44.8 million in hospital profits. Consumer surplus increases, driven by a reduction in negotiated prices between formerly integrated hospitals and non-integrated insurers, as reflected in the changes in hospital market shares shown in Table 8. Both integrated and non-integrated insurers are better off without integration. On the one hand, integrated insurers are better off because they set baseline premiums below the individually profit-maximizing levels to attract enrollees and steer them to their integrated hospitals. On the other hand, non-integrated insurers face lower hospital prices from formerly integrated hospitals when vertical integration is banned, and they no longer compete with integrated insurers that set premiums aggressively to steer demand. Hospitals are worse off without integration due to the decrease in prices of formerly integrated hospitals, which no longer have incentives to increase hospital prices to rivals to steer enrollees to their plans. As a result of this decrease in hospital prices, rivals face more competition and either lower prices or lose market share, reducing overall hospital profits. Therefore, banning vertical integration increases overall efficiency and shifts rents from hospitals to consumers and insurers.

Cost efficiencies in the range we consider modify this result only quantitatively. For larger cost efficiencies to the right of Figure 3-a, the welfare effect of banning vertical integration remains positive but decreases, reflecting those cost efficiencies are lost in the counterfactual. The effect of banning vertical integration on consumer surplus is smaller for larger cost efficiencies, but that on hospital and insurer profits is mostly constant across them, such that cost efficiencies are mostly passed-through to consumers. However, there is underlying heterogeneity across integrated and non-integrated firms. Figures 3-b and 3-c show that integrated hospitals (insurers) get more losses (gains) than non-integrated hospitals (insurers) from banning vertical integration, and that the gap increases with cost efficiencies. These patterns can be explained by the pass-through of cost efficiencies to consumers in the form of lower prices by integrated hospitals. By decreasing hospital prices under higher cost efficiencies, integrated firms can increase premiums and still increase profits, bringing them closer to the premiums they would set if non-integrated.[49]

5.4 Cost Efficiencies at the Hospital Level as an Antitrust Remedy

Our analysis of cost efficiencies in the previous section is not explicit about their source and assumes they only affect admissions within the integrated firm. Better processing of claims, integration of information systems and reduced managerial costs are all firm-specific sources of synergies. However, vertical integration might also improve the use of resources within the hospital and the management of cases. These changes may induce improvements that could potentially lower the costs of admissions of enrollees coming from rival insurers. Regulators may be able to force firms to share such efficiencies with non-integrated insurers through non-discrimination clauses, which

[49] Integrated firms are more likely to decrease hospital prices than premiums because consumers are more sensitive to the former, making it more appealing for integrated firms to attract consumers with lower hospital prices.

may mitigate the potentially adverse effects of vertical integration.

Cost efficiencies at the hospital level do modify our results from the previous section, as shown by Figure A.4. Results for the scenario under no cost efficiencies remains unchanged, by construction. However, we find that higher cost efficiencies partially compensate the distortions introduced by vertical integration. In particular, cost efficiencies higher than 17% imply that banning vertical integration is welfare detrimental in Chile.

5.5 The Role of Price Sensitivity for the Effects of Vertical Integration

Our discussion of the effects of vertical integration focuses on steering incentives. Consumer price sensitivity determines the strength of these incentives as integrated firms' ability to steer demand increases when consumers are more price sensitive. However, price sensitivity intensifies competition, limiting the profitability of steering. Which of these effects dominates is theoretically unclear, yet relevant to the overall impact of vertical integration.

We study how our results depend on consumer price sensitivity. In particular, we scale price and premium preferences as $(\tau^M \times \alpha_i^M, \tau^H \times \alpha_f^H)$ for a grid $(\tau^M, \tau^H) \in \{0.5, 0.75, 1, 1.25, 1.5\}^2$, while holding all other estimates fixed. This analysis is therefore comparable with our previous counterfactual analysis, up to consumer price sensitivity. Figures 4 and 5 display the main results from this analysis, which we implement for a case without cost efficiencies.[50]

Steering incentives vary substantially with consumer price sensitivity. Figure 4-a shows that patient-steering incentives are stronger when consumers are more price sensitive and less premium sensitive. In that case, integrated insurers can steer hospital demand by negotiating higher hospital prices with rivals, without decreasing the demand for their plans substantially. Similarly, Figure 4-b shows that enrollee-steering incentives are stronger when consumers are less price sensitive and more premium sensitive, as in such case integrated hospitals can steer enrollees by negotiating higher hospital prices with rivals and compensating consumers with lower premiums.[51]

Our analysis of steering incentives highlights two channels through which vertical integration distorts outcomes: (i) increasing hospital prices to rivals and (ii) adjusting premiums. However, the extent by which integrated firms exploit each channel vitally depends on consumer price sensitivity. When consumers are more sensitive to prices than to premiums, integrated firms steer demand by increasing hospital prices to rival insurers and decreasing prices to the integrated insurer, as shown by Figures 4-c and 4-d. Unlike in our baseline scenario, these firms increase

[50] For reference, Figure A.5 displays baseline average hospital prices and plan premiums across our range of scenarios.

[51] Additionally, steering becomes costlier when both price and premium sensitivity are low, as it requires larger changes in price and premiums. On the other hand, when consumers are highly price and premium sensitive, rivals can offset steering incentives by slightly reducing premiums and prices. Thus, both of these scenarios limit steering incentives.

their premiums driven by the increase in the relative value of their integrated plan networks with respect to rival insurers', as shown by Figure 4-g. On the other hand, when consumers are less responsive to prices than to premiums, integrated insurers decrease premiums to attract enrollees.

The welfare effects of banning vertical integration also vary with price and premium sensitivity, as shown in Figure 5. Whereas our main results in Section 5.2 show that banning vertical integration would benefit consumers in our setting, the opposite could happen depending on consumers price sensitivity. When consumer price sensitivity is low, and premium sensitivity is high, consumer surplus *decreases* upon banning vertical integration, regardless of the existence of cost efficiencies. This result is partly driven by the substantial increase in premiums of integrated insurers, which more than compensates the decrease in hospital prices by integrated hospitals.[52,53]

The connection among price sensitivity, steering incentives and the effects of vertical integration is strong and quantitatively relevant. Consumer price sensitivity limits the ability of integrated firms to exercise the additional market power granted by integration. As a consequence, the effects of vertical integration on consumer surplus vary both in magnitude and sign with consumer price sensitivity, suggesting this dimension might be relevant for antitrust discussions.

5.6 Discussion and Limitations

Given the complexity of our counterfactual exercises, we require various assumptions and simplification, thus, we discuss some of the main caveats and limitations. First, we assume that insurers can only adjust premiums while keeping constant the menu of plans, and their coinsurance rates and networks. One could argue that insurers would optimize along these margins in the absence of vertical integration. However, legal restrictions in our application limit this concern: guaranteed renewability of plans implies that plan switching must be voluntary, which limits the extent to which insurers may alter existing insurance plans. In any case, we should expect that having more margins of adjustment would dampen the adverse effects of banning vertical integration on insurer profits, and our estimates of welfare effects may change.

Second, our analysis does not consider changes in fixed costs. If integrated firms share capital that is not captured in per-consumer costs, vertical integration might have implications for entry and consolidation. This aspect lies beyond the scope of our work. However, we observe no entry or exit of large hospitals or insurers during our sample, which suggests these effects might be of second order in our setting.

---

[52]Interestingly, this can provide some rationale for the success of the integrated system Kaiser, since estimates for hospital price sensitivity are relatively low in the U.S. and close to our case with $(\tau^M, \tau^H) = (1.0, 0.5)$ in Figure 5-c.

[53]Cost efficiencies caused by vertical integration reduce the benefits from banning vertical integration. Figure A.7 shows the total welfare in a simulation where vertical integration induces a cost efficiency of 20% within the integrated firm. All qualitative results remain the same in this case, yet the benefits from banning vertical integration are smaller, and we can find a scenario in which banning vertical integration would reduce overall welfare.

6 Conclusion

This paper proposes an empirical approach for the assessment of the equilibrium effects of vertical integration on market outcomes and welfare. On the theoretical side, we develop an equilibrium model of bargaining between hospitals and insurers, which accommodates vertical integration. Our model highlights two relevant incentives that affect pricing at the margin under vertical integration. First, the *patient-steering* effect, by which integrated insurers induce demand to their integrated hospitals by negotiating higher prices with competing hospitals, thus reducing their value within the network. Second, the *enrollee-steering* effect, by which integrated hospitals induce demand to their integrated insurers by negotiating higher hospital prices with competing insurers, thus reducing the value of competing networks.

On the empirical side, our model has implications for researchers and policymakers about the desirability of vertical integration in health markets. We estimate our model using individual-level data from Chile, where private insurers own about half of the private health care sector. Using our estimated model, we quantify the equilibrium effects of vertical integration. We find that banning vertical integration is welfare enhancing in our setting, as the gains in consumer surplus and insurer profit more than compensate decreases in hospital profits. Furthermore, this result does not change qualitatively for a range of cost efficiencies induced by vertical integration.

To further inform the regulation of vertical integration, we explore how our results change under alternative scenarios. First, we examine a situation in which vertical integration creates cost efficiencies at the hospital level that apply to all insurers. In this case, vertical integration can increase welfare for moderate cost efficiencies. We see this as a useful result for antitrust regulation as anti-discrimination clauses can be enforced. Second, we explore the role of price and premium sensitivity for the effects of vertical integration. We find that when consumers are more sensitive to premiums than to hospital prices, integrated firms optimally decrease premiums to attract consumers, enough to increase consumer surplus. This analysis suggests that price and premium sensitivity are relevant inputs in the assessment of vertical mergers.

We see clear avenues to extend our work. First, identifying the organizational features that are affected by vertical integration, and quantifying their changes, could clarify the mechanisms of action of vertical integration. For example, specific work could be done on changes to physician incentives and hospital spending under vertical integration. Second, we see the study of the industry characteristics that lead to vertical integration, as a critical pending question for the determination of the desirability of integration in health care markets.

References

Abaluck, J. and Gruber, J. (2011). Choice Inconsistencies among the Elderly: Evidence from Plan Choice in the Medicare Part D Program. *American Economic Review*, 101(4):1180–1210.

Aron-Dine, A., Einav, L., and Finkelstein, A. (2013). The RAND Health Insurance Experiment, Three Decades Later. *The Journal of Economic Perspectives*, 27:197–222.

Atal, J. P. (2015). Lock-in in Guaranteed-Renewable Health Insurance Contracts: The Case of Chile. Manuscript.

Atalay, E., Hortaçsu, A., and Syverson, C. (2014). Vertical Integration and Input Flows. *American Economic Review*, 104(4):1120–48.

Berry, S., Levinsohn, J., and Pakes, A. (1995). Automobile Prices in Market Equilibrium. *Econometrica*, 63(4):841–890.

Bitrán, R., Escobar, L., and Gassibe, P. (2010). After Chile's Health Reform: Increase in Coverage and Access, Decline in Hospitalization and Death Rates. *Health Affairs*, 29(12):2061–2170.

Bossert, T., Blanchet, N., Sheetz, S., Pinto, D., Cali, J., and Pérez Cuevas, R. (2014). Comparative review of health system integration in selected countries in Latin America. Technical Note IDB-TN-585, Inter-American Development Bank.

Bresnahan, T. and Levin, J. (2012). Vertical Integration and Market Structure. In Gibbons, R. and Roberts, J., editors, *The Handbook of Organizational Economics*, pages 853–890. Princeton University Press.

Capps, C., Dranove, D., and Satterthwaite, M. (2003). Competition and Market Power in Option Demand Markets. *The Rand Journal of Economics*, 34(4):737–763.

Chipty, T. (2001). Vertical Integration, Market Foreclosure, and Consumer Welfare in the Cable Television Industry. *American Economic Review*, 91(3):428–453.

Chorniy, A., Miller, D., and Tang, T. (2016). Mergers in Medicare part D: Decomposing Market Power, Cost Efficiencies and Bargaining Power. Manuscript.

Clínicas de Chile, A. (2012). Dimensionamiento del Sector de Salud Privado de Chile. Technical report, Clínicas de Chile A.G.

Collard-Wexler, A., Gowrisankaran, G., and Lee, R. S. (2017). "Nash-in-Nash" Bargaining: A Microfoundation for Applied Work. *Forthcoming at the Journal of Political Economy*.

Cooper, Z., Craig, S., Gaynor, M., and Reenen, J. V. (2018). The Price Ain't Right? Hospital Prices and Health Spending on the Privately Insured. *Quarterly Journal of Economics*.

Copetta, M. (2013). Prestadores de Salud, Isapres y Holdings: ¿Relación Estrecha? *Depto Estudios, Superintendencia de Salud*.

Craig, S., Grennan, M., and Swanson, A. (2018). Mergers and Marginal Costs: New Evidence on Hospital Buyer Power. Working Paper 24926, National Bureau of Economic Research.

Crawford, G. S., Lee, R. S., Whinston, M. D., and Yurukoglu, A. (2018). The Welfare Effects of Vertical Integration in Multichannel Television Markets. *Econometrica*, 86(3):891–954.

Crawford, G. S. and Yurukoglu, A. (2012). The Welfare Effects of Bundling in Multichannel Television Markets. *American Economic Review*, 102(2):643–85.

Curto, V., Einav, L., Levin, J., and Bhattacharya, J. (2015). Can Health Insurance Competition Work? Evidence from Medicare Advantage. Manuscript.

Cybermetrics Lab (2016). Webometrics Ranking of World Hospitals. https://bit.ly/2AiJ00S. Accessed: 2018-12-27.

Dafny, L. (2009). Estimation and Identification of Merger Effects: An Application to Hospital Mergers. *Journal of Law and Economics*, 52(3):523–550.

Dafny, L. (2014). Hospital Industry Consolidation: Still More to Come? *New England Journal of Medicine*, 370(3):198–199.

Dafny, L., Duggan, M., and Ramanarayanan, S. (2012). Paying a Premium on Your Premium? Consolidation in the US Health Insurance Industry. *American Economic Review*, 102(2):1161–85.

Dafny, L., Ho, K., and Lee, R. (2018). The Price Effects of Cross-Market Hospital Mergers. *RAND Journal of Economics*.

Diebel, A. S. (2018). Vertical Integration in the US Health Care Market: An Empirical Analysis of Hospital-Insurer Consolidation. Manuscript.

Duarte, F. (2011). Switching Behavior in a Health System with Public Option. Manuscript.

Duarte, F. (2012). Price Elasticity of Expenditure across Health Care Services. *Journal of Health Economics*, 31(6):824–841.

Gal-Or, E. (1997). Exclusionary Equilibria in Health-Care Markets. *Journal of Economics and Management Strategy*, 6(1):5–43.

Gal-Or, E. (1999). Mergers and Exclusionary Practices in Health Care Markets. *Journal of Economics & Management Strategy*, 8(3):315–350.

Galetovic, A. and Sanhueza, R. (2013). Un Análisis Económico de la Integración Vertical entre Isapres y Prestadores. Manuscript.

Gaynor, M., Ho, K., and Town, R. J. (2015). The Industrial Organization of Health-Care Markets. *Journal of Economic Literature*, 53(2):235–84.

Gaynor, M. and Town, R. J. (2011). Competition in Health Care Markets. In Pauly, M. V., McGuire, T. G., and Barros, P. P., editors, *Handbook of Health Economics*, volume 2 of *Handbook of Health Economics*, pages 499 – 637. Elsevier.

Ghili, S. (2017). Network Formation and Bargaining in Vertical Markets: The Case of Narrow Networks in Health Insurance. Manuscript.

Gowrisankaran, G., Nevo, A., and Town, R. J. (2015). Mergers When Prices Are Negotiated: Evidence from the Hospital Industry. *American Economic Review*, 105(1):172–203.

Grennan, M. (2013). Price Discrimination and Bargaining: Empirical Evidence from Medical Devices. *American Economic Review*, 103(1):145–77.

Grossman, S. and Hart, O. (1986). The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration. *Journal of Political Economy*, 94(4):691–719.

Hansen, L. P. and Singleton, K. J. (1982). Generalized instrumental variables estimation of nonlinear rational expectations models. *Econometrica*, 50(5):1269–1286.

Hart, O. and Tirole, J. (1990). Vertical Integration and Market Foreclosure. *Brookings Papers on Economic Activity, Microeconomics*, pages 205–285.

Hastings, J. (2004). Vertical Relationships and Competition in Retail Gasoline Markets: Empirical Evidence from Contract Changes in Southern California. *American Economic Review*, 94(1):317–28.

Ho, K. (2006). The Welfare Effects of Restricted Hospital Choice in the U.S Medical Care Market. *Journal of Applied Econometrics*, 21(7):1039–1079.

Ho, K. (2009). Barriers to Entry of a Vertically Integrated Health Insurer: An Analysis of Welfare and Entry Costs. *Journal of Economics and Management Strategy*, 18(2):487–545.

Ho, K. and Lee, R. (2017). Insurer Competition in Health Care Markets. *Econometrica*, 85(2):379–417.

Ho, K. and Lee, R. (2018). Equilibrium Insurer-Provider Networks: Bargaining and Exclusion in Health Care Markets. *American Economic Review*.

Horn, H. and Wolinsky, A. (1988). Bilateral Monopolies and Incentives for Merger. *The RAND Journal of Economics*, 19(3):408–419.

Hortaçsu, A. and Syverson, C. (2007). Cementing Relationships: Vertical Integration, Foreclosure, Productivity, and Prices. *Journal of Political Economy*, 115(2):250–301.

Johnson, E. M. and Rehavi, M. M. (2016). Physicians Treating Physicians: Information and Incentives in Childbirth. *American Economic Journal: Economic Policy*, 8(1):115–141.

La Tercera (2017). Ganancias de las isapres suben 40,6% y llegan a $70.577 millones en 2017. https://bit.ly/2z3AmD2. Accessed: 2018-12-27.

Lee, R. S. (2013). Vertical integration and exclusivity in platform and two-sided markets. *American Economic Review*, 103(7):2960–3000.

Lewis, M. S. and Pflum, K. E. (2015). Diagnosing Hospital System Bargaining Power in Managed Care Networks. *American Economic Journal: Economic Policy*, 7(1):243–74.

Lewis, M. S. and Pflum, K. E. (2017). Hospital Systems and Bargaining Power: Evidence from Out-of-market Acquisitions. *The RAND Journal of Economics*, 48(3):579–610.

Liebman, E. (2018). Bargaining in Markets with Exclusion: An Analysis of Health Insurance Networks. Manuscript.

Moresi, S. and Salop, S. C. (2013). vGUPPI: Scoring Unilateral Pricing Incentives in Vertical Mergers. *Antitrust Law Journal*, 79(1):185–214.

Ordover, J. A., Saloner, G., and Salop, S. C. (1990). Equilibrium Vertical Foreclosure. *The American Economic Review*, 80(1):127–142.

Pardo, C. and Schott, W. (2012). Public versus Private: Evidence on Health Insurance Selection. *International Journal of Health Care Finance and Economics*, 12:39–61.

Pardo, C. and Schott, W. (2013). Health Insurance Selection: A Cross-sectional and Panel Analysis. *Health Policy and Planning*, pages 1–11.

Powell, M. J. (2007). A View of Algorithms for Optimization without Derivatives. *Mathematics Today-Bulletin of the Institute of Mathematics and its Applications*, 43(5):170–174.

Prager, E. (2016). Tiered Hospital Networks, Health Care Demand, and Prices. Manuscript.

Prager, E. (2018). Consumer Responsiveness to Simple Health Care Prices: Evidence From Tiered Hospital Networks. Manuscript.

Salop, S. C. and Scheffman, D. T. (1983). Raising rivals' costs. *The American Economic Review P& P*, 73(2):267–271.

Small, K. and Rosen, H. (1981). Applied Welfare Economics with Discrete Choice Models. *Econometrica*, 49(1):105–30.

Spengler, J. J. (1950). Vertical Integration and Antitrust Policy. *Journal of Political Economy*, 58(4):347–352.

Superintendencia de Salud (2015). Boletín Estadístico. Technical report, Superintendencia de Salud.

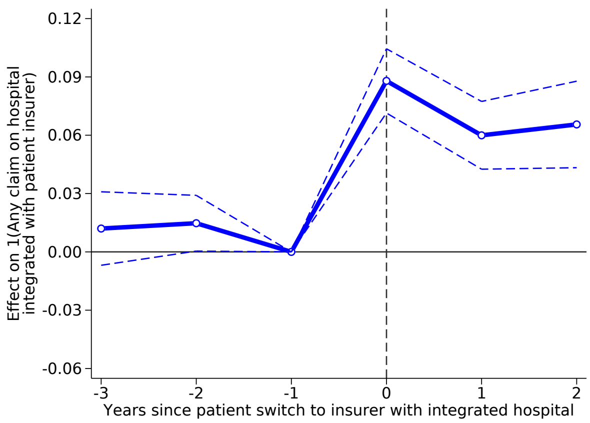
Tebaldi, P. (2017). Estimating Equilibrium in Health Insurance Exchanges: Analysis of the Californian Market under ACA. Manuscript.

Tobar, J., Cabrera, S., Nuñez, P., Vassallo, C., Guerrero, J. L., and Ríos, M. (2012). Mercado de la Salud privada en Chile. Technical report, Pontificia Universidad Católica de Valparaíso.

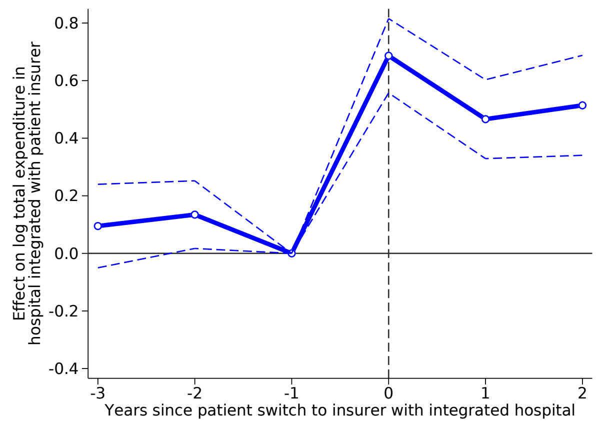
VOX (2017). What the CVS-Aetna merger could mean for health care deals, drug prices, and Amazon. https://www.vox.com/business-and-finance/2017/12/4/16731310/cvs-aetna-merger. Accessed: 2019-04-11.

Williamson, O. (1971). The Vertical Integration of Production: Market Failure Considerations. *American Economic Review*, 61(2):112–23.

Figure 1: Vertical Integration, Hospital Choices and Expenditure



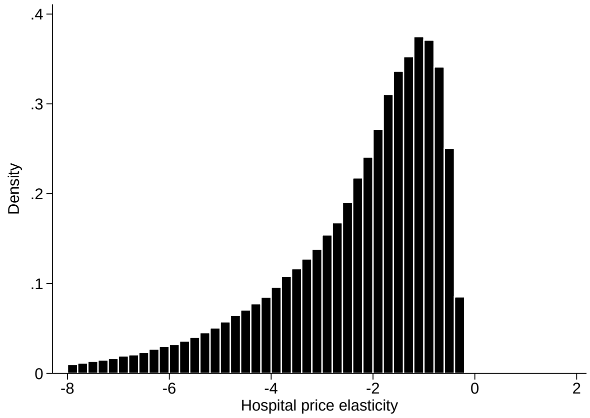
(a) Any claims in integrated hospital



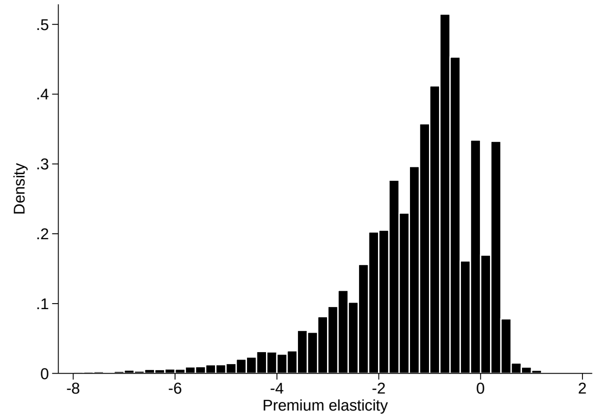
(b) Expenditure in integrated hospital

Notes: This figure displays event study estimates from equation (2). Each dot is a coefficient estimate for a year around patients switching insurer. Dashed lines indicate 95% confidence intervals.

Figure 2: Histogram of Health Care Price Elasticities and Plan Premium Elasticities elasticities



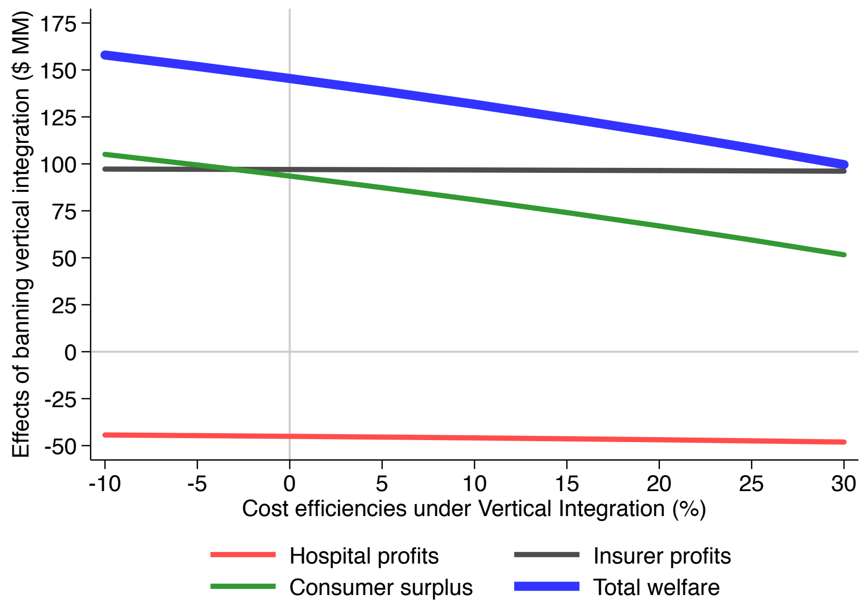
(a) Hospital price elasticity



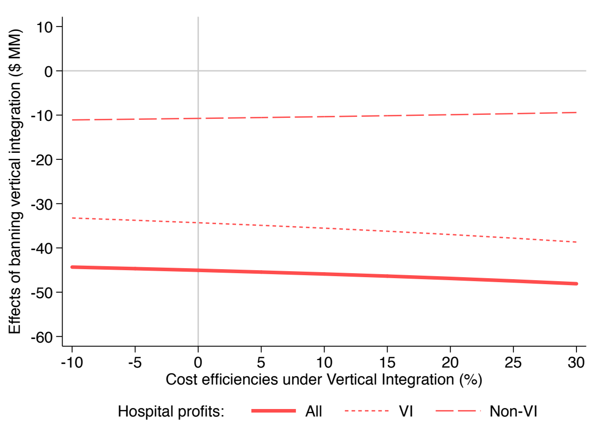
(b) Plan premium elasticity

Notes: Panel (a) displays the histogram of estimated price elasticities for hospitals using estimates in column (1) of Table 5. The logit elasticities are given by: $\hat{\eta}_{iht} = \hat{\alpha}^H_i c_{jh} p_{jhdt}(1 - \hat{\sigma}^H_{ijhdt})$, where $\hat{\sigma}^H_{ihjt}$ is the predicted choice probability of hospital h by consumer type i enrolled in plan j at time t. Panel (b) displays the histogram of premium elasticities for insurance plans using estimates in column (1) of Table 6. The logit elasticities are given by: $\hat{\eta}_{fjt} = \hat{\alpha}^M_f \phi_{fjt}(1 - \hat{\sigma}^M_{fjt})$ is the predicted choice probability of household type f enrolled in plan j at time t.

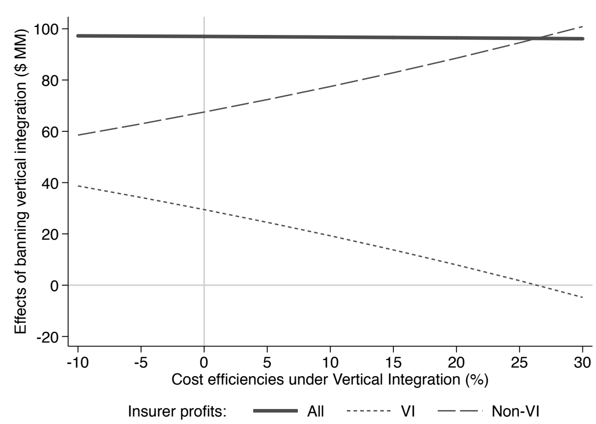
Figure 3: Welfare Effects of Banning Vertical Integration for Cost Efficiencies: Chilean Market



(a) Aggregate effects



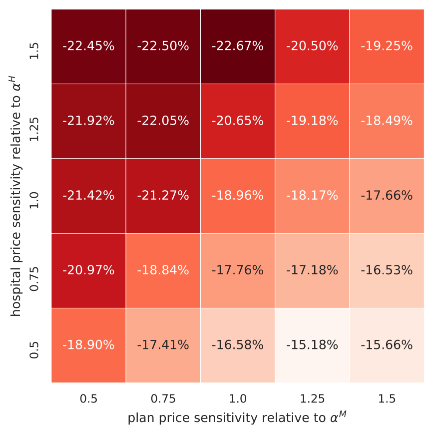
(b) Effects on hospitals, by vertical integration



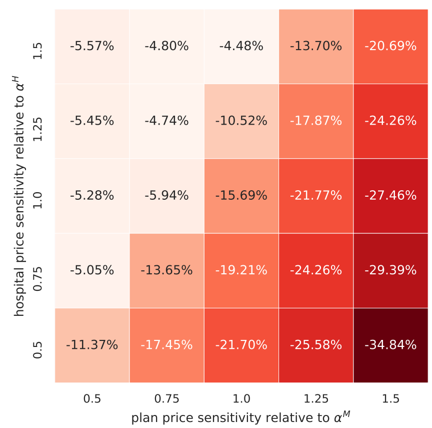
(c) Effects on insurers, by vertical integration

Notes: This figure shows the effect of banning vertical integration on equilibrium welfare outcomes for different levels of cost efficiencies, for the Chilean market. Panel (a) displays aggregate effects, Panels (b) and (c) respectively decompose effects on hospitals and insurers profits by vertical integration at baseline. The x-axis in each graph measure cost efficiencies induced by vertical integration on integrated hospital-insurer pairs. Blue lines show overall welfare effects, green lines show effects on consumer surplus, red lines show effects on hospital profits, and black lines show effects on insurer profits.

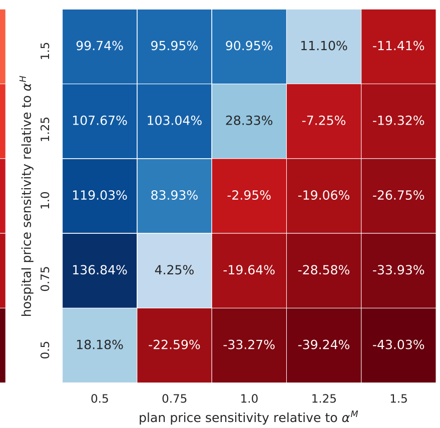
Figure 4: The Role of Price Sensitivity for the Effects of Banning Vertical Integration: Outcomes



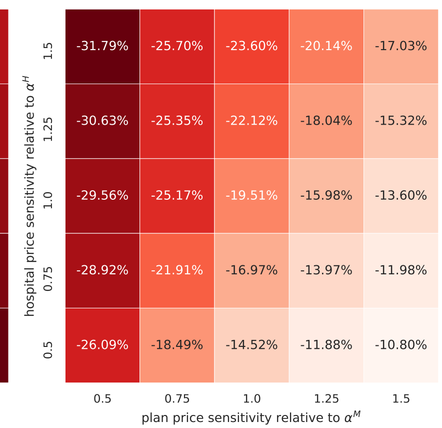
(a) Patient-steering effects



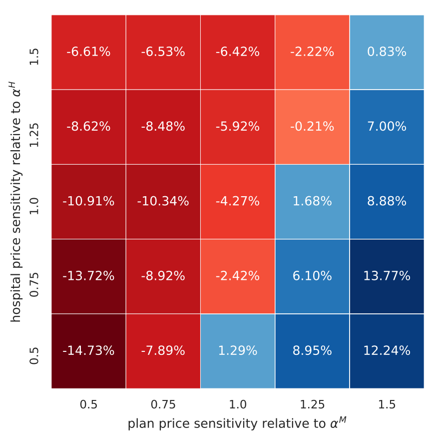
(b) Enrollee-steering effects



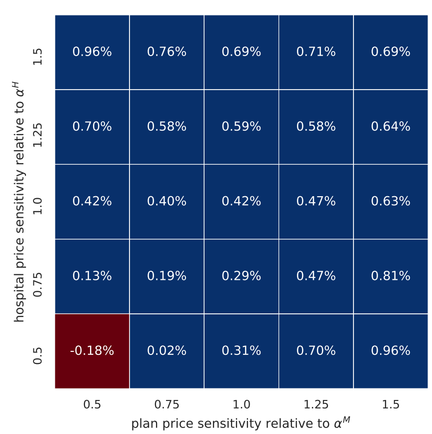
(c) Effects on prices VI to VI



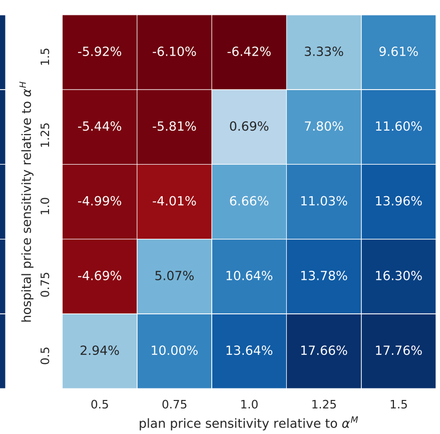
(d) Effects on prices VI to non-VI



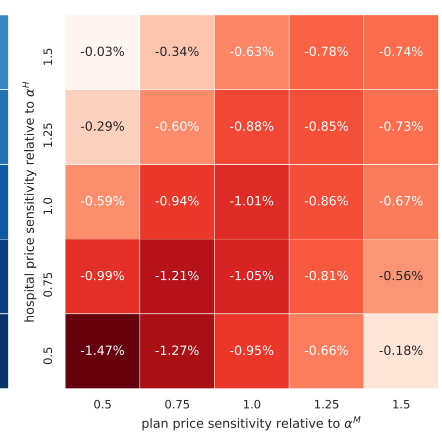
(e) Effects on prices non-VI to VI



(f) Effects on prices non-VI to non-VI



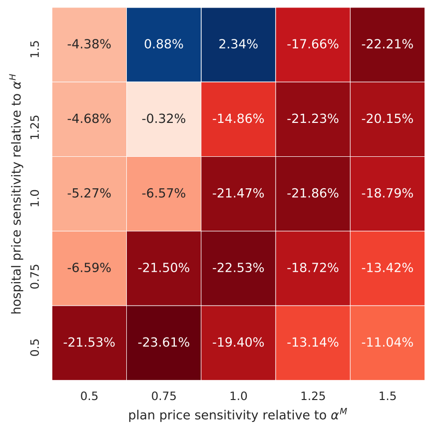
(g) Effects on VI plan premiums



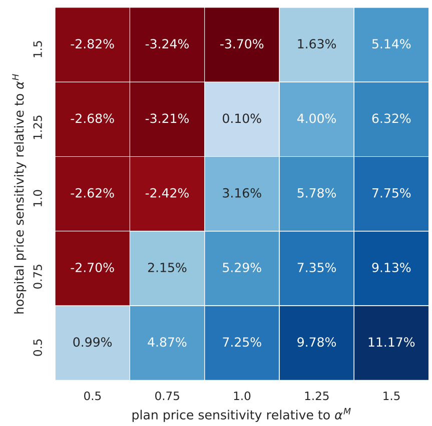
(h) Effects on non-VI plan premiums

Notes: This figure shows the effect of banning vertical integration on a variety of outcomes for a grid of consumer price sensitivity. For each plot, we show results for a 5×5 grid of hospital and plan demand sensitivity defined by $(\tau^M \times \alpha_i^M, \tau^H \times \alpha_f^H)$ for $\tau = \{0.5, 0.75, 1, 1.25, 1.5\}$. Panels (a) and (b) quantify patient- and enrollee-steering effects respectively in the baseline scenario, as described in Section 4.5. Panels (c) through (f) display the effect of banning vertical integration on quantity-weighted average hospital prices from a VI/non-VI hospital to a VI/non-VI insurer, and panels (g) and (h) display plan premiums for VI/non-VI insurers. For each such figure, blue (red) indicates increases (decreases) in the outcome, and the intensity of the color indicates the relative magnitude of the change.

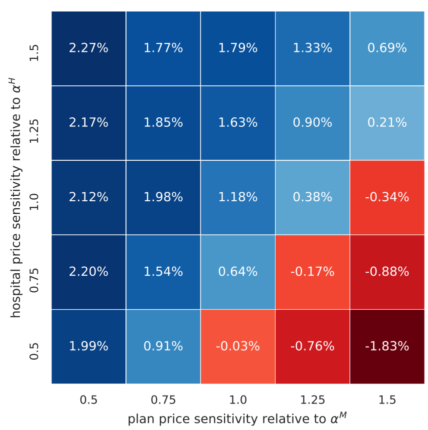
Figure 5: The Role of Price Sensitivity for the Effects of Banning Vertical Integration: Welfare Effects



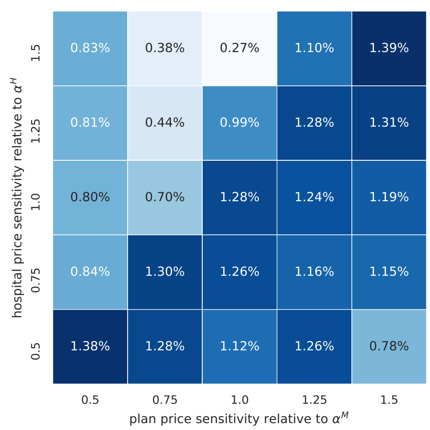
(a) Effects on hospital profits



(b) Effects on insurer profits



(c) Effects on consumer surplus



(d) Effects on total welfare

Notes: This figure shows the effect of banning vertical integration on a variety of outcomes for a grid of consumer price sensitivity. For each plot, we show results for a 5×5 grid of hospital and plan demand sensitivity defined by $(\tau^M \times \alpha_i^M, \tau^H \times \alpha_f^H)$ for $\tau = \{0.5, 0.75, 1, 1.25, 1.5\}$. Panels (a) through (d) display the effect of banning vertical integration on a variety of equilibrium outcomes, measure as a percentage change relative to the baseline level. The outcomes are hospital and insurer profits, consumer surplus and overall welfare. For each such figure, blue (red) indicates increases (decreases) in the outcome, and the intensity of the color indicates the relative magnitude of the change.

Table 1: Descriptive Statistics for Plans Dataset

	Panel A - Policyholders attributes					
Variable	N	Mean	SD	p10	p50	p90
Paid premium	1,104,344	0.16	0.09	0.08	0.14	0.27
Policyholder age	1,104,344	40.38	13.41	26.00	37.00	60.00
Policyholder income	1,104,344	1.61	1.13	0.00	1.54	3.03
Single male	1,104,344	0.34				
Single female	1,104,344	0.22				
Has dependents	1,104,344	0.43				

	Panel B - Plan attributes					
Attribute	N	Mean	SD	p10	p50	p90
Inpatient coverage rate	4,358	85.35	23.67	70.00	90.00	100.00
Outpatient coverage rate	4,358	71.83	21.73	60.00	70.00	90.00
Has coverage cap	4,358	0.87				
Has preferential hospital	4,358	0.86				

	Panel C - Insurer market shares and premiums					
	Market	Paid premium				
Insurer	share	Mean	SD	p10	p50	p90
m_1	20.42	0.15	0.09	0.07	0.12	0.26
m_2	17.11	0.19	0.11	0.11	0.17	0.32
m_3	13.72	0.14	0.07	0.06	0.12	0.23
m_4	19.63	0.16	0.08	0.08	0.14	0.26
m_5	25.50	0.15	0.06	0.09	0.14	0.24
m_6	3.63	0.27	0.16	0.13	0.21	0.47

Notes: This table displays descriptive statistics for our estimating plans dataset. Panel A displays statistics across all policyholders in the sample. Panel B displays statistics for plan attributes across al plans in the sample. Panel C displays market shares and premiums paid by policyholders for each insurer in the market. All prices are measured in thousands of U.S. dollars for December, 2014.

Table 2: Descriptive Statistics for Admissions Dataset

	Panel A - Admission attributes					
Variable	N	Mean	SD	p10	p50	p90
Full price	641,392	3.79	6.21	0.08	2.25	8.61
Copayment	641,392	1.22	3.03	0.00	0.33	3.25
Coverage	641,392	3.05	4.91	0.34	1.94	6.29
Preferential hospital	641,392	0.38	0.49	0.00	0.00	1.00
Patient age	641,392	37.43	19.44	6.00	37.00	64.00
Policyholder income	641,392	1.88	1.22	0.00	1.95	2.95
Single male	641,392	0.14				
Single female	641,392	0.17				
Has dependents	641,392	0.69				

	Panel B - Hospital market shares and prices					
	Market	Full price				
Hospital	share	Mean	SD	p10	p50	p90
h_1	13.03	6.80	7.91	0.89	4.96	13.50
h_2	4.20	2.70	3.39	0.81	2.04	4.95
h_3	3.82	3.13	4.98	0.75	2.14	6.30
h_4	10.98	3.38	5.48	0.63	2.12	6.22
h_5	9.87	4.32	4.62	1.18	3.61	7.26
h_6	7.51	8.09	10.39	1.39	5.59	16.56
h_7	12.23	5.01	6.71	0.87	3.48	9.69
h_8	2.79	4.37	4.92	0.95	2.99	9.39
h_9	1.37	4.28	6.83	0.32	2.77	8.70
h_{10}	2.34	5.07	5.25	1.22	4.02	8.79
h_{11}	2.67	2.91	3.57	0.95	2.21	5.16
h_{12}	5.14	2.98	5.91	0.58	1.89	5.85
Other	24.05	0.52	1.25	0.01	0.13	1.58

Notes: This table displays descriptive statistics for our estimating admissions dataset. Only admissions on the hospitals in the sample are considered for these statistics. Panel A displays statistics across all hospitals in the sample. Panel B displays statistics for market shares and full prices by hospital. All prices are measured in thousands of U.S. dollars for December, 2014.

Table 3: Admission Market Shares and Prices between Hospitals and Insurers

Panel A - Admission Market Shares							
Hospital	m_1	m_2	m_3	m_4	m_5	m_6	VI share
h_1	15.24	37.53	5.56	24.34	7.57	9.77	0.00
h_2	10.05	10.34	52.62	22.26	3.12	1.61	52.62
h_3	6.30	6.55	63.17	21.80	1.89	0.29	63.17
h_4	67.89	5.21	12.24	9.43	1.86	3.38	71.27
h_5	11.57	25.46	8.46	24.28	27.61	2.62	0.00
h_6	17.98	37.42	5.33	21.12	9.06	9.09	0.00
h_7	44.73	17.88	4.59	17.45	6.14	9.21	53.94
h_8	12.14	17.25	43.38	18.71	4.57	3.95	43.38
h_9	0.43	11.13	22.36	65.14	0.78	0.15	0.00
h_{10}	7.84	64.03	3.20	15.49	5.90	3.54	64.03
h_{11}	63.30	6.30	16.64	9.63	2.51	1.62	64.92
h_{12}	21.60	9.34	46.20	19.78	1.81	1.26	0.00

Panel B - Admission Full Prices (% of Total Industry Payments)							
Hospital	m_1	m_2	m_3	m_4	m_5	m_6	Total
h_1	2.19	2.10	2.19	2.19	1.34	2.21	12.23
h_2	1.04	0.93	0.81	0.99	1.03	1.09	5.88
h_3	1.26	1.07	0.94	1.08	0.97	1.01	6.33
h_4	1.07	1.06	1.01	1.09	0.80	1.12	6.16
h_5	1.55	1.51	1.36	1.45	1.14	1.63	8.63
h_6	2.37	2.34	2.53	2.47	1.97	2.32	14.00
h_7	1.62	1.57	1.66	1.53	1.12	1.59	9.09
h_8	1.53	1.73	1.31	1.46	1.27	1.51	8.80
h_9	1.70	2.12	1.30	1.21	1.32	0.95	8.60
h_{10}	1.70	1.71	1.31	1.33	1.27	1.77	9.09
h_{11}	1.02	0.99	0.79	0.92	0.70	0.92	5.34
h_{12}	1.06	1.08	0.87	0.84	1.01	0.99	5.84
Total	18.10	18.21	16.08	16.55	13.95	17.12	100.00

Panel C - Estimated Negotiated Prices (% of Total Industry Payments)							
Hospital	m_1	m_2	m_3	m_4	m_5	m_6	Total
h_1	2.21	1.91	2.86	2.21	1.53	2.26	12.98
h_2	0.82	0.66	0.76	0.83	1.11	0.90	5.09
h_3	0.97	0.91	1.03	0.96	1.00	0.90	5.76
h_4	0.75	0.78	1.07	0.87	0.80	0.79	5.06
h_5	1.38	1.37	1.72	1.34	1.33	1.45	8.59
h_6	2.37	2.27	3.20	2.25	2.22	2.35	14.67
h_7	1.38	1.19	1.86	1.47	1.22	1.39	8.52
h_8	1.24	1.39	1.33	1.30	1.24	1.30	7.79
h_9	2.37	1.98	1.57	1.18	2.10	2.06	11.26
h_{10}	1.64	1.68	2.02	1.78	1.40	1.63	10.15
h_{11}	0.91	0.94	1.03	0.90	0.79	0.87	5.44
h_{12}	0.74	0.74	0.88	0.69	0.99	0.66	4.70
Total	16.79	15.82	19.35	15.75	15.72	16.56	100.00

Notes: The table displays a breakdown of the admissions market shares in Panel A, admission negotiated prices in Panel B, and estimated admission negotiated prices by hospital and insurer pair in Panel C. Vertically integrated pairs are underlined. Panels A and B are calculated from the raw data. Panel C is estimated using the procedure described in Section 4.1. The prices are expressed as a percentage of the industry payments.

Table 4: Vertical Integration, Hospital Prices and Coverage

	(1)	(2)	(3)	(4)	(5)
	Panel A - OLS estimates on Total bill				
Vertically integrated	-0.291***	-0.031	-0.002	-0.073***	-0.079***
	(0.100)	(0.026)	(0.022)	(0.018)	(0.017)
Observations	545,718	545,718	545,718	545,718	545,716
R-squared	0.026	0.118	0.408	0.411	0.430
	Panel B - OLS estimates on Patient copayment				
Vertically integrated	-0.369***	-0.105***	-0.094**	-0.227***	-0.230***
	(0.103)	(0.039)	(0.040)	(0.031)	(0.031)
Observations	545,718	545,718	545,718	545,718	545,716
R-squared	0.041	0.176	0.304	0.430	0.444
	Panel C - OLS estimates on Insurer coverage				
Vertically integrated	-0.148*	0.021	0.048***	0.044*	0.039*
	(0.076)	(0.023)	(0.016)	(0.022)	(0.022)
Observations	545,718	545,718	545,718	545,718	545,716
R-squared	0.007	0.055	0.320	0.370	0.384
Hospital FEs	N	Y	Y	Y	Y
Diagnosis FEs	N	N	Y	Y	Y
Diagnosis public prices	N	N	Y	Y	Y
Insurer controls	N	N	N	Y	Y
Patient controls	N	N	N	N	Y

Notes: This table shows results from estimating equation (1) using the log amount of total bill (Panel A), patient copayment (Panel B), and insurer coverage (Panel C) as the dependent variables (we add 500 USD to avoid zero amounts). Each column includes a different set of control variables. Diagnosis fixed effects are based on ICD10 chapters, and diagnosis public system prices are the prices of the same admissions in public hospitals. Insurer controls include insurer fixed effect, plan premium, coinsurance rate for inpatient and outpatient admissions, and dummies for whether the plan has a coverage cap and a preferential hospital. Patient controls include gender, age, income, number of dependents, an indicator for independent worker and fixed effects by county of residence. The sample considers the admissions in the 12 main private hospitals. Standard errors in parentheses are clustered by insurer-hospital combination. P-values notation: *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Demand and Elasticities for Health Care

	(1)	(2)	(3)	(4)	(5)
	All	All	All	Age ≤ 45	Age > 45
Panel A - Preferences estimates					
α^H - Hospital price					
Age ≤ 25	-0.829***	-2.150***	-2.133***	-2.639***	
	(0.010)	(0.011)	(0.011)	(0.017)	
Age ∈ (25, 45]	-0.903***	-2.126***	-2.168***	-2.644***	
	(0.009)	(0.010)	(0.010)	(0.015)	
Age ∈ (45, 60]	-0.984***	-2.214***	-2.078***		-1.558***
	(0.009)	(0.011)	(0.011)		(0.013)
Age > 60	-0.884***	-2.135***	-1.970***		-1.489***
	(0.009)	(0.011)	(0.011)		(0.013)
Single female	0.250***	0.454***	0.441***	0.796***	0.165***
	(0.009)	(0.010)	(0.010)	(0.015)	(0.012)
Dependents	0.224***	0.477***	0.375***	0.682***	0.169***
	(0.008)	(0.009)	(0.009)	(0.014)	(0.011)
Income 2nd quartile	-0.298***	-0.273***	-0.294***	-0.285***	-0.288***
	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)
Income 3rd quartile	0.144***	0.061***	0.083***	0.167***	-0.040***
	(0.007)	(0.007)	(0.007)	(0.009)	(0.010)
Income 4th quartile	0.504***	0.456***	0.495***	0.631***	0.295***
	(0.006)	(0.006)	(0.007)	(0.009)	(0.010)
β_v - Distance to hospital	-0.086***	-0.091***	-0.094***	-0.101***	-0.083***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Panel B - Price elasticities					
Mean	-1.290	-2.322	-2.396	-2.607	-2.015
SD	0.993	1.702	1.762	1.905	1.487
p10	-2.640	-4.666	-4.827	-5.242	-4.048
p50	-1.001	-1.819	-1.877	-2.050	-1.574
p90	-0.354	-0.686	-0.701	-0.762	-0.594
Observations	7,899,554	7,899,554	7,899,554	5,098,860	2,800,694
Hospital FEs	N	Y	N	N	N
Hospital-diagnosis FEs	N	N	Y	Y	Y

Notes: Panel A shows demand estimates for hospitals. The price coefficient varies across age groups, household composition and income. The single male category is the baseline. The price coefficient for another specific group is the sum of the age-group for single male plus the price coefficient of that group. $income_i$ corresponds to the taxable income of the consumer as recorded in the administrative data. Panel B displays the summary statistics for the individual estimated price elasticities. Namely, $\hat{\eta}_{iht} = \hat{\alpha}_i^H c_{jh} p_{ijhdt}(1 - \hat{\sigma}_{ijhdt}^H)$, where $\hat{\sigma}_{ijhdt}$ is the predicted choice probability of hospital h by consumer type i enrolled in plan j under diagnosis d at time t. Robust standard errors in parentheses. P-value notation: ***p<0.01, ** p<0.05, * p<0.1.

Table 6: Demand Estimates and Elasticities for Insurance Plans

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	α^M - Plan premium					β - Expected utility from health care				
	All	All	All	Age ≤ 45	Age > 45	All	All	All	Age ≤ 45	Age > 45
Panel A - Preferences estimates										
Age ≤ 25	-11.038***	-4.330***	-15.839***	-19.889***		3.062***	2.865***	5.871***	11.027***	
	(0.161)	(0.177)	(0.223)	(0.321)		(0.056)	(0.061)	(0.071)	(0.106)	
Age ∈ (25, 45]	-6.016***	-2.646***	-6.486***	-14.385***		4.331***	4.105***	5.492***	10.347***	
	(0.054)	(0.055)	(0.097)	(0.253)		(0.025)	(0.028)	(0.034)	(0.083)	
Age ∈ (45, 60]	-7.840***	-5.210***	-8.552***		-3.945***	3.975***	3.733***	4.910***		5.246***
	(0.060)	(0.060)	(0.092)		(0.133)	(0.026)	(0.030)	(0.036)		(0.048)
Age > 60	-3.831***	-2.217***	-4.805***		0.375***	2.187***	1.879***	2.283***		2.416***
	(0.057)	(0.056)	(0.082)		(0.108)	(0.024)	(0.026)	(0.030)		(0.038)
Single female	-1.053***	-0.971***	-0.409***	0.606**	0.724***	-1.385***	-0.821***	-0.116***	-5.464***	0.781***
	(0.058)	(0.061)	(0.087)	(0.257)	(0.113)	(0.026)	(0.026)	(0.029)	(0.076)	(0.037)
Dependents	-3.200***	-4.497***	-2.747***	-2.484***	-1.609***	-2.777***	-2.350***	-2.630***	-8.175***	-2.076***
	(0.044)	(0.043)	(0.068)	(0.244)	(0.082)	(0.023)	(0.016)	(0.028)	(0.077)	(0.032)
Income 2nd quartile	-8.422***	-8.746***	-9.407***	-7.743***	-8.128***	-0.203***	-0.163***	-0.059***	0.309***	-0.192***
	(0.067)	(0.068)	(0.070)	(0.103)	(0.095)	(0.016)	(0.025)	(0.017)	(0.022)	(0.025)
Income 3rd quartile	1.467***	1.334***	1.268***	8.157***	-3.287***	0.648***	0.657***	0.748***	1.269***	0.492***
	(0.055)	(0.056)	(0.058)	(0.088)	(0.077)	(0.015)	(0.016)	(0.016)	(0.022)	(0.023)
Income 4th quartile	8.817***	8.664***	9.101***	19.940***	2.569***	0.731***	0.688***	0.674***	1.199***	0.714***
	(0.049)	(0.049)	(0.053)	(0.086)	(0.058)	(0.016)	(0.015)	(0.017)	(0.024)	(0.024)
Panel B - Premium elasticities										
Mean	-1.216	-0.847	-1.319	-1.484	-1.038					
SD	1.314	1.286	1.411	1.807	1.065					
p10	-2.757	-2.344	-2.976	-3.580	-2.293					
p50	-0.926	-0.503	-1.012	-1.330	-0.842					
p90	0.180	-0.503	0.173	0.668	0.081					
Observations	44,276,610	44,276,610	44,276,610	30,234,540	14,042,070	44,276,610	44,276,610	44,276,610	30,234,540	14,042,070
Insurer FEs	N	Y	N	N	N	N	Y	N	N	N
Plan FEs	N	N	Y	Y	Y	N	N	Y	Y	Y

Notes: Panel A shows the logit estimates of the demand for insurance plans. The premium and expected utility of health care coefficients vary across age groups, household composition, and income. Different columns show estimates considering a different set of fixed effects. Columns (1) and (3) consider insurer fixed effects, while columns (2) and (4) consider insurance plan fixed effects. Panel B displays the summary statistics for the individual estimated price elasticities for the chosen plans. Namely, $\hat{\eta}_{fjt} = \hat{\alpha}^M_f \phi_{fjt}(1-\hat{\sigma}^M_{fjt})$, where $\hat{\sigma}^M_{fjt}$ is the predicted choice probability of plan j by household type f in time t. Robust standard errors in parentheses. P-value notation: *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Estimated Bargaining Weights and Marginal Costs

Negotiating firms		(1) Mean	(2) SD
Panel A - Hospital Bargaining Weights $(1-\lambda)$			
All Hospitals and Insurers		0.515	0.374
Non-VI hospital and Non-VI insurer		0.696	0.025
Non-VI hospital and VI insurer		0.949	0.038
VI hospital and Non-VI insurer		0.083	0.083
VI hospital and VI insurer from different holding		0.423	0.286
Panel B - Marginal Costs and Mark-ups	Outcome	Mean	SD
All Hospitals	Marginal cost	3.032	2.053
	Negotiated price	4.504	2.041
	Mark-up	0.383	0.254
Integrated hospitals only	Marginal cost	2.113	1.137
	Negotiated price	3.404	1.103
	Mark-up	0.400	0.231
Non-integrated hospitals only	Marginal cost	3.950	2.338
	Negotiated price	5.605	2.171
	Mark-up	0.366	0.276
Integrated hospital to own VI insurer only	Marginal cost	2.316	1.573
	Negotiated price	3.332	1.203
	Mark-up	0.332	0.363
Integrated hospital to other insurers	Marginal cost	2.062	1.004
	Negotiated price	3.422	1.082
	Mark-up	0.416	0.182

Notes: Non-VI stands for non-integrated, and VI stands for vertically integrated. Panel A displays summary statistics for the estimates of hospital bargaining weights (i.e. $1-\lambda_{ms}$). Each row provides statistics for a different combinations of negotiators. Panel B displays summary statistics for the estimated hospital marginal costs; the estimated negotiated prices as estimated in Section 4.1, and the implied hospital mark-up different for different subsample of hospitals.

Table 8: Counterfactual Simulation of Banning Vertical Integration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Hospital prices			Market shares			Total profits			Mark-ups		
Panel A - Hospitals	Base	CF	Δ%	Base	CF	Δ%	Base	CF	Δ%	Base	CF	Δ%
VI to own-VI	3.368	3.279	-2.629%	0.174	0.143	-18.169%	48.800	40.109	-17.809%	0.527	0.528	0.181%
VI to non-VI	3.470	2.793	-19.517%	0.327	0.380	16.108%	75.264	49.647	-34.036%	0.420	0.288	-31.444%
Non-VI to VI	5.609	5.560	-0.881%	0.143	0.142	-0.880%	44.267	34.455	-22.165%	0.348	0.268	-23.059%
Non-VI to non-VI	5.360	5.391	0.588%	0.355	0.335	-5.579%	44.430	43.499	-2.097%	0.148	0.148	0.112%
Non-VI to all	5.431	5.441	0.183%	0.499	0.477	-4.227%	88.697	77.954	-12.113%	0.207	0.185	-11.040%
	Plan premiums			Market shares			Total profits			Costs per enrollee		
Panel B - Insurers	Base	CF	Δ%	Base	CF	Δ%	Base	CF	Δ%	Base	CF	Δ%
VI at baseline	2.210	2.297	4.563%	0.206	0.195	-1.447%	599.858	614.598	3.693%	0.007	0.007	-1.425%
Non-VI at baseline	2.384	2.374	-0.351%	0.196	0.203	3.599%	604.922	627.428	3.751%	0.014	0.014	-3.270%

Panel C - Consumers	Share of market	Premium sensitivity	Δ Consumer surplus
Female 0-24	1.482%	-21.480	-0.002
Female 25-44	22.747%	-11.332	0.025
Female 45-60	9.510%	-7.954	0.075
Female 60+	4.204%	-4.151	0.200
Male 0-24	4.633%	-24.093	-0.007
Male 25-44	36.839%	-9.879	0.043
Male 45-60	14.562%	-7.069	0.070
Male 60+	6.022%	-3.758	0.132
Weighted average		-9.838	0.055

Notes: This table displays results from a counterfactual in which vertical integration is banned in the market and all vertical linkages are removed. Non-VI stands for non-integrated, and VI stands for vertically integrated. Panel A displays outcomes in the health care market, in which shares are weighted by resource intensity weights. Changes are market-size weighted averages per hospital, averaged by the level indicated on the leftmost column. Profits and prices are in USD thousands, with profit being hospital annual averages. Panel B displays yearly averages over insurers, weighted by the market size. Premiums are averaged at the plan level, while share, costs and profits correspond to insurer level averages. Baseline values are expressed in thousands of dollars, with profits being total yearly values averaged over all insurers. Panel C shows consumer surplus change per consumer, measured in thousands of dollars per year.

For Online Publication

Vertical Integration between Hospitals and Insurers

José Ignacio Cuesta, Carlos Noton and Benjamín Vatter

A Data Appendix

A.1 Construction of Admissions Dataset

Denote plans data by $\mathcal{P}$, claims data by $\mathcal{C}$. The estimating dataset is constructed following steps given by:

1. Keep all plans in $\mathcal{P}$ in 2013 and 2014.
2. Recover preferential hospitals for each plan from $\mathcal{C}$, using years 2008 to 2016. We keep the three most relevant preferential hospitals of each plan.
3. Merge preferential hospitals from $\mathcal{C}$ by plan name to plans in $\mathcal{P}$. Only 6% of the plans in $\mathcal{P}$ are not in $\mathcal{C}$, equivalent to 0.1% of the claims in $\mathcal{C}$. We drop them.
4. Construct plan identifiers by collecting plans with the same insurer, inpatient and outpatient coinsurance rate, whether it has a coverage cap or not, in the same base price decile, and with the same preferential hospitals. From now on, this is the definition of plans.
5. Merge plans identifiers in $\mathcal{P}$ to each claim in $\mathcal{C}$ for 2013 to 2016.
6. Construct events as a collection of claims.
7. Define main hospital as one of 12 main hospitals (Alemana, Avansalud, Bicentenario, Dávila, Indisa, Las Condes, Santa María, Tabancura, UC, UC San Carlos, Vespucio, UChile). These hospital account for 76% of events in $\mathcal{C}$. Collect all other hospitals in another category, "other".
8. Assign each event to a main hospital.
9. Collapse claims in each event to a single, event-level, observation. We construct price paid and full price for each event.
10. Recover effective coinsurance rate by plan, for preferential and non-preferential hospitals.
11. Merge consumer covariates. Drop if no consumer information.
12. Select estimating data. Keep only plans with more that 100 policyholders and claims for more than 10 diagnosis.

13. Define markets as the combination of year, plan and diagnosis. Drop markets with claims from 3 main hospitals or less in C.

A.2 Estimation of Negotiated Prices and Resource Intensity Weights

Equation (13) in the main text shows the generic decomposition of observed price into a negotiated price and resource intensity weights. The assumptions made in that section imply that our estimating equation takes the form:

$$\rho_{ihmdt} = p_{hmt}\omega_{id}$$

which separates observed prices into a negotiated component and a common utilization based component. The econometric challenge is that ω_{id} varies by potentially unobserved attributes of consumer i, and as not all consumer get ill of all conditions, we can not recover these values directly from the data. Our approach to solving this issue leverages our data on the public system prices and the fact that we observe the itemized claims of each admissions. This allows us to construct the exact price that the admissions would have cost in the public hospital system, which we denote p_{id}^{pub}. The public price is unrelated to the negotiation between h and m, as neither are affected by the public system's prices. However, this price is a clear metric of consumer utilization and the cost of providing treatment for the consumer. Using this we proceed by estimating the equation:

$$\log(\rho_{ihmdt}) = \log(p_{hmt})\iota_{hmt} + \alpha_h p_{id}^{pub} + \epsilon_{ihmdt}$$

where ι_{hmt} is an indicator for hospital h, insurer m and time t. This regressions identifies the negotiated prices as the coefficient on the indicators. Importantly, we allow for the connection between the public system price to scale differently for different hospitals, as captured by α_h. We then reduce the dimensionality of the utilization component to consumer types κ defined by gender and age (binned in 25-year age brackets) by:

$$\omega_{\kappa d} = \frac{1}{|I_{\kappa,d}|}\sum_{i\in I_{\kappa,d}} \hat{\alpha}_h p_{id}^{pub} \quad \forall\kappa$$

where $I_{\kappa,d}$ is the set of observations for the consumer group κ and diagnosis d.

Table A.2 provides details regarding the distribution of the prediction error for four different methods of estimation. The first column shows the error distribution from the first stage. This stage is used to recover the negotiated prices. The second columns shows the loss of prediction that we incur by reducing the dimensionality of ω to tractable levels. The following two columns correspond to estimating the resource intensity weights using fixed effects. The first shows the error from using only a diagnosis fixed effect, while the second uses a diagnosis and consumer attribute interaction fixed effect. By construction, the last column provides a better fit, however it drastically trades off precision in the estimated parameters, crucially so for the negotiated prices which play a central role in our structural estimation. Finally, table A.3 shows the estimated resource intensity weights [54] and figure A.3 shows the prediction fit averaged over insurer-hospital-year.

A.3 Construction of Insurance Plans Choice Sets

The construction of the plan demand estimation panel builds upon the hospital demand panel and the associated estimates. The main issue this code has to tackle is the overwhelming computation cost of calculating network expected utilities for each consumer and their dependents for each plan in each year, i.e computing equation (15). The algorithm proceeds as follows:

1. Load the hospital demand panel and filter the columns relevant for either equation (15) or (16). Split income into deciles to create a large yet finite number of consumer types. Consumer types will determine groups that share the same expected utility of networks as they agree over all hospital and plan utility dimensions.

2. Load the payer and dependent panels for the year 2013-2017. Merge and reduce to the consumers that belong to plans for which we have sufficient information to compute conditional hospital demands. This is the same filter applied in the hospital demand panel formation.

3. Define plan demand markets as combinations of year, gender, age group and whether the consumer has dependents. Split plans into independent plans over markets and compute their market share. For each insurer-market keep the 5 plans with the largest market shares. Expand the consumer and dependent data such that each individual now has all options available in his market.

4. Operating in batches of consumers, add for each plan all available hospitals. Expand to include all diagnoses. Using the estimated medical risk, resource intensity weights and negotiated price, compute equation (15) for all possible combinations of consumer-plan-hospital-diagnosis. Collapse over payer-plans (i.e, sum dependents expected utility if necessary) and update consumers that share the same utility type as the ones just computed to reduce computation time.

5. Finally, for each market restrict the choice set of consumer to only include their current plan and plans currently being commercialized. This removes less than 2% of alternatives and leaves no consumer with less than 5 alternatives.

[54] We do not include the disaggregated estimated negotiated price for confidentiality reasons.

B Details about Health Insurance in Chile

B.1 How do Public and Private Sectors Interact?

The public and private health systems seem to operate in practice in a remarkably isolated fashion. For instance, most of the consumers that purchase insurance in the private sector are also provided health care services mostly by private sector hospitals. A substantial 97% of all payments by private insurers are collected by private hospitals, while only 3% are collected by public hospitals (Galetovic and Sanhueza, 2013). Research on sorting across sectors points towards the remarkable differences in premium structures across sectors as the most relevant determinant of consumers' choice between public and private insurance (Pardo and Schott, 2012, 2013).

In terms of the evolution of their market shares, Figure A.8 shows that through the period of study there has been a slight increase in the market share of public insurance, from 66% to 76%, while the market share of private insurers has remained almost unchanged at around 18%. The increase in the public insurance market share originates mostly from a reduction in the share of consumers with either no insurance or other forms of insurance. An interesting margin of study in this market is that of switching across the private and public sector. Data availability only allows for looking at switching out of the private sector. Duarte (2011) provides preliminary evidence showing that (i) the amount of switching across sectors is low, and that (ii) the public sector operates as a safety net, as one of the major determinants of a consumer's decision to switch is job loss.

There are some aspects that are worth studying in further detail in term of the relationship between these two sectors. First, there are some remarkable differences and interactions in terms of regulation. Second, additional policies and regulations have been enacted during the period of study of this paper.

Constraints on plan design. Private insurers are mandated to offer coverage caps that are at least as large as those offered by the public insurer, FONASA. Therefore, private insurers' coverage caps are updated annually following the the public insurer updates, which are implemented every April. Presumably, private insurers optimally adjust premiums as well as a response to this change in coverage caps induced by the public insurer.

Differences in risk pricing. A notable feature that distinguishes the public and private system in this market is the differential ability of the latter to implement risk pricing or risk selection. As mentioned above, FONASA's only distinction across consumers is based on income and, to a second order, family size. However, they do not offer different plans across other dimensions. On the other side, while regulation limits the extent of risk pricing by private insurers, they can still price differently across age and gender. Moreover, private insurers are able to reject applications from consumers based on pre-existing conditions. Finally, the large number of plans available in the market suggest that such variety could be a vehicle through which private insurers implement some form of risk pricing. The result of these differences is cream skimming: the concentration of risky consumers is lower in the private than in the public sector.

***Ley Larga* de Isapres.** Through law 20,015, enacted in May, 2005, the government introduced a number of regulations to the private insurance sector. The focus of these was to reduce the extent for risk pricing by private insurers. Two relevant constraints on pricing that were introduced by this law were already described above: (i) the number of risk-rating functions (i.e. f in section 2.1) was limited to 2 per insurer, and (ii) the extent to which premiums could be adjusted through time was limited to 1.3 of the average premium change, to reduce the extent for risk reclassification. Additionally, this law arguably increased the cost of vertical integration. This, as it explicitly established that insurers are not allowed to participate in the provision of health care services. This is the reason why vertical integration in this market is organized through common ownership of insurers and hospitals by *holdings*, rather than through direct ownership of hospitals by insurers.

AUGE-GES plan. Through law 19,966, enacted in September, 2004, the government made mandatory the coverage of a list of health conditions dictated by the Ministry of Health. This regulation implied that since June, 2005, both public and private insurers are required to provide adequate treatment and insurance for consumers under conditions included in the list. The four elements considered by the law were (i) *access* to adequate treatment, (ii) certification of the *quality* of treatment by hospitals, (iii) *financial protection* of consumers through the imposition of thresholds below which there is a 20% coinsurance rate and beyond which such rate is set to 0%, and (iv) *opportunity*, by imposing maximum wait times for consumers to be treated by the system. The list started by including 25 conditions since July, 2005, and then was extended to 40 and 56 by July, 2006 and July, 2007 respectively.

B.2 Structure of Private Insurance Plans

Private insurers are allowed to engage in risk selection by rejecting applications based on pre-existing medical conditions. In contrast, the public insurer cannot deny coverage, which has led to a relative concentration of risky consumers in the public sector. However, in the private sector there is guaranteed renewability, by which contracts are automatically renewed for current enrollees under the original agreement terms, regardless of changes in health status.

Contracts offered in the private sector are regulated and are composed of the following elements. First, they have a monthly premium P which is a combination of a base price P_B and a risk-rating factor f, so that $P = P_B \times f$, where f is a gender-specific step function of age. Second, insurers choose a base price for each plan, which can be adjusted yearly.[55] Third, each plan has separate coinsurance rates for inpatient and outpatient care. Coinsurance rates are constant across claims for the same service. Fourth, plans may specify a coverage cap for each service, which is equivalent to having the coinsurance rate becoming one beyond that expenditure level. This maximum payment is constant across claims for the same service.[56]

Payments from insurers to hospitals operate in a fee-for-service system. Copayments that policyholders pay for a given service are a function of plan attributes as follows:

$$\text{copayment} = \text{price} - \min\{\text{price} \times (1 - \text{coinsurance}), \text{cap}\}$$

such that the marginal price increases after the coverage cap is reached.

Regarding hospital networks, plans offer either unrestricted open networks or tiered networks.[57] Unrestricted network plans provide the same coverage for all hospitals. Tiered networks offer differentiated coverage across different sets of private hospitals, similar to PPO plans in the U.S.. Hospitals cannot deny health care to patients, and thus all consumers have access to all hospitals, although they may have zero coverage from their plan. Overall, private insurers provide better coverage in private hospitals, which are generally perceived as being of higher quality than public hospitals in terms of waiting time, medical resources, and medical outcomes.

C Model Appendix

C.1 GMM Estimation Algorithm

The GMM estimation algorithm builds upon equation (17). The general procedure of the estimation was described in section 4.4. In this Appendix, we provide additional details regarding our implementation.

We start by describing the structure of the estimation algorithm, which comprises the following iterative steps:

[55] Risk-based pricing is allowed in the private market but regulated since 2005. First, base-prices are chosen at the plan and not the individual level. Second, each insurer may use only two f functions. Third, the increase in a plan price cannot be higher than 1.3 times the average increase in plan base prices across all plans offered by an insurer. However, plan proliferation is evident from the data, as around 40% of insurance plans in the market serve only one consumer, and the average number of consumers per plan is 28 (Atal, 2015). This proliferation suggests that insurers possibly implement some form risk pricing through that mechanism.

[56] Although private plans may impose coverage caps for some services, in our application we use the ex-post empirical coverage for each claim, and thus, our results are robust to the face value of these caps.

[57] Few plans offer restricted networks, similar to HMO plans in the U.S. They are rarely observed in the data and not offered publicly. We do not consider them in our analysis.

$t = 0$ - Initialize variables and load data

$t \geq 1$ - Recover a guess of bargaining weights from a non-linear solver

- t_1 - Compute the GMM objective function
  - $t_1^{'}$ - Evaluate $\boldsymbol{c}' = C(\boldsymbol{\phi}^*(\boldsymbol{c}), \lambda)$
    - $t_1^{''}$ - Evaluate $\boldsymbol{\phi}' = \Phi^*(\boldsymbol{\phi}, \boldsymbol{p}, \boldsymbol{c})$
    - $t_2^{''}$ - If $||\boldsymbol{\phi}' - \boldsymbol{\phi}||_2 \leq \epsilon_\phi$ break loop, otherwise set $\boldsymbol{\phi} = \boldsymbol{\phi}'$ and return to $t_1^{''}$
  - t_2' - If $||\boldsymbol{c}' - \boldsymbol{c}||_2 \leq \epsilon_c$ break loop, otherwise set $\boldsymbol{c} = \boldsymbol{c}'$ and return to t_1'.
- t_2 - Assess if the change in the GMM objective function is below tolerance. If so break the loop, otherwise update solver and return to t_1 with $t = t + 1$.

There are two important implementation details that are worth mentioning. First, this code needs to recurrently access multiple data sets to compute the different steps. Furthermore, often datasets need to be accessed in different orders or specific values need to be found. For example, the bargaining first order conditions requires computing the derivative of premiums with respect to negotiated prices, this implies iterating over premiums and looking up whether they belong to integrated insurer and if so to which hospital system. As our code builds upon nested fixed points which need to be evaluated often tens of thousand of times, these operations need to be extremely fast. To tackle this problem we rely heavily on pointer-based operations and hash-table lookups. For this purpose, we code our GMM in C and use highly optimized linear algebra routines whenever available.

Second, our implementation of the equilibrium premium is substantially more detailed than the illustrative FOC of equation (12). To present the exact premium formula we need to further extend our notation.

Let I denote the set of markets and define $\mathcal{J}_m^i$ the set of plans insurer m offers in some market $i \in I$.[58] Also, denote $\mathcal{J}^i$ the complete set of plans offered in market i, i.e $\mathcal{J}^i = \cup_{m \in M} \mathcal{J}_m^i$. Furthermore, $\sigma_{j|k}^M(\boldsymbol{\phi}, \boldsymbol{p})$ denotes the share of plan j if plan k were removed from the market, keeping all else constant. As we assume that insurers optimize at a mean consumer level in each market, we can identify each plan with its relevant consumer. Denote α_j^M the mean premium sensitivity of consumers in the market in which plan j is offered. Furthermore, we denote $\delta_k^M = \alpha_f^M \phi_{fk} + \beta_f \sum_{i \in f} EU_{ik}^H + \delta_{m(k)\kappa(f)}^M$ for the mean consumer f of plan k.

Using this, it can be shown that the equilibrium premium of a plan j being offered in market i by insurer m can be written as:

$$\phi_j^* = \pi_{m|j}^M + \mathbb{1}\{m \in \mathcal{V}\} \tilde{\pi}_{s(m)|j,i}^H + c_j^M - \frac{1}{\alpha_j^M}(1 + W(\tilde{\lambda}_j)) \tag{21}$$

[58]In this appendix, we suppress the time subscript t for simplicity.

where $\Bbbk\{m \in \mathcal{V}\}$ indicates if insurer m is vertically integrated with some system $s(m)$ and c_j^M is the expected cost of plan j. $\pi^M_{m|j}$ corresponds to the profit of insurer m if it were to remove plan j from the market:

$$\pi^M_{m|j} = \sum_{r \in \mathcal{J}_m} \sigma^M_{r|j}(\phi_r - c^M_r)$$

Moreover, $W(\cdot)$ in equation (21) is the Lambert W function and $\tilde{\lambda}_j$ is:

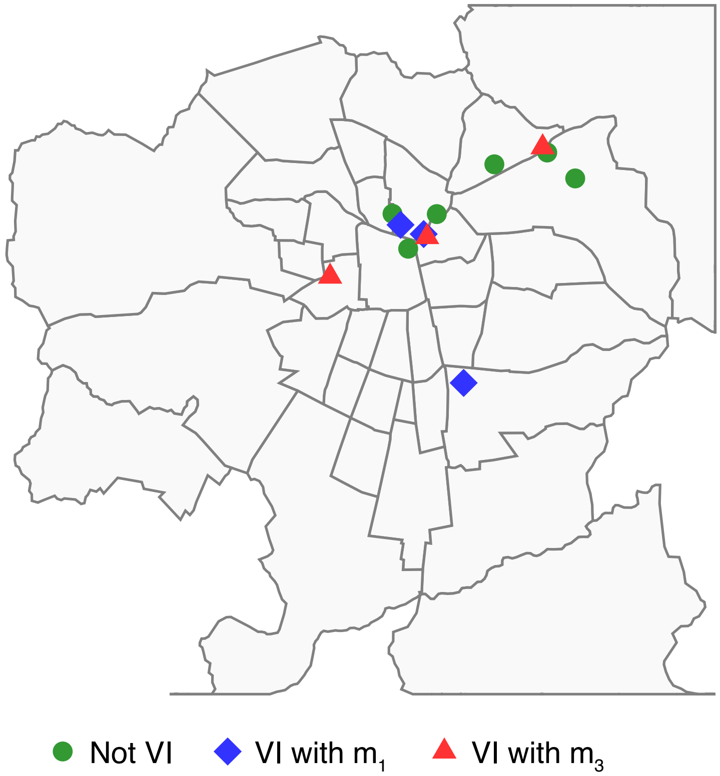
$$\bar{\lambda}_j = \frac{\exp(\alpha^M_j \pi^M_{m|j} + \alpha^M_j c_j - 1 + \delta^M_j - \alpha^M_j \phi_j + \Bbbk\{m \in \mathcal{V}\}\alpha^M_j \tilde{\pi}^H_{s(m)|j,i})}{\sum_{k \in \mathcal{J}^i \setminus \{j\}} \exp(\delta^M_k)}$$

Finally, the vertical integration effect is given by:

$$\tilde{\pi}^H_{s(m)|j,i} = \sum_{l \in M} \sum_{h \in H_s} \left(\sum_{k \in \mathcal{J}^i_l} \sigma^M_{k|j} \sum_{d \in D} \gamma_{di} \omega_{di} \sigma^H(ikh|d) \right) (p_{lh} - c^H_{lh}) - \sum_{h \in H_s} \sum_{d \in D} \gamma_{di} \omega_{di} \sigma^H_{ijh|d}(p_{hj} - c^H_{hj})$$

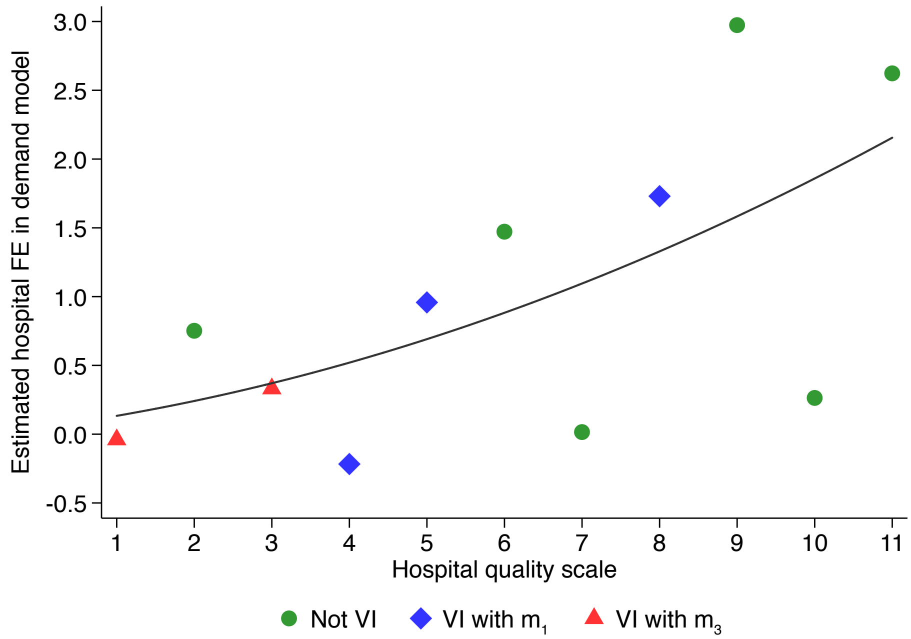
The benefit of the reformulation presented in equation (21) is that ϕ_j only appears on the left hand side. This helps the convergence of the fixed point equation and allows easier computation of the derivatives of premiums with respect to other premiums and prices.

Figure A.1: Location of Hospitals in the Market



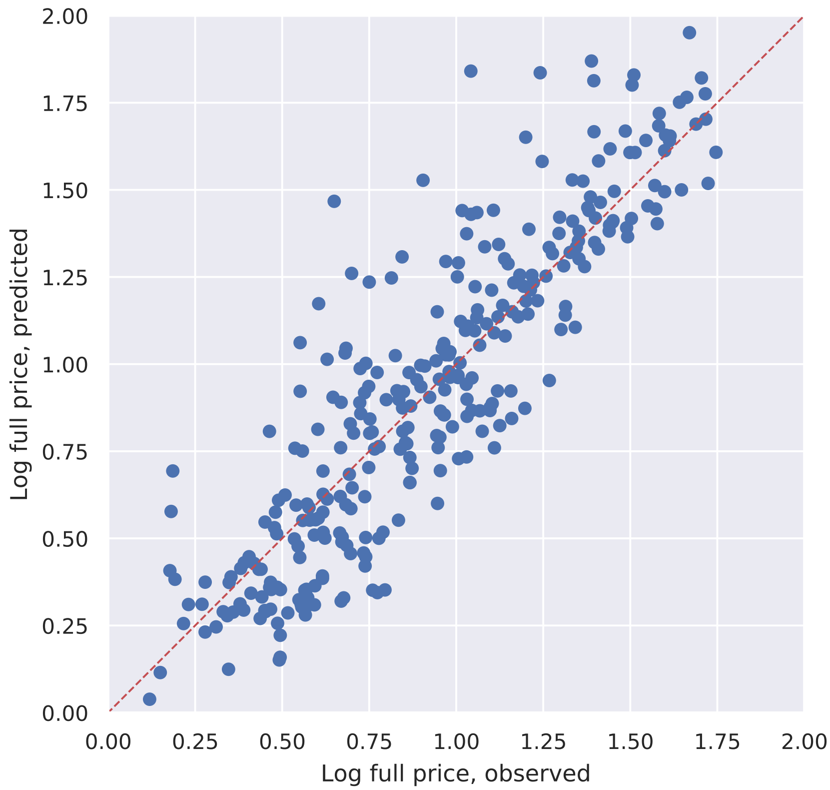
Notes: This figure shows the location of hospitals in the market. The map covers most of urban Santiago, out market of interest. Green circles indicate independent hospitals, blue diamonds indicate hospitals that are vertically integrated with insurer m_1, and red triangles indicate hospitals vertically integrated with insurer m_3.

Figure A.2: Unobserved preferences for hospitals and observable hospital attributes



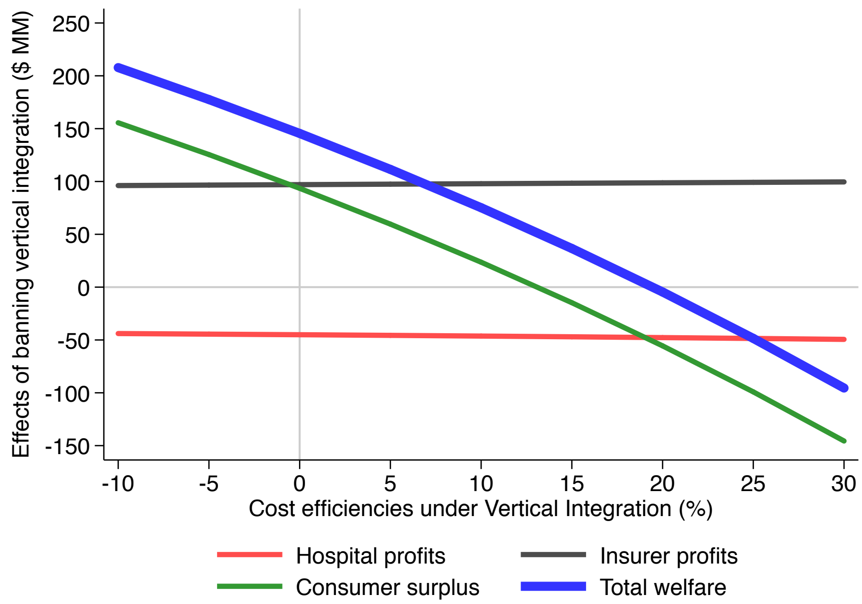
Notes: This figure shows the relationship between estimated hospital fixed effects in Column (2) of Table 5 and an objective measure of quality, which comes from the position of the hospital in the Webometrics Ranking of World Hospitals developed by Cybermetrics Lab (Cybermetrics Lab, 2016). h_3 is not considered in the ranking, and therefore not included in the figure. Green circles indicate independent hospitals, blue diamonds indicate hospitals that are vertically integrated with insurer m_1, and red triangles indicate hospitals vertically integrated with insurer m_3. The black line is a quadratic fit for the relationship between both variables.

Figure A.3: Observed and Predicted Hospital Prices

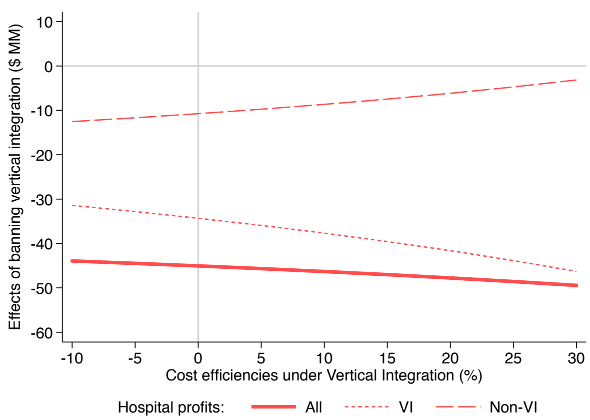


Notes: This figure shows the comparison between predicted and observed mean prices for each combination of insurer-hospital-year. Recall that predicted prices are constructed using estimates from equation (13).

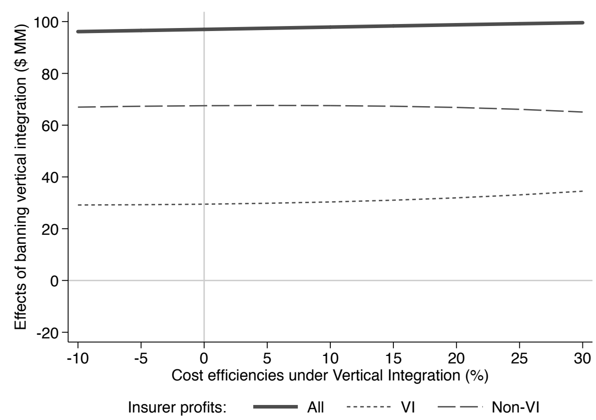
Figure A.4: Welfare Effects of Banning Vertical Integration for Shared Cost Efficiencies: Chilean Market



(a) Aggregate effects



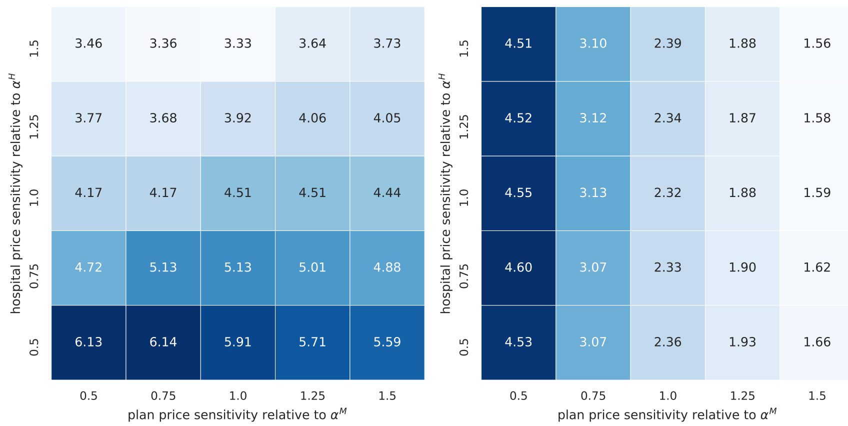
(b) Effects on hospitals, by vertical integration



(c) Effects on insurers, by vertical integration

Notes: This figure shows the effect of banning vertical integration on equilibrium welfare outcomes for different levels of cost efficiencies, for the Chilean market. In this case, vertical integration efficiency reduce the cost for all insurers at integrated hospitals. Panel (a) displays aggregate effects, Panels (b) and (c) respectively decompose effects on hospitals and insurers profits by vertical integration at baseline. The x-axis in each graph measure cost efficiencies induced by vertical integration on integrated hospitals for all insurers. Blue lines show overall welfare effects, green lines show effects on consumer surplus, red lines show effects on hospital profits, and black lines show effects on insurer profits.

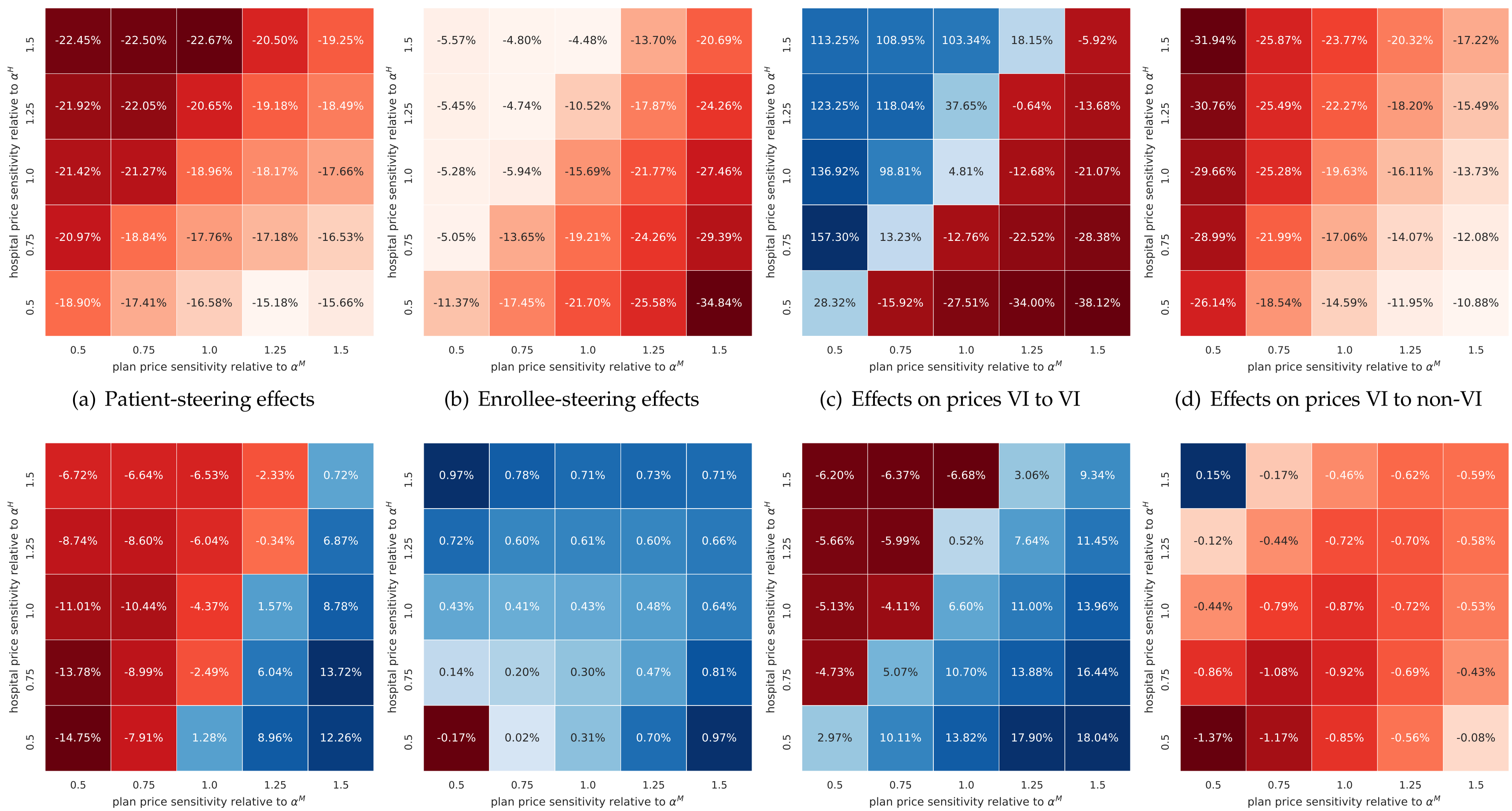
Figure A.5: The Role of Price Sensitivity for the Effects of Banning Vertical Integration: Baseline Prices



(a) Baseline hospital prices (b) Baseline plan premiums

Notes: This figure shows simulated baseline hospital prices and plan premiums under the baseline market structure for a grid of consumer price sensitivity. For each plot, we show results for a 5×5 grid of hospital and plan demand sensitivity defined by $(\tau^M \times \alpha_i^M, \tau^H \times \alpha_f^H)$ for $\tau = \{0.5, 0.75, 1, 1.25, 1.5\}$. Darker blue indicates a higher price or premium respectively.

Figure A.6: The Role of Price Sensitivity for the Effects of Banning Vertical Integration with 20% Cost Efficiency: Outcomes



(a) Patient-steering effects

(b) Enrollee-steering effects

(c) Effects on prices VI to VI

(d) Effects on prices VI to non-VI

(e) Effects on prices non-VI to VI

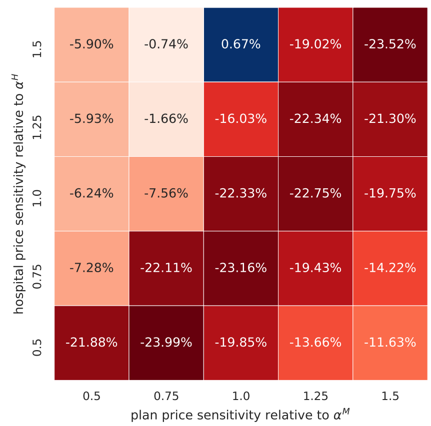
(f) Effects on prices non-VI to non-VI

(g) Effects on VI plan premiums

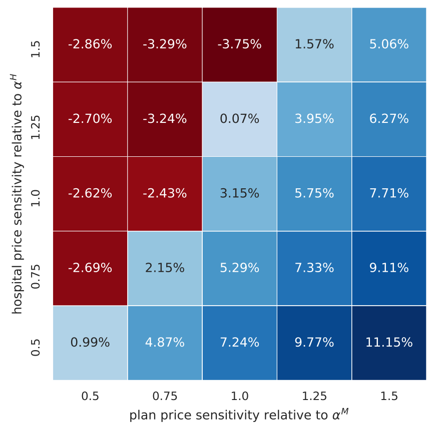
(h) Effects on non-VI plan premiums

Notes: This figure shows the effect of banning vertical integration on a variety of outcomes for a grid of consumer price sensitivity. For each plot, we show results for a 5×5 grid of hospital and plan demand sensitivity defined by $(\tau^M \times \alpha_i^M, \tau^H \times \alpha_f^H)$ for $\tau = \{0.5, 0.75, 1, 1.25, 1.5\}$. Panels (a) and (b) quantify patient- and enrollee-steering effects respectively in the baseline scenario, as described in Section 4.5. Panels (c) through (f) display the effect of banning vertical integration on quantity-weighted average hospital prices from a VI/non-VI hospital to a VI/non-VI insurer, and panels (g) and (h) display plan premiums for VI/non-VI insurers. For each such figure, blue (red) indicates increases (decreases) in the outcome, and the intensity of the color indicates the relative magnitude of the change. This simulation is done assuming a 20% cost efficiency within integrated firms.

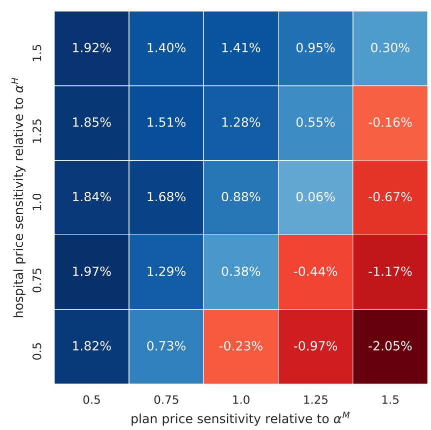
Figure A.7: The Role of Price Sensitivity for the Effects of Banning Vertical Integration with 20% Cost Efficiency: Welfare Effects



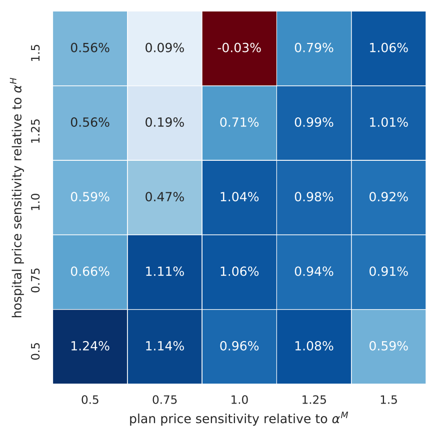
(a) Effects on hospital profits



(b) Effects on insurer profits



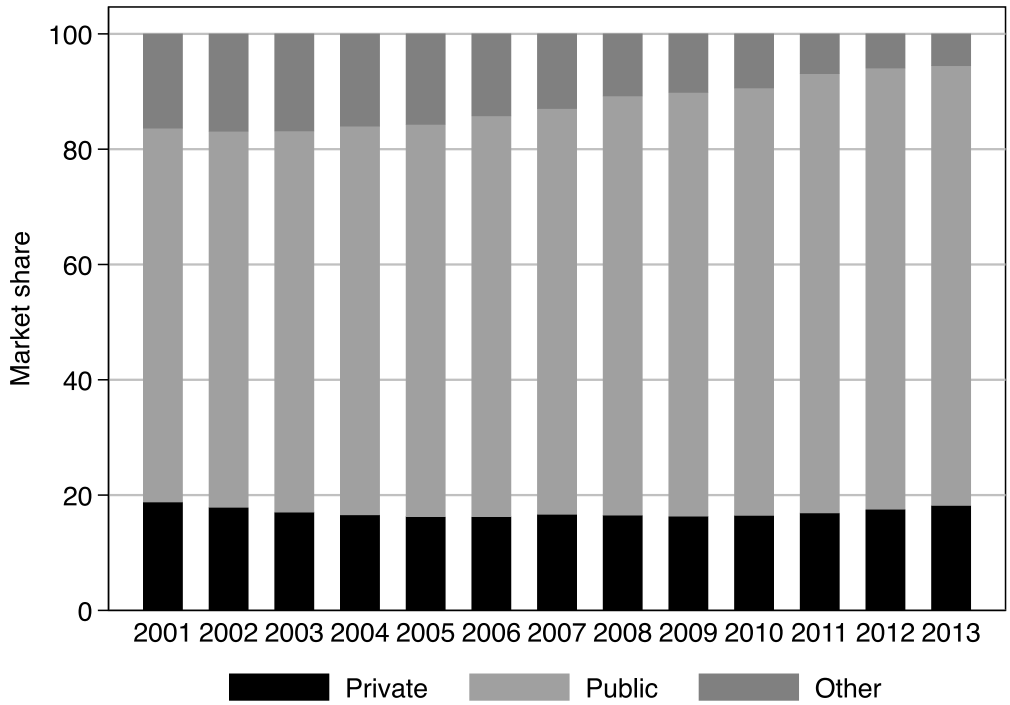
(c) Effects on consumer surplus



(d) Effects on total welfare

Notes: This figure shows the effect of banning vertical integration on a variety of outcomes for a grid of consumer price sensitivity. For each plot, we show results for a 5×5 grid of hospital and plan demand sensitivity defined by $(\tau^M \times \alpha_i^M, \tau^H \times \alpha_f^H)$ for $\tau = \{0.5, 0.75, 1, 1.25, 1.5\}$. Panels (a) through (d) display the effect of banning vertical integration on a variety of equilibrium outcomes, measure as a percentage change relative to the baseline level. The outcomes are hospital and insurer profits, consumer surplus and overall welfare. For each such figure, blue (red) indicates increases (decreases) in the outcome, and the intensity of the color indicates the relative magnitude of the change. This simulation is done assuming a 20% cost efficiency within integrated firms.

Figure A.8: Insurance market shares in across sectors



Notes: This figure displays the evolution of market shares of different types of insurance in Chile.

Table A.1: Reduced Form Estimates of Vertical Integration on Payments, Alternative Specification

	(1)	(2)	(3)	(4)	(5)
	Panel A - OLS estimates on Total bill				
Vertically integrated	-0.313***	-0.035	-0.002	-0.073***	-0.080***
	(0.107)	(0.028)	(0.022)	(0.020)	(0.019)
Observations	545,718	545,718	545,718	545,718	545,716
R-squared	0.026	0.120	0.398	0.402	0.419
	Panel B - OLS estimates on Patient copayment				
Vertically integrated	-0.368***	-0.100***	-0.091**	-0.214***	-0.217***
	(0.098)	(0.034)	(0.035)	(0.031)	(0.030)
Observations	545,718	545,718	545,718	545,718	545,716
R-squared	0.041	0.177	0.302	0.418	0.431
	Panel C - OLS estimates on Insurer coverage				
Vertically integrated	-0.160*	0.021	0.051***	0.051**	0.045*
	(0.082)	(0.024)	(0.016)	(0.023)	(0.023)
Observations	545,718	545,718	545,718	545,718	545,716
R-squared	0.008	0.057	0.311	0.362	0.375
Hospital FEs	N	Y	Y	Y	Y
Diagnosis FEs	N	N	Y	Y	Y
Diagnosis public prices	N	N	Y	Y	Y
Insurer controls	N	N	N	Y	Y
Patient controls	N	N	N	N	Y

Notes: This table shows results from estimating equation (1) using the inverse hyperbolic sine transformation ($\log(y + \sqrt{y^2 + 1})$) of total bill (Panel A), patient copayment (Panel B), and insurer coverage (Panel C) as dependent variables. Each column includes a different set of control variables. Diagnosis fixed effects are based on ICD10 chapters, and diagnosis public system prices are the prices of the same admissions in public hospitals. Insurer controls include insurer fixed effect, plan premium, coinsurance rate for inpatient and outpatient admissions, and dummies for whether the plan has a coverage cap and a preferential hospital. Patient controls include gender, age, income, number of dependents, an indicator for independent worker and fixed effects by county of residence. The sample considers the admissions in the 12 main private hospitals. Standard errors in parentheses are clustered by insurer-hospital combination. P-values notation: *** p<0.01, ** p<0.05, * p<0.1.

Table A.2: Price prediction error distribution

	(1)	(2)	(3)	(4)
Statistic	First stage	Second stage		
Min	-13.856	-14.374	-14.373	-14.540
Median	0.037	0.093	0.082	0.070
Mean	0.000	0.000	-0.000	0.000
Max	6.784	6.057	6.346	6.529
MSE	0.872	1.215	1.131	1.098
Diagnosis FE	-	N	Y	N
Diagnosis-age-gender FE	-	N	N	Y

Notes: This table displays the distribution of the in-sample prediction error of our negotiated price estimation routine. Column (1) shows the prediction of our method using public system prices, which is used to estimate negotiated prices. Column (2) is the our final estimate, which recovers the resource intensity weights. Columns (3) and (4) show results using fixed effects for diagnosis and for diagnosis-age-gender interactions, respectively. The error is defined as observed minus predicted.

Table A.3: Diagnosis cost intensity weights by demographic group, in logs

	Panel A: Females				Panel B: Males			
	0-25	26-45	46-60	60+	0-25	26-45	46-60	60+
Diagnosis								
I - Infections and parasites	0.467	0.466	0.480	0.472	0.466	0.508	0.498	0.505
	[0.45, 0.48]	[0.44, 0.49]	[0.45, 0.51]	[0.44, 0.51]	[0.45, 0.48]	[0.49, 0.53]	[0.47, 0.53]	[0.47, 0.54]
II - Neoplasms	0.597	0.599	0.605	0.550	0.548	0.562	0.552	0.553
	[0.59, 0.61]	[0.59, 0.60]	[0.60, 0.61]	[0.55, 0.55]	[0.54, 0.55]	[0.56, 0.57]	[0.55, 0.56]	[0.55, 0.56]
III - Blood diseases	0.373	0.374	0.371	0.403	0.478	0.392	0.459	0.580
	[0.33, 0.42]	[0.31, 0.45]	[0.32, 0.43]	[0.32, 0.50]	[0.40, 0.57]	[0.30, 0.52]	[0.31, 0.68]	[0.45, 0.74]
IV - Endocrine	0.662	0.813	0.786	0.692	0.563	0.670	0.648	0.549
	[0.64, 0.69]	[0.80, 0.83]	[0.77, 0.81]	[0.66, 0.73]	[0.54, 0.58]	[0.66, 0.68]	[0.63, 0.67]	[0.52, 0.58]
VI - Nervous system	0.516	0.535	0.599	0.572	0.543	0.512	0.519	0.531
	[0.50, 0.53]	[0.52, 0.55]	[0.58, 0.61]	[0.55, 0.59]	[0.53, 0.56]	[0.50, 0.52]	[0.51, 0.53]	[0.51, 0.55]
VII - Ocular diseases	0.818	0.844	0.889	0.935	0.858	0.851	0.887	0.932
	[0.79, 0.84]	[0.83, 0.86]	[0.87, 0.91]	[0.92, 0.95]	[0.83, 0.88]	[0.84, 0.86]	[0.87, 0.91]	[0.91, 0.95]
VIII - Ear diseases	0.783	0.692	0.687	0.609	0.794	0.778	0.814	0.607
	[0.71, 0.86]	[0.61, 0.79]	[0.61, 0.78]	[0.51, 0.73]	[0.74, 0.86]	[0.68, 0.90]	[0.71, 0.94]	[0.49, 0.76]
IX - Circulatory	0.573	0.709	0.726	0.690	0.619	0.683	0.682	0.709
	[0.55, 0.59]	[0.70, 0.72]	[0.71, 0.74]	[0.68, 0.70]	[0.60, 0.64]	[0.67, 0.69]	[0.67, 0.69]	[0.70, 0.72]
X - Respiratory	0.606	0.655	0.595	0.520	0.599	0.714	0.649	0.534
	[0.60, 0.61]	[0.64, 0.66]	[0.58, 0.61]	[0.51, 0.53]	[0.59, 0.60]	[0.70, 0.72]	[0.63, 0.66]	[0.52, 0.55]
XI - Digestive	0.629	0.647	0.643	0.622	0.663	0.660	0.652	0.639
	[0.62, 0.64]	[0.64, 0.65]	[0.64, 0.65]	[0.61, 0.63]	[0.66, 0.67]	[0.66, 0.67]	[0.65, 0.66]	[0.63, 0.65]
XII - Skin diseases	0.595	0.575	0.569	0.523	0.580	0.598	0.531	0.537
	[0.56, 0.63]	[0.55, 0.61]	[0.53, 0.61]	[0.48, 0.56]	[0.55, 0.61]	[0.57, 0.63]	[0.50, 0.57]	[0.49, 0.58]
XIII - Musculoskeletal	0.764	0.679	0.751	0.778	0.782	0.768	0.768	0.823
	[0.75, 0.78]	[0.67, 0.69]	[0.74, 0.76]	[0.77, 0.79]	[0.77, 0.80]	[0.76, 0.78]	[0.76, 0.78]	[0.81, 0.84]
XIV - Genitourinary	0.609	0.701	0.749	0.698	0.693	0.765	0.778	0.817
	[0.60, 0.62]	[0.69, 0.71]	[0.74, 0.76]	[0.68, 0.71]	[0.69, 0.70]	[0.76, 0.77]	[0.77, 0.79]	[0.80, 0.83]
XV - Pregnancy	0.587	0.778	0.608	0.532	0.420	0.576	0.544	0.410
	[0.58, 0.59]	[0.77, 0.78]	[0.59, 0.63]	[0.50, 0.56]	[0.41, 0.43]	[0.57, 0.58]	[0.52, 0.57]	[0.38, 0.45]
XVI - Perninatal	0.404	0.293	0.304	0.154	0.407	0.376	0.393	0.330
	[0.39, 0.41]	[0.26, 0.33]	[0.19, 0.48]	[0.05, 0.51]	[0.40, 0.42]	[0.23, 0.61]	[0.26, 0.59]	[0.23, 0.47]
XVII - Congenital malformation	0.860	0.799	0.839	0.775	0.918	0.772	0.689	0.743
	[0.82, 0.90]	[0.75, 0.85]	[0.77, 0.92]	[0.68, 0.88]	[0.89, 0.95]	[0.72, 0.83]	[0.63, 0.76]	[0.65, 0.85]

Notes: This table displays diagnosis cost intensity weights by gender and age group. These cost weights are used for constructing hospital prices. Number in braces correspond to 90% confidence intervals, estimate via 100 bootstrap draws.

Table A.4: Diagnosis probabilities by demographic group

Diagnosis	Age group													
	0-2	3-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61+
Panel A: Females														
I - Infections and parasites	0.009	0.004	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002
II - Neoplasms	0.004	0.005	0.004	0.004	0.005	0.004	0.006	0.009	0.014	0.021	0.029	0.034	0.041	0.058
III - Blood diseases	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
IV - Endocrine	0.002	0.000	0.000	0.001	0.002	0.002	0.003	0.004	0.005	0.004	0.004	0.004	0.004	0.003
VI - Nervous system	0.003	0.001	0.001	0.001	0.002	0.001	0.002	0.002	0.003	0.003	0.004	0.005	0.006	0.006
VII - Ocular diseases	0.001	0.001	0.001	0.001	0.002	0.005	0.008	0.009	0.007	0.005	0.007	0.010	0.014	0.025
VIII - Ear diseases	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
IX - Circulatory	0.002	0.001	0.000	0.000	0.001	0.001	0.002	0.003	0.003	0.004	0.005	0.007	0.009	0.019
X - Respiratory	0.037	0.032	0.013	0.005	0.007	0.004	0.004	0.004	0.003	0.003	0.003	0.003	0.004	0.010
XI - Digestive	0.012	0.007	0.006	0.008	0.010	0.008	0.010	0.012	0.012	0.011	0.012	0.015	0.018	0.023
XII - Skin diseases	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002
XIII - Musculoskeletal	0.001	0.001	0.001	0.003	0.004	0.003	0.003	0.005	0.006	0.008	0.010	0.014	0.018	0.022
XIV - Genitourinary	0.006	0.003	0.002	0.001	0.004	0.004	0.005	0.009	0.011	0.012	0.011	0.010	0.010	0.014
XV - Pregnancy	0.030	0.000	0.000	0.000	0.009	0.018	0.044	0.078	0.056	0.016	0.002	0.001	0.001	0.001
XVI - Perinatal	0.052	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
XVII - Congenital malformation	0.006	0.002	0.001	0.001	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001
Panel B: Males														
I - Infections and parasites	0.010	0.005	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.005
II - Neoplasms	0.004	0.006	0.005	0.004	0.006	0.007	0.008	0.011	0.013	0.018	0.026	0.037	0.064	0.134
III - Blood diseases	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.002
IV - Endocrine	0.003	0.000	0.000	0.000	0.001	0.001	0.002	0.003	0.004	0.005	0.005	0.005	0.005	0.006
VI - Nervous system	0.003	0.002	0.002	0.001	0.002	0.002	0.003	0.006	0.008	0.009	0.012	0.014	0.014	0.015
VII - Ocular diseases	0.001	0.001	0.001	0.001	0.002	0.009	0.016	0.019	0.016	0.013	0.014	0.016	0.018	0.037
VIII - Ear diseases	0.001	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
IX - Circulatory	0.002	0.001	0.001	0.001	0.002	0.003	0.003	0.005	0.006	0.010	0.015	0.022	0.029	0.060
X - Respiratory	0.046	0.039	0.016	0.005	0.007	0.007	0.007	0.008	0.008	0.007	0.007	0.008	0.009	0.022
XI - Digestive	0.016	0.009	0.008	0.009	0.010	0.012	0.014	0.018	0.022	0.025	0.030	0.035	0.040	0.059
XII - Skin diseases	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004
XIII - Musculoskeletal	0.001	0.002	0.001	0.002	0.006	0.008	0.010	0.014	0.018	0.021	0.024	0.026	0.027	0.029
XIV - Genitourinary	0.011	0.020	0.011	0.005	0.006	0.006	0.008	0.009	0.012	0.015	0.017	0.018	0.024	0.043
XV - Pregnancy	0.033	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.001	0.001
XVI - Perinatal	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
XVII - Congenital malformation	0.009	0.004	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002

Notes: This table displays diagnosis probabilities by gender and age group. These probabilities are used for calculating the expected utility from health care services from insurance plans.

Table A.5: Financial Data on Aggregated Revenues and Costs for Hospitals and Insurers (2013-2016)

	(1)	(2)	(3)	(4)
	Revenues	Direct Costs	Profits (1)-(2)	Mark-up Rate [(1)-(2)]/(1)
Panel A - Hospitals				
h_2	249	187	61	25%
h_3	310	252	58	19%
h_4	744	593	151	20%
h_5	726	507	220	30%
h_6	1,106	875	232	21%
h_7	1,113	819	294	26%
h_8	236	183	53	23%
h_{11}	316	240	76	24%
Holding 1	2,174	1,652	522	24%
Holding 2	795	622	173	22%
Total Hospital Industry	4,802	3,656	1,146	24%
	Revenues	Direct Costs	Profits (1)-(2)	Mark-up Rate [(1)-(2)]/(1)
Panel B - Insurers				
m_1	2,531	2,218	313	12%
m_2	2,427	2,124	303	12%
m_3	2,161	1,865	296	14%
m_4	2,765	2,412	353	13%
m_5	871	770	101	12%
m_6	774	665	109	14%
Holding 1	3,305	2,883	422	13%
Holding 2	2,161	1,865	296	14%
Total Insurance Industry	11,528	10,054	1,474	13%

Notes: Panel A is based on the Annual Financial Report of each hospital for years 2013-2016. Public financial data are unavailable for the following unintegrated hospitals: h_1, h_9, h_{10}, and h_{12}. Holding 1 includes h_7, h_4 and h_{11} (data on h_{11} unavailable for 2013). Holding 2 includes h_2, h_3, and h_8. Panel B is based on the Annual Financial Report of each insurer for years 2013-2016. Data on m_5 unavailable for 2015-2016. Amounts expressed in millions of dollars, using the exchange rate of Dec 31, 2014. Direct costs do not consider investments or financial costs.

Table A.6: First Stage of GMM Instruments as Predictor of Negotiated Prices

	(1)	(2)	(3)	(4)	(5)	(6)
	$\hat{\beta}$	S.E.	z	$P > \|z\|$	[0.025,0.975]	
WTP hospital	-0.0596	0.051	-1.164	0.244	-0.160	0.041
WTP system	0.0631	0.052	1.207	0.227	-0.039	0.166
WTP rivals	-0.2873	0.058	-4.922	0.000	-0.402	-0.173
WTP system rivals	0.3046	0.060	5.110	0.000	0.188	0.421
Observations	288					
R-squared	0.854					
F-statistic	437.0					

Notes: This table shows the first stage estimates of regressing negotiated prices on our instruments. The four instruments are willingness to pay metrics built using public system prices.