What Do Not-For-Profit Hospitals Maximize? Evidence from California's Seismic Retrofit Mandate [1]

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Abstract

Do not-for-profit hospitals warrant their public subsidy? Does increased competition among hospitals decrease social welfare? To answer these and other questions about the role of not-for-profits in healthcare provision one must first know what exactly not-for-profit hospitals do. While theories of not-for-profit hospital behavior abound, most are general statements of preferences and do not yield empirically testable (differentiable) predictions. To address this shortcoming we use a unified theoretical framework to model three popular theories of not-for profit hospital behavior: (1) "for-profits in disguise," (2) social welfare maximizers and (3) perquisite maximizers. We develop testable implications of a hospital's response to a fixed cost shock under each of these theories. We then examine the effect of a recent un-funded mandate in California that requires hospitals to retrofit or rebuild in order to comply with modern seismic safety standards. Since the majority of hospitals in the State were built between 1940 and 1970, well before a sophisticated understanding of seismic safety, a hospital's compliance cost is plausibly exogenously predetermined by its underlying geologic risk. We present evidence that within counties seismic risk is uncorrelated with a host of hospital characteristics, including ownership type. We show that hospitals with higher seismic risk experience larger increases in the category of spending that should be affected by retrofitting and that hospitals facing higher compliance costs are more likely to shut down, irrespective of ownership type. In contrast, private not-for-profits alone increase their mix of profitable services such as neonatal intensive care days, obstetrics discharges and MRI minutes. Government hospitals respond by decreasing the provision of charity care. As expected, for-profit hospitals do not change their service mix in response to this shock. These results are most consistent with the theory of not-for-profit hospitals as perquisite maximizers and allow us to reject two of the leading theories of not-for-profit hospital behavior - "for-profits in disguise" and "pure altruism." These results also imply that government owned hospitals have welfare as their maximand. More work is needed to determine the overall welfare implications of these different ownership structures.

1 Introduction

About a fifth of all U.S. corporations have not-for-profit status (Philipson and Posner, 2006). Not-for-profits include organizations as diverse as museums, religious institutions, universities, and hospitals. They share tax-exempt status and can raise capital in the form of private (tax-deductible) donations. But, they cannot issue equity or disburse any net revenues to employees or owners. Indeed not-for-profits have no owners but rather are run by self-perpetuating nonprofit boards (Glaeser, 2003). Not-for-profits are common in markets characterized by asymmetric information and, in particular, ones in which the consumer is ill-equipped to judge the quality or quantity of services provided (Hansmann, 1996). One implication is that for-profits may underprovide the quality or quantity of services. Tax subsidies are then justified as a means to counter underprovision by the private market (Hansmann, 1981).

Measuring the value of not-for-profit hospitals has proved challenging. In 2006, the Internal Revenue Service conducted a random audit of roughly 500 not-for-profit hospitals to determine how they provide benefits to the community (IRS, 2007). Although not explicitly stated in the report, at issue was what not-for-profits offer in return for their public subsidy.[1] While not-for-profit hospitals are charged with providing "community benefits" as a condition of the federal tax exemption, we have no widely accepted metric of community benefits. Prior to 1969, the IRS interpreted community benefits as the provision of care for those not able to pay to the best of a hospital's "financial ability." The community benefit standard has been relaxed successively over time. Today a not-for-profit hospital can comply by "promoting the health of any broad class of persons" (CBO, 2006). Providing charity care or operating an emergency room falls into this category but so does offering community health screening or conducting basic research.

Due in part to ambiguity in the community benefit standard, Congress and state and local policymakers have repeatedly questioned the motives of not-for-profit hospitals (Horwitz, 2006; Schlesinger and Gray, 2006).[2] Why, they ask, do not-for-profit hospitals look

[1]Estimates from the Joint Committee on Taxation put the 2002 value of this subsidy, as measured by federal, state and local tax exemptions, at $12.6 billion (CBO, 2006).

[2]Recently, Senator Charles Grassley (R-Iowa) proposed that Congress mandate a minimum level of charity care that not-for-profit hospitals must provide to qualify for federal tax-exempt status. And hospitals

more like money-making than charitable institutions? Literatures in economics, sociology, health policy and legal studies have also struggled to understand what not-for-profit hospitals do and how they contribute to social welfare. While theories of not-for-profit hospitals abound, they typically lay out general motivations or mechanisms without specifying a formal structure, making it difficult to generate empirically testable predictions of most models. Furthermore the interaction of a hospital's budget constraint with any change in incentives means that strong assumptions on the form of the firm's objective function are required to generate testable implications. As described in Pauly (1987), "The presence of profit in the budget constraint means that all the variables which affect profits appear in the comparative statics of [models of not-for-profit behavior]... Since the same variables with the same predicted signs show up in all models, it is obviously impossible to distinguish among them on this basis." Finally, distinguishing among models of not-for-profit behavior is complicated by the fact that hospitals have some choice over ownership status.

In this paper, we explicitly model three of the leading theories of not-for profit hospital behavior. We use a unified theoretical framework to model not-for-profit hospitals as: (1) "for-profits in disguise," (2) social welfare maximizers or (3) "perquisite" maximizers. Based on these models, we generate empirically testable predictions of the response of hospital service provision (level and mix) to a large fixed cost shock. We then examine the response of California's hospitals to a large and plausibly exogenous financial shock – a recent, unfunded mandate (SB1953) that requires hundreds of general acute care hospitals in the State to retrofit or rebuild in order to comply with modern seismic safety standards.

The majority of hospitals in California were built between 1940 and 1970, well before the development of these standards or a sophisticated understanding of seismic safety. Thus, a hospital's cost of compliance is plausibly exogenously predetermined by its underlying geologic risk factors. As support for this claim, we present evidence that within counties seismic risk, a key determinant of the fixed cost shock, is uncorrelated with various neighborhood demographics, such as the share of households living below the poverty line in the ZIP code, or baseline hospital characteristics, such as not-for-profit status. Impor-

in at least one state, Illinois, have been stripped of their tax-exempt status because they were not providing "enough" charity care (Francis, 2007).

tantly, because of the long timeframe of new hospital construction (upwards of ten years), the varying cost of compliance determined by seismic risk represents a shock to a hospital's budget constraint with no change in a hospital's production function. Moreover, in contrast to most previous studies of not-for-profit behavior, our source of variation affects a firm's budget constraint without changing its incentive structure. Consequently, we do not have to deal with contemporaneous changes in a firm's incentives and budget constraint. We can thus generate and test falsifiable predictions of hospital behavior using models that make far fewer assumptions than those typically used to study not-for-profit hospital behavior.

We find that a hospital's seismic risk, as measured by the maximum ground acceleration expected with a 10 percent probability in the next 50 years, strongly predicts the probability of hospital closure post-mandate. This response does not differ by ownership type. We find no relationship between increased exposure to SB1953 and the probability that a not-for-profit hospital converts to for-profit status. Although this first set of results cannot distinguish among our competing hypotheses without the addition of substantial functional form restrictions, they allow us to reject the hypothesis that not-for-profit hospital performance is severely limited by capital constraints.

We then show that hospitals with higher seismic risk spend more on plant, property and equipment between 1997 and 2005. We estimate that a one-standard deviation increase in seismic risk is associated with a $330 million increase in spending on plant, property and equipment over this period. The increase comes largely from improvements in leaseholds, and the purchase of major new equipment. It is concentrated among not-for-profit hospitals, which may reflect differences in the dynamic response to the mandate.

Next we study the impact of seismic risk on changes in resource utilization and service provision. Here we find that a hospital's ownership status (for-profit, private not-for-profit, or government-owned) has very strong and differential effects on its response to the fixed cost shock of SB1953. As predicted by standard theory, for-profit hospitals do not change their service level or mix in response to the fixed-cost shock. In contrast, private not-for-profit hospitals respond by increasing their provision of profitable services (neonatal intensive care, obstetrics care, MRI minutes). In other words, consistent with much of the prior literature (Gruber, 1994; Cutler and Horwitz, 2000; Duggan, 2002; Horwitz and Nichols, 2007), we find that increased competition reduces the difference between private hospitals by forcing not-for-profits to act more like their for-profit peers. Theoretically these results are consistent with the private not-for-profit hospitals as perquisite maximizing firms, and allow us to reject theories of not-for-profit hospitals as either "for-profits in disguise" or purely altruistic entities.

Government-owned hospitals meanwhile respond largely by cutting uncompensated care, as measured by both GAC days and clinic visits for indigent patients. This behavior is most consistent with the predictions of welfare maximizing models of hospital behavior. Given the debate over whether these hospitals are subject to a binding budget constraint, we remain somewhat cautious about the precise nature of the government hospitals' maximand. However, our own results on hospital closure indicate that the financial shock of SB1953 is large enough to exceed the governement's ability to fully shielded its hospitals. This implies that the budget constraint for these hospitals has some bite and lends credence to interpreting their maximand as welfare. But even if welfare is the proper maximand, we cannot draw strong conclusions about the relative welfare provided by government and private profit-maximizing hospitals. As described in Hart et al. (1997), government-owned firms, lacking incentives to reduce costs, may generate welfare losses due to cost-inefficiencies that outweigh the benefits of their altruistic goals.

On net, these results suggest that both ownership (government vs. private) and organizational structure (for-profit vs. not-for-profit) are important factors in determining hospital response to policy changes. Our results imply that the subsidies provided to not-for-profit hospitals allow them to pursue higher "quality" of services at the expense of quantity. Whether this tradeoff leads to an increase in welfare is theoretically ambigious; additional data on outcomes and long term spillovers would be required to make such a determination.[3] Assuming government-owned hospitals are inefficient even if altruisitic, not-for-profits may represent the second-best solution to meeting our health care needs.

Finally, our results also shed light on the hidden (indirect) cost of California's seismic

[3]For example, as is discussed in the medical literature, teaching hospitals face a conflict between providing health care services now and ensuring a sufficient supply of well trained doctors in the future. Moreover, overinvestment in new technologies (i.e. early adoption by some hospitals) may lead to technological spillover and improvements in healthcare provision in all types of hospitals.

retrofit mandate, SB1953. In addition to imposing direct costs associated with retrofitting or rebuilding, California's mandate has decreased both the number of hospitals in the State and the provision of uncompensated care by government-owned hospitals.

2 Literature Review

A vast literature, both theoretical and empirical, seeks to understand the objectives of not-for-profit hospitals. We divide this literature into three broad categories: (1) "for-profits in disguise," (2) social welfare maximizers and (3) "perquisite" maximizers.[4]

The not-for-profits as "for-profits in-disguise" (hereafter FPID) hypothesis implies that hospitals masquerade as charitable organizations but, in fact, operate as profit maximizing entities (Weisbrod, 1988). This could occur because of either lack of enforcement or ambiguity in the legal requirements to qualify as tax-exempt.[5] A large empirical literature has tried to look for differences in the equilibrium behavior of for-profit and not-for-profit firms.[6] An early example of such a paper, Sloan and Vraciu (1983) compares costs, patient mix, and quality across non-teaching for-profit and not-for-profit hospitals in Florida. The authors find no differences in after-tax profit margins, the share of Medicare and Medicaid patient days, the value of charity care, and bad debt adjustments to revenue. They find some small differences in service mix but none vary systematically across profitable versus nonprofitable services. They conclude that all hospitals, regardless of ownership type, are forced to balance social objectives and financial considerations.

Where, like Sloan and Vraciu (1983), others have found little or no difference in costs, profitability, pricing patterns, the provision of uncompensated care, the quality of care or the diffusion of technology across ownership type, they conclude that not-for-profit hospitals

[4]Our classification system differs from much of the recent literature, (e.g., Silverman and Skinner (2004), which adopts the taxonomy in Malani et al. (2003)). Malani et al. (2003) effectively distinguishes among four class of models – 'for-profits in disguise," "altruism," "physician cooperatives," and "non-contractible quality." Our taxonomy defines three categories but the final category – "the perquisite maximizers" – captures several alternate models of hospital behavior including physician cooperatives (Pauly and Redisch, 1973; Young, 1981), mission-driven hospitals and prestige maximizers (Newhouse, 1970). All our models allow for some aspect of "non-contractible quality" as opposed to treating it as a separate class of models.

[5]Why in such a world would not all hospitals obtain not-for-profit status to take advantage of the tax benefits? Some may have higher masquerading costs. Others may require broader access to capital than is available to not-for-profits. Switching costs, e.g. regulatory friction, may be high. And some may have difficulty extracting super-ordinary excess profits.

[6]Sloan (2000) provides an extensive review of the literature.

behave no differently than their for-profit counterparts (e.g., see Becker and Sloan, 1985; Gaumer, 1986; Shortell and Hughes, 1988; Keeler et al., 1992; Norton and Staiger, 1994; McClellan and Staiger, 2000; Sloan et al., 2001; Schlesinger and Gray, 2003). Duggan (2000), which improves on the earlier literature by studying differential responsiveness to a *change* in the financial incentives to treat indigent patients in California, finds that the important behavioral distinction is between public and private hospitals regardless of not-for-profit status.[7] To the extent that hospitals share the same costs, quality, and service mix (including uncompensated care), the implication is that either (1) not-for-profits are profit-maximizers or (2) competition is so intense that not-for-profits are forced to subvert their altruistic objectives to survive (Sloan and Vraciu, 1983). In so far as some papers (e.g., Gruber, 1994; Cutler and Horwitz, 2000; Duggan, 2002; Horwitz and Nichols, 2007) have shown that when competition increases, not-for-profits change their behavior to more closely match their for-profit peers, the latter hypothesis cannot be broadly applicable to the hospital industry.

A second class of models we consider posits that hospitals maximize some measure of social welfare. The usual justification given for these preferences is a taste for altruism or social welfare. For instance, altruistic managers and employees may sort into not-for-profit firms (Rose-Akerman 1996, Besley and Ghatak 2004). They use the tax advantage from non-profit status to address unsatisfied demand for government-funded provision of certain public goods and may accept lower wages to further cross-subsidize the provision of public goods. Alternatively, welfare maximizing not-for-profit firms might occur as a socially optimal response to asymmetric information (Arrow, 1963; Nelson and Kashinsky, 1973; Easley and OHara 1983; Hansmann 1980; Weisbrod, 1978; Weisbrod and Schlesinger, 1986; Hirth, 1999; Glaeser and Shleifer, 2001). In other words, firms may use not-for-profit status to commit themselves to provide quality by constraining their own incentives to reduce (unobserved and noncontractible) quality in favor of profits. Empirical support for this hypothesis is largely based on the literature showing that not-for-profit hospitals

[7]The literature on behavioral differences between not-for-profit and for-profit hospitals is quite mixed. To our reading, most find no differences. But, several find that not-for-profits provide more unprofitable services (Schlesinger et al., 1997; Horwitz, 2005)or higher quality care (Shen, 2002), employ fewer performance bonuses in executive compensation (Erus and Weisbrod, 2003), have lower marginal costs but higher markups (Gaynor and Vogt, 2003) and engage in less upcoding (Silverman and Skinner, 2003; Dafny, 2005).

provide more charity and subsidized care than their for-profit peers (Schlesinger et al., 1987; Frank et al., 1990; Mann et al., 1995; Clement et al., 2002; Horwitz, 2005).

The final class of models studied here assumes that not-for-profit hospitals maximize something other than profit or social welfare. It thus covers a wide range of theories. Newhouse (1970) is the starting point for this group. That work suggests that not-for-profit hospitals maximize "prestige", a weighted average of quality and quantity, subject to a break-even or zero profit constraint (Newhouse, 1970). That is hospitals have a taste for quality and quantity that distorts their production away from both profit and welfare maximization.[8] Alternatively, not-for-profit hospitals may compete with each other to gain public goodwill (Frank and Salkever 1991). In what they term a model of impure altruism, hospitals aim to provide quality (length of stay or intensity of services) to indigent patients that is similar to that of their rivals.[9] This type of model may capture a quasi-altruistic motive: hospitals take not-for-profit status to financially support the provision of high quality care (Newhouse, 1970; Lakdawalla and Philipson, 1998).

These variants of perquisite maximization can be seen as part of the CEO empire building literature in finance (e.g., see Hart, 1991; Grossman and Hart, 1982; Jensen, 1986 or Shleifer and Vishny, 1991) or may be the result of "mission driven" firms, whose goals, though perhaps altruistic in origin, create inefficiencies in heath care production.[10] As a very simple example, a firm that attempts to fulfill a mission of providing "only the highest level of care" may consequently provide an inefficiently high level of quality and treat an inefficiently low number of patients.

Models in this category need not have any quasi-altruistic motivation. As an example,

[8]As discussed in Newhouse (1970), since the pursuit of profit maximization can lead to underprovision of both quality and quantity, a hospital's taste for quality and quantity can lead to welfare improvements.

[9]Frank and Salkever (1991) note that if not-for-profits maximize social welfare, they should care about the total volume of charitable care not their own provision of such care. Finding little evidence of either crowding out or large income effects, they posit the model of impure altruism.

[10]Historically not-for-profit hospitals were charitable organizations created to provide care for the poor (Willard 1989). While many not-for-profit hospitals now have missions to provide "cost effective" care to the community at large, some have more specific or multifaceted goals. For example Florida Hospital's mission statement begins,"Our first responsibility as a Christian hospital is to extend the healing ministry of Christ to all patients who come to us." Barnes Jewish Hospital's mission statement declares that it is "committed to optimizing the quality of care the patients receive in our health care environment and to implement changes toward that effect." Representative of the multifaceted goals of teaching hospitals, Beth Israel Deaconess Medical Center's mission is to "serve patients, students, science and our community."

Pauly and Redisch (1973) model not-for-profit hospitals as physician cooperatives. Organizing as a cooperative frees physicians of the demands of outside investors and allows them to assume control over resource allocation. The physicians then make input and output decisions so as to maximize net individual income, distorting their behavior away from efficient production. Specifically, because of the incentives generated by this organizational structure, physicians distort their production process to include more perquisites (e.g. overinvestment in capacity or technology) to maximize their individual utility.

3 Models

We begin by modeling these three categories of not-for-profit hospital behavior. The first model assumes that not-for-profit hospitals are simply "for-profits in disguise" (Weisbrod 1988). Corresponding to a simple model of a profit maximizing firm, it serves as the basis for our subsequent models. Our second model corresponds to the idea of not-for-profit hospitals as purely altruistic firms that have as their maximand some weighted version of social welfare. In our third and final model, not-for-profit hospitals maximize perquisites.

3.1 The Basic Model

Hospitals are assumed to maximize an objective function

$$V = V(R, P, u) \tag{1}$$

subject to a break-even constraint

$$R = \pi(q, Q) - P - u + F \geq 0 \tag{2}$$

where R is net revenue, P are non-pecuniary perquisites, Q is the "quality" of compensated care,[11] u is the amount of uncompensated (indigent) care, and F is a fixed cost shock. We make the standard assumption that perquisites are inferior to cash.[12] In addition, we assume that hospitals are price-takers with access to similar production technologies.[13] The assumption of access to the same technologies does not require that all hospital have identical production functions but rather that the cost functions for each hospital meets the first order conditions described later in this section.

Profit can be simply expressed as the difference between the quantity of profitable services produced (q) and a cost function convex in q and increasing in quality Q:

$$\pi(q, Q) = \int_0^q p - c(x, Q))dx \tag{3}$$

where the cost function c is continuous, differentiable and convex in its arguments: (c_q, c_{qq}, c_Q, c_{QQ},c_{qQ}) ≥ 0. Hereafter WLOG we normalize the price p for a unit of profitable service to 1.

The timing of hospital behavior, as it corresponds to the natural experiment we study below, can be thought of as follows:

1. Hospitals choose q, Q, R, u to maximize $V(R, P, u)$ subject to their budget constraint $R = \pi(q, Q) - P - u \geq 0$.

[11] Our use of the term "quality" is somewhat unusual. Much of the literature treats quality as a characteristic of care that is positively correlated with the welfare provided by a given procedure. As will hopefully become clear, we treat quality in more general terms as *a*ny characteristic of care that distorts costs, regardless of whether its welfare-improving. As a rather unlikely example of a quality improvement that does not improve welfare, imagine providing surgeons with disposable solid gold scalpels. These scalpels would increase the cost of surgery without increasing the welfare provided to the patient undergoing surgery.

[12] In addition to the usual argument that goods-in-kind are weakly inferior to cash since one could always purchase the perquisites, this assumption can also be the result of intrinsic frictions or other costs of transforming cash into perquisites (e.g. the cost of circumventing detection). The IRS's 2004-2006 Executive Compensation Compliance Initiative report acknowledges the importance of perquisites for not-for-profit hospitals, identifying the practice of providing "insiders" with loans and unreported "fringe benefits" as particularly problematic.

[13] Given the high degree of price regulation and the dominance of large private and public insurers this is the standard assumption in much of the literature. See Frank and Salkever (1991) for further discussion on this topic. The price-taking assumption though does not drive our results and are not required to obtain the basic results of our model.

2. Hospitals receive a fixed cost shock F.

3. Hospitals choose q', Q', R', u' to maximize $V(R, P, u)$ subject to their new budget constraint $R = \pi(q, Q) - P - u + F \geq 0$.

4. If a hospital is unable to meet its budget constraint, it shuts down.

3.2 Profit Maximization

Behind the notion of FPID is the idea that restrictions on the operations of not-for-profit hospitals are not binding and that they are de-facto operating as for-profit institutions. In terms of our model, this has three implications. First since perquisites are inferior to cash (i.e. $V_R \geq V_P$), the hospital will choose the corner solution $P = 0$. Second since the maximand R is decreasing in Q, FPID firms will set $Q = 0$. Third since uncompensated care simply reduces revenue one-for-one, hospitals will also not provide any uncompensated care, $u = 0$.[14]

Setting $P = Q = u = 0$, normalizing output prices to one, and substituting equations (2) and (3) into (1), the firms objective function can be rewritten as $V(q, Q|F) = V(\pi(q, Q) - F) = V(\int_0^q (1 - c(x, Q))dx - F)$. The first order condition is then simply

$$\frac{dV}{dq} = V_R(1 - c(q)) = 0 \tag{4}$$

Since R is a normal good, $V_R > 0$ so equation 4 requires that $R_q = 0$ and $q^* = c^{-1}(1)$. As expected, for-profit firms simply produce q until the marginal cost equals the price and quantity q^* is independent of the fixed cost shock F. So the production behavior of a profit maximizing firm is unaffected by fixed cost shocks. Thus, with the exception of firm shutdown, we would expect both the level and mix of services provided by a FPID to be unaffected by a fixed cost shock.

[14]Empirically for-profit hospitals provide a non-zero level of indigent care. The most common reasons given for this somewhat unexpected fact is that such charitable actions engender goodwill. Therefore, as with quality, values of zero for indigent care should be thought of as mapping to some minimum non-zero amount of indigent care a hospital must, for whatever reason, provide.

Though both obvious and expected, this prediction is quite important for two reasons. First it provides us with a very basic 'gut' check of the external validity of our model and the credibility of our research design. That is if the behavior of for-profit hospitals are markedly different from that predicted in our model, it would give us serious pause regarding either the applicability of the standard neo-classical model or the validity of our natural experiment as a fixed cost shock.

Second it illustrates the advantage of the fixed shock approach; it is robust to both the specific form of the objective function and the level of any of the parameters. For example even if FPID firms have different cost than for-profits or specify that not-for-profit hospitals are located in fundamentally different markets than their for-profit peers, the model's predictions remain unchanged.

3.3 Altruism

An alternative model of not-for-profit behavior posits that hospitals maximize not profit, but rather some measure of social welfare.[15] An important component of most models of not-for-profits as welfare maximizers is the idea that not-for-profits provide higher "quality" than a purely profit maximizing firm. The idea behind this is that for many health services, quality Q, which is costly to the firm, is both welfare increasing and non-contractable. The non-contractibility of this additional socially efficient quality improvement means that profit-maximizing firms will not provide it since the increased cost is not offset by a countervailing increase in payment. An altruistic firm though would prefer to provide Q if it increases the total welfare generated by the hospital.

In terms of our model we incorporate this idea of welfare maximization by simply defining welfare as a perquisite P. Specifically for an altruistic firm we define $P = W$ where W is simply the sum of the welfare provided to each person who receives a unit of healthcare q (i.e. $W = q(1 + g(Q))$ where the welfare provided by q itself is normalized to 1 and $g(Q)$ is weakly increasing and concave ($g'(Q) \geq 0$, $g''(Q) < 0$) $g(0) = 0$). Altruistic firms can then be thought of as having a demand function for two normal goods $\{q, Q\}$; that is demand for both quality and quantity are non-decreasing in wealth. That altruistic

[15] The literature generally conceives of this occurring through altruistically motivated managers or agents. See for example Rose-Ackerman 1996, Frank and Salkever 1991 or Besley and Ghatak 2004.

hospitals do not value quality in and of itself, but rather as a vehicle for providing better care to patients is straightforward but, as discussed in the next section, is also key for distinguishing between altruisitic and perquisite maximizing firms.

An altruistic hospital's objective function can be thought of as a function of the social surplus generated by providing uncompensated care u and compensated care q with quality $Q \geq 0$. This implies that $R = 0$, independent of a binding non-distribution constraint; altruistic hospitals preference is to transform any surplus into more or better health services. Setting $R = 0$ and substituting $P = W = q(1 + g(Q))$ into (1), the firm's objective function can be rewritten as $V = V(q(1 + g(Q)), \pi(q, Q) + F)$. The first order conditions are then:

$$\frac{dV}{dq} = V_P(1 + g(Q)) + V_u \pi_q(q, Q) = 0 \tag{5}$$

$$\frac{dV}{dQ} = V_P q g_Q(Q) + V_u \pi_Q(q, Q) = 0 \tag{6}$$

Since V_P, V_u and $g(Q)$ all have positive values, (5) requires that $\pi_q = 1 - c(q, Q) < 0$. This means that, controlling for quality, altruistic hospitals will "overproduce" relative to for-profit firms by continuing to provide units of q even after marginal cost exceeds price. In addition, in response to a positive fixed cost shock F, altruistic hospitals will weakly increase q, Q and u as determined by our first order conditions. Intuitively because altruistic hospitals have a preference for q, Q and u, they will spend any "extra" money on weakly increasing all three goods. Borrowing terminology from consumer demand theory, we can recast the problem as that of an individual choosing a consumption bundle $\{q, Q, u\}$ for three normal goods where prices for two of the goods (q, Q) are are both increasing in q and Q. Let $\{q^*, Q^*, u^*\}$ be the chosen bundle for wealth $W \leq \pi$. If wealth is increased to $W' = W + F > W$ then for the new bundle choice $\{q', Q', u'\}$ must be weakly greater in each good (i.e. $q' \geq q^*, Q' \geq Q^*, u' \geq u^*$).

Note that overproduction is defined relative to a profit-maximizing firm. But in this context the profit-maximizing quantity is not socially optimal. In terms of our natural experiment, this model predicts that altruistic not-for-profits should decrease their provision of profitable services, the quality of service and/or uncompensated care in response to the negative financial shock imposed by the seismic retrofit mandate. That is since altruistic hospitals use their revenue to subsidize the production of excess quantity q, quality Q, and uncompensated care u, they will be less able to subsidize these activities when faced with a negative fixed cost shock and will (weakly) reduce production along all three dimensions.

3.4 Perquisite Maximization

Our final model of not-for-profit hospital behavior follows from the observation that a binding non-distribution constraint will lead a not-for-profit firm to disburse profits through non-pecuniary perquisites (see Glaeser and Shleifer 2001).[16] Because our fixed cost shock policy experiment allows us to be quite general as to the specific structural form of the distortion, we will remain largely agnostic as to the exact nature of the perquisites. Instead we will simply model perquisites as something consumed by the hospital that can increase the cost of producing units of q. Perquisites that raise the cost of production correspond in our model to valuing quality Q. In contrast to the previous model, here quality is valued in and of itself and not as an input into increasing the value of units of q. That is for perquisite maximizing hospitals "quality" is itself a desired good, whereas altruistic hospitals have a preference for total welfare (which is jointly determined by quantity and quality). This models also allows for perquisites that do not affect production; this corresponds to a taste for R. Note that if none of the perquisites raise the cost of production, the model reduces to the FPID case.

In the context of health care, quality is usually thought of as a vertical feature of health care (i.e. it increases a patients willingness-to-pay (WT)P amount for a unit of q). In our model quality should instead be thought of as any characteristic of that distorts the cost function regardless of whether or not it affects a recepient's WTP. We assume $P = f(Q)$ where $f(\bullet)$ makes Q as perquisite is increasing and concave in V (i.e. $f_Q > 0$ and $V_P P_{QQ} + V_{PQ} P_Q < 0$).

[16] We will assume for simplicity that perquisite maximizing firms do not care about providing uncompensated care (i.e. $u = 0$). Note though that this is solely for the purposes of expositional simplicity as any of our results would hold by simply re-labeling uncompensated care as a perquisite.

The canonical example of a perquisite would be the case of managers providing themselves with excessively luxurious work environments (i.e. nice offices, corporate jets, \$15,000 umbrella stands).[17] In this example the nice office would be considered a non-distortionary perquisite (R) since it does not change the cost of production. A corporate jet though would be considered a distortionary perquisite (P) since it presumably increases the cost of travel relative to commercial air travel. Note that in both examples the increase in Q is not likely to affect the end consumers WTP. In a hospital setting, the pursuit of these "selfish" perquisites might correspond to overinvestment in capital and capacity in ways both distortionary and non-distortionary in nature.[18]

Perquisites could also arise if hospitals pursue a "mission" other than maximization of social welfare. For example, a hospital that wants a reputation as the "best" or providing "only the highest quality care," may overprovide vertical quality at the expense of total welfare. Another example of a not-for-profit hospital mission is that of teaching hospitals. If a hospital cares about training high quality doctors, they might pursue quality teaching even at the expense of current welfare or profits.[19]

Setting $u = 0$, a perquisite maximizing firm's objective function can be written as $V = V(\pi(q, Q) + F, f(Q)))$. Taking first order conditions we get

$$\frac{dV}{dq} = V_R(1 - c(q, Q)) = 0 \tag{7}$$

$$\frac{dV}{dQ} = V_R(\pi_Q) + V_P f'(Q) = 0. \tag{8}$$

Since $V_R > 0$, from(7) we find that, conditional on quality Q, perquisite seeking firms will produce q until marginal cost equals marginal revenue so q^* is fully determined by the hospital's choice of Q^*. This makes intuitive sense since producing any other quantity would

[17] The \$15,000 umbrella stand, along with a \$6,000 shower curtain and a \$2 million birthday party for his wife were some of the more unusual perks received by L. Dennis Kozlowski, the former chief executive officer of Tyco who was eventually convicted of misappropriating \$400 million in company funds

[18] This is often cited in the context of physician cooperatives (Pauly and Redisch, 1973).

[19] Since this preference for teaching might reasonably be seen as an attempt to maximize some multi-period welfare function, this example reminds us that additional data on health outcomes is required before a normative analysis of the welfare implications of these models can be attempted. This issue is discussed in more detail in the results section of this paper.

simply reduce firm profits, profits that could otherwise be used to pay for more perquisites $\{R, P\}$.

Rearranging (8), we can express $V_R = \frac{V_P f'(Q)}{-\pi_Q}$. From the budget constraint, we can conclude that an increase in F leads to an increase in R. From the concavity of V with respect to R, this implies that V_R is decreasing in F. On the right hand side, the numerator $V_P f'(Q)$ is decreasing in Q, while the denominator $-\pi_Q$ is increasing in Q so the expression on the right hand side is decreasing in Q. An increase in F will then lead to an increase in Q.

Returning to our consumer demand theory analogy, Q and R are normal goods where the price of R is 1 and the price of Q is increasing in Q. Q and R will then both weakly increase with increases in wealth (i.e. F). That is a positive shock F means firms can afford more of each desired good. The intuition is again simply that when the budget constraint is loosened, firms are able to afford a larger distortion of their production away from the profit maximizing quantity/quality mix to better meet their preferences. Since profitable services q are negatively related to Q, the increase in Q results in an decrease in production q. In terms of our natural experiment, a large negative fixed cost shock should cause a perquisite maximizing hospitals to increase their provision of profitable services, q, and have no effect on uncompensated care.

It should be noted that although perquisite seeking hospitals obviously fall short of altruistic hospitals in terms of generating welfare, the welfare implication of this distortion relative to the profit maximizing case is theoretically ambiguous. Moreover, while a negative fixed cost shock and increased competition decrease the total welfare generated by altruistic firms, the welfare implications for a prestige-maximixing firm can only be determined with additional functional form assumptions.

3.5 Summary of Predictions

Table II summarizes the predicted responses to a fixed cost shock implied by each of our three classes of models. For FPID, we expect no change in service provision or quality in response to this shock. In comparison the altruistic model predicts a decrease in profitable care, uncompensated care and quality in response to a fixed cost shock. We can further distinguish perquisite maximizing hospitals based on the prediction that they should increase the provision of profitable services and decrease quality following a negative fixed cost shock. Unfortunately we do not have good measures of quality. Nonetheless, the predictions on the quantity of profitable and uncompensated care are sufficient to distinguish across our three classes of models. In the next section we describe a natural experiment that allows us to test these different predictions.

4 The Program: California's Seismic Retrofit Mandate

California's original hospital seismic safety code, The Alquist Hospital Facilities Seismic Safety Act, was enacted in 1973. Prompted by the 1971 San Fernando Valley earthquake, which destroyed several hospitals, the Alquist Act required newly constructed hospitals to follow stringent seismic safety guidelines. Perhaps in response to these requirements and despite the state's aging healthcare infrastructure, hospital construction projects remained rare throughout the 1980s (Meade and Kulick, 2007).[20]

On January 17, 1994 at 4:30am a 6.7 magnitude earthquake hit 20 miles northwest of Los Angeles, near the community of Northridge.[21] The 1994 Northridge earthquake caused billions of dollars in damage and left several area hospitals unusable.[22] Damage extended as far as 85 miles away from the epicenter. In its wake, California amended the Alquist Act to mandate a timeline by which all general acute care (GAC) hospitals must demonstrate that their facilities can both withstand and remain operational following a major seismic event. No money has been earmarked to aid in this process.

Although the amendment, SB 1953, was passed quickly, its requirements were only finalized in March of 1998, after approval by the California Building Standards Commission.[23] SB 1953's primary innovation was to establish deadlines by which all GAC hospitals had to meet certain seismic safety requirements or be removed from operation (see Table I). Its

[20] A state-sponsored engineering survey of all hospitals found that by 1990 over 83 percent of hospital beds were in buildings that did not comply with the 1973 Alquist Act (Meade et al. 2002).

[21] http://earthquake.usgs.gov/regional/states/events/1994_01_17.php

[22] According to the California Hospital Association, 23 hospitals had to suspend some or all services. See http://www.calhealth.org/public/press/Article%5C103%5CSB1953factsheet%20-%20Final.pdf Six facilities had to evacuate within hours of the earthquake (Schultz et al. 2003). But no hospitals collapsed and those built according to the specifications of the Alquist Act suffered comparatively little damage.

[23] See http://www.oshpd.state.ca.us/FDD/SB1953/index.htm.

ultimate goal was to enable hospitals to remain operational following a strong earthquake so as to maintain current patients and provide care to earthquake victims. The deadlines were to offer hospitals a "phased" approach to compliance (Meade and Kulick, 2007).

The first deadline facing GAC hospitals was January 2001. By that date, all GAC hospitals were to submit a survey of the seismic vulnerability of each of its buildings. Most hospitals (over 90%) complied with this requirement (Alesch and Petak, 2004). As part of the survey, each hospital classified the nonstructural elements (e.g. power generators, communication systems, bulk medical gas, etc.) in each of its buildings according to five "Non-structural Performance Categories" (NPC). Similarly, the structural support in each building was rated according to five "Structural Performance Categories" (SPC). These ratings indicate how a hospital should fare in a strong earthquake (OSHPD, 2001). Table I describes the full set of SPC ratings. Broadly, the first categories, both NPC-1 and SPC-1, represent the worst and the last categories, NPC-5 and SPC-5, the best ratings.

About 70 percent of hospital buildings were in the NPC-1 category (Meade et al. 2002). This rating indicates that major non-structural elements essential for providing life-saving care are not adequately braced to withstand a major earthquake. Hospitals faced a January 1, 2002 deadline for bracing these systems, shifting their NPC-1 buildings to the NPC-2 rating. While we know of no estimates of the costs of compliance, this requirement was viewed as a relatively minor aspect of the law.[24]

The first major deadline facing California hospitals was January 2008 (or January 2013 with an extension). By this date, all hospitals with SPC-1 buildings were to have retrofitted to remain standing following a strong earthquake or taken out of operation. Based on the initial ratings, about 40 percent of hospital buildings or 52.4 million square feet of floor space weas SPC-1 (Meade and Kulick, 2007). Expressed in terms of beds, about 50 percent were in the lowest compliance category of buildings. Only 99 hospitals in California or about 20 percent of the 2001 total had no SPC-1 buildings and were thereby in compliance with the 2008 requirements (Meade et al., 2002).

The final deadline facing GAC hospitals is January 1, 2030. By 2030, all SPC-1 and

[24]RAND estimated the total cost of compliance with this requirement at about $42 million. In contrast, their initial estimate of the cost of reconstructing SPC 1 buildings was about three orders of magnitude higher, at $41.1 billion (Meade et al. 2002).

SPC-2 buildings must be replaced or upgraded. The upgraded buildings will be usable following strong ground motion. While the legislature thought that hospitals would retrofit SPC-1 buildings, upgrading them to SPC-2 status by 2008/2013, and then replacing them completely by 2030, few hospitals have gone this route. Rather, to avoid the expense and disruption of a retrofit, most hospitals with SPC-1 buildings have chosen to rebuild from the outset, effectively moving the final deadline up from 2030 to 2008 or 2013, if granted an extension, and causing an unprecedented growth in demand for hospital construction (Meade and Kulick, 2007).

Recognizing that most hospitals would not meet the 2008/2013 deadlines and that the original SPC ratings were based on crude assessments, the Office of Statewide Health Planning and Development (OSHPD) recently (on November 14, 2007) authorized a voluntary program allowing hospitals with SPC-1 buildings to use a "state-of-the-art" technology called HAZUS (Hazards U.S. Multi-Hazard) to re-evaluate their seismic risk.[25] Hospitals that opt into the program must submit a written request along with their seismic evaluation report and a supplemental report identifying where the original ratings may have been inaccurate. Participation in the program effectively moves the compliance deadline to 2013, if any buildings are still deemed SPC-1, or to 2030, if all buildings are reclassified as SPC-2, meaning they can withstand a major earthquake but may not be functional afterwards. Despite the extensions and reclassifications, most hospitals in the State are already or will soon be engaging in major near-term capital investment projects.

Figure 1 shows the mean and median value of hospital construction in progress since 1996. After 2001, the year hospitals had to submit their building surveys, the mean value of construction in progress rose sharply, from $5.5 to almost $14 million (in 2005 terms). Some of this increase must reflect the national increase in construction costs as well as the specific increase in health care construction costs in California. But even the California Health Care Association's claim of a 57 percent increase in the cost of hospital construction between 1995 and 2005 (Langdon 2006), cannot fully explain the roughly 150 percent growth in the value of construction in progress that occurred over a similar period. As suggested by the exceptionally long wait times to book specialized health care construction firms, much of

[25]See http://www.oshpd.ca.gov/fdd/sb1953/FinalJan2008Bul.PDF

the growth is due to an increase in construction projects.

Figure 1 also reveals a big discrepancy between trends in the median and mean value of construction spending. While median construction spending also picked up in 2001, the trend was clearly upward between 1996 and 2001. More importantly, however, the median value is well below the mean. The large difference between the mean and median value of construction in progress implies that a few hospitals are spending a lot on construction while the typical hospital is spending much less. This disparity is congruent with the idea that there is no break in trend for hospitals in general. Rather, the increase in spending is driven by those hospitals disproportionately affected by the seismic retrofit mandate. Indeed in the work that follows, we find, among other things, that differential exposure to the mandate predicts differences in spending on plant, property and equipment.[26]

5 Data and Methods

5.1 Data Sources

To assess the impact of California's seismic retrofit mandate, we combine data on the seismic risk, service provision, and finances of all general acute care hospitals in the state of California from 1996 through 2005. Data on finances are from the Office of Statewide Health Planning and Development's Annual Hospital Disclosure Report (AHDR). All financial data are normalized to 2005 dollars. Service provision data are largely from the AHDR as well. Since the ADHR service provision data are not comparable prior to 2001, we analyze changes between 2002 and 2005.[27] We supplement these service provision data with information from OSHPD's Inpatient Hospital Discharge Data files for 1997 and 2005.

Seismic ratings and SB 1953 extension requests are all maintained in separate databases by OSHPD. The California Geological Survey (CGS) provided data on the underlying seismic risk of each hospital's location. Specifically, we use a measure called the ground

[26]We also compare hospital construction spending in California to private healthcare construction spending in the South Atlantic and private educational spending in the Pacific Division, the lowest level of aggregation available from the Census Bureau's "Manufacturing, Mining and Construction Statistics" (Figure 2). This figure suggests that the sharp increase in hospital construction spending in California starting in 2001 is not driven by underlying industry or region trends.

[27]Based on discussions with OSHPD, we were advised to not use the first year of available service data. That said, results are quite similar if we use 2001 as the base year. In some cases our estimates are more and in others less precisely estimated.

acceleration factor, g, which is the maximum expected ground acceleration that will occur with a 10 percent probability within the next 50 years normalized to Earth's gravity.[28]

5.2 Identification Strategy

Together these data can be used to understand how the large increase in expenditures necessitated by SB 1953 impacts a hospital's finances and service provision. The financial burden associated with SB 1953 is largely reflected in a hospital's SPC building ratings. Since these ratings, which reflect both building quality and location, are nonrandom, we cannot simply compare ratings and outcomes. Hospitals in worse financial condition are also likely to have lower ratings.

However, one feature of the SPC ratings is largely predetermined - underlying geologic seismic risk. Most hospitals in the State were built between 1940 and 1970, at a very early stage in our understanding of seismic risk and well before the development of modern seismic safety standards. New construction has been slow relative to estimates of a reasonable building lifespan (Meade et al., 2002). And, although many hospitals have built new additions, most are in their original location (Jones 2004). Many of the new additions have been so well integrated into the original hospital structure that they will need to be replaced along with the older buildings (Jones 2004). Combined with high seismic variability at relatively small distances (e.g., see Appendix Figure 1), the result is that well-performing hospitals are unlikely to have selected into "better" locations (along seismic risk dimensions), at least within a locality.

Our identification strategy relies on the assumption that a hospital building's underlying seismic risk (g) is effectively randomly matched to hospitals within a geographic area (e.g. a county or city). This assumption seems consistent with discussions between the authors and seismologists, who lament the fact that seismic risk is factored into building construction on only a very gross, highly-aggregated level (e.g. by county). This assumption is further corroborated by empirical tests (shown below) of the distribution of observables.

[28]This is a standard way of expressing seismic risk. For more details, see http://www.consrv.ca.gov/cgs/rghm/psha/ofr9608/Pages/index.aspx

5.3 Econometric Specifications

Our basic regression specification is:

$$Y_h = g_h + \beta X_h + \gamma_c + \epsilon_{h,c} \tag{9}$$

where Y_h is our outcome of interest, such as spending on plant, property and equipment (PPE) or days of care provided to indigent patients in hospital (h), g_h is a hospital's inherent seismic risk, as measured by its predicted ground acceleration factor, X_h is a hospital's observable characteristics, and γ_c is a county (or city) fixed effect. Ideally we would include pre-mandate (e.g., 1993) hospital characteristics as controls since the mandate itself may alter hospital observables. Due to data limitations, we include hospital characteristics from the 1996 fiscal year, almost two full years prior to the finalization of the mandate's provisions. Since the specifics of the legislation were not finalized until March 1998 and hospitals did not know their full exposure to the legislation until 2000 when their buildings were rated, the risk of endogeneity of the 1996 fiscal year (July 1995-June 1996) hospital characteristics should be minimal.

In order to test for differences in the response of hospitals by ownership type, we run all regressions as (10) and then augment them to include interactions between seismic risk and ownership status (for-profit or public, with not-for-profit the omitted category). It is these interaction terms that allow us to test our models of hospital behavior. If, for example, not-for-profit and for-profit hospitals have similar coefficients (i.e. responses to the fixed cost shock of retrofitting), then we might take it as support for the FPID hypothesis. Alternatively, to the extent that not-for-profit hospitals alone increase the provision of profitable services in response to a fixed cost shock, then we can both reject theories of pure profit-maximization and pure altruism.

We consider three alternate specifications for our outcome variables. First we look at the simple level of our dependent variables in the most recent year (2005). We use the most recent year since it is the closest to the retrofit deadline and should therefore represent the year for which the effect of the legislation is the largest. This intuition is confirmed by evidence from both Meade and Kulick (2007) and our own regressions using the levels of our outcome variable for other years. We find a systematic and largely monotonic increase in the magnitude of the effect of g on our outcomes as we approach 2005.

Second we sum the levels of each outcome variable for all available years (1997-2005 for spending measures and 2002-2005 for most service measures). These results represent the aggregate effect of the legislation for the entire period of available data. This specification helps avoid the possibility that our results are driven by the idiosyncrasies of any specific year. The results from this specification look very similar to our first specification, but with generally more precisely estimated coefficients.

Finally we take a long difference approach and use the change in levels between 2005 and 1997 or 2002, depending on the earliest year available for a given measure. Specifically we estimate regressions of the following form:

$$\Delta Y_{hct,t-n} = g_h + \beta X_{hct,t-n} + \gamma_c + \epsilon_{hct,t-n} \tag{10}$$

where $\Delta Y_{hct,t-n}$ is the change in an outcome of interest, such as spending on plant, property and equipment or days of care provided to indigent patients in hospital h, located in county c, between years t and $t-n$. These results are again qualitatively similar to those from our other specifications. Because the long difference minimizes the possible correlation between observed and unobserved hospital characteristics, this third approach is our preferred specification. Thus, throughout the paper, we focus on the results from this third specification.

In addition to spending and service provision, we are also interested in the effect of SB 1953 on the probability of a hospital's closure. Because this outcome is dichotomous, we use probit models to estimate these effects. Since closure is not an uncommon outcome (roughly 12 percent of hospitals in the State closed during our sample period), we also test the sensitivity of these results to simple linear probability models (analogous to the specification above) and obtain similar results.

In all regressions, we control for a basic set of hospital characteristics X_{hct} as of 1996: bed size, teaching status, ownership status (for-profit, not-for-profit, or public), whether the hospital is part of a multi-hospital system or chain, and rural status. We also include location (county) fixed effects to control for fixed differences in outcomes that are correlated with broad statewide seismic risk patterns. Thus, the effect of SB 1953 on finances and service provision is identified by differences in seismic risk within an area and across hospital types. The advantage of this approach is that we can account for differences in hospital quality or demand that may exist across areas due to differences in factors such as the socioeconomic characteristics of the population across areas.

6 Results

6.1 Descriptive Statistics

Table III presents descriptive statistics for all GAC hospitals that filed OSHPD's (required) Annual Financial Reports in both 1997 and 2005.[29] Panel A shows baseline hospital characteristics in 1996 and Panel B shows some of the outcomes we will study. Across both panels, we show descriptive statistics for the full sample and then separately for hospitals that are above and those that are at or below median seismic risk.

As shown in the first column or Panel A, the mean ground acceleration factor is just below 0.5g. Within our sample, seismic risk varies from a minimum of 0.05 and maximum of 1.15 g's and follows a rather bell-shaped distribution. About 28 percent of the hospitals in our sample are investor-owned or for-profit institutions and 19 percent are government-owned. Although investor-owned are slightly more common (28.5 versus 27.8 percent) and government-owned slightly less common (17.5 versus 20.5 percent) in above median g areas, these differences are both small in magnitude and statistically insignificant. Almost 46 percent of hospitals in the sample are part of a large system or chain. This feature is also relatively invariant across low and high g areas.

About 25 percent of the sample are teaching hospitals and 8.5 percent are in rural areas. The average hospital has 216 licensed beds. These baseline characteristics vary sharply across above and below median g areas. Whereas 30 percent of hospitals in high g areas have a teaching program, only 22 percent in low g areas do. The average hospital has 250 licensed beds in high g areas and only 188 in low g areas. These differences can be explained in part by the rural divide. Low g areas are systematically more rural. Indeed

[29] Hospitals that do not file the reports on time are fined $100 per day they are late. For details on non-filing penalties, see http://www.oshpd.cahwnet.gov/HID/hospital/finance/manuals/ch7000.pdf

over 15 percent of hospitals in low g areas are rural. Fewer than 1 percent of hospitals in high g areas areas are rural. Importantly, our analysis does not rely on an across State, high versus low g comparison. Rather, our analysis relies on within-county comparisons in seismic risk, which eliminates much of the urban-rural differences. As we will show below (in Table IV), once we control for county, these characteristics do not differ systematically with seismic risk. And in all regressions we control for the characteristics listed in Panel A.

Panel B shows means for many of the outcomes we study below. In our regressions, however, we specify most of these variables in changes relative to the 1997 value so as to control for baseline differences across hospitals. Total spending on plant, property and equipment (PPE) in the 2005 fiscal year is $107 million, with over half of the change in value dedicated to building improvements. Building improvement spending includes architectural, consulting, and legal fees related to the acquisition or construction of buildings as well as interest paid for construction financing. Fixed equipment such as boilers, generators, and elevators are also included in this accounting category.[30] In contrast, spending on construction in progress only accounts for about 8 percent of PPE spending. The difference may reflect the relatively long organizational time horizon for constructing a new facility - four to five years for the in-house planning process alone (Meade and Kulick, 2007). Importantly, the level of PPE spending (overall and by type) is systematically higher in high g areas.

Of the 445 hospitals in the sample in 1996, roughly 12 percent, or 55, of them closed and almost 5 percent, or 21 of them converted to for-profit status during our sample period. The share of hospitals that closed or converted to for-profit status are roughly equal across high and low g hospitals. Those hospitals remaining in the market in 2005 are licensed to have on average 232 beds. And, as in 1996, those in high g areas are systematically larger, with 272 as compared to 199 licensed beds. This difference is partly offset by differences in staffing. Of the licensed beds, 84 percent are staffed – 81 percent in high g and 87 percent in low g areas. As expected given the rural divide, high g areas have systematically more hospitals days and discharges, both overall and by type.

The above versus below median g comparisons in Table III give us a feel for the type of

[30]See http://www.oshpd.cahwnet.gov/HID/hospital/finance/manuals/ch2000.pdf for details on this and other accounting categories studied here.

hospitals that have high versus low seismic risk. Our main analysis, however, is based on a continuous measure of seismic risk and, more importantly, on within county comparisons of this risk. Thus, to give us some confidence in our research design, we next verify that many observable hospital characteristics are uncorrelated with g. We first consider neighborhood characteristics, where neighborhood is defined by the hospital's ZIP code of operation. We run regressions, based on our main result specifications discussed above, of both the level and change in a hospital's neighborhood characteristics as a function of its seismic risk and county fixed effects. In robustness checks, we also use city fixed effects. We include geographic controls because broad seismic risk patterns across the State correlate closely with broad demographic and socioeconomics differences.[31] Unlike our main results, we generally find no significant correlation between seismic risk and these dependent variables.

Panel A of Table IV presents estimates based on the 2000 Census. They show that within-county the ground acceleration factor (g) is unrelated to the characteristics of the neighborhoods where hospitals are located. Specifically, within a county, we find no meaningful relationship between g and the share of the population that is below the federal poverty line, the share Hispanic, the share 5 to 17 years old, and the median household income in the hospital's ZIP code of operation. Similarly, (in Panel B), we find no relationship between the ground acceleration factor and *changes* in these neighborhood characteristics between 1990 and 2000. We also fail to find within-county relationships between seismic risk and a range of other observable characteristics - e.g. the share of the population female, the share African-American, the share native-born and the share of households on public assistance - both in 2000 levels and 1990 to 2000 changes (not shown here). These results are both statistically and economically insignificant. Moreover, they are generally insensitive to the use of hospital characteristics as controls or to our choice of either city or county fixed effects.

In panels C and D of Table IV, we demonstrate the lack of a systematic relationship between g and basic characteristics of California's GAC hospitals as of 1996, prior to the finalizing of SB 1953 requirements. Specifically, within a county, we find no relationship

[31] E.g., San Francisco County is both high seismic risk and high income relative to Sacramento County. As a result, our identification uses only within county (or city) variation in seismic risk. The problem with using within-city variation is that, many small to medium cities have only one hospital.

between a hospital's ground acceleration factor and the likelihood that it is public, not-for-profit, or a teaching hospital (which can take on any ownership structure). We also find no relationship between g and a hospital's pre-existing expenditures on construction in progress. Similarly, after taking out county-level averages, a hospital's seismic risk is unrelated to the probability it has an emergency department, a neonatal clinic, or an MRI machine on site. It also does not predict the hospital's participation in a county's indigent care program.

Since a hospital's ground acceleration factor is unrelated to its observable hospital and neighborhood characteristics but, as we will demonstrate, is directly related to the cost shock imposed by SB 1953, we can use it as a source of randomization of our treatment. In other words, we can identify the impact of SB 1953 by comparing the response of similar hospitals (based on city or county co-location, rural status, ownership type, and so on) BUT for their inherent seismic risk. Because of the considerable small area variation in ground acceleration within a county and even a city, we should have enough power to identify the effect of this cost shock.

6.2 Hospital Shutdowns

To the extent that SB 1953 causes a large fixed cost shock and increases the cost of capital, as hospitals compete for scarce financing resources, it may have the unintended consequence of increasing closures. For example, if equity and bond ratings decline for those with higher seismic risk, some hospitals may have difficulty financing their day-to-day activities and may choose to shut down. None of our models generates different predictions for the probability of closure. However, this outcome is interesting in its own right. Moreover, if we find differential probabilities of closure by ownership type, we will face a sample selection problem in our assessments of the effect of seismic risk on other outcomes.

Table V presents both probit and linear probability models of the likelihood that a hospital shuts down after 1997. Both models imply a significant impact of seismic risk on the probability of closure: a one standard deviation increase in the ground acceleration factor increases the likelihood of closure by 6 to 7 percentage points. Importantly for our research design, we cannot reject that the impact of seismic risk on the probability of closure is similar across ownership types. This suggest that the negative financial shock from SB1953 does not simply exacerbate pre-existing trends in hospital closures, which are largely concentrated in for-profit facilities (Buchmueller et al. 2006), but rather puts financial pressure on all hospitals with high seismic risk. Furthermore, they imply that the government is not shielding its hospitals from this pressure. While Duggan (2000) finds that localities reduce their allocations to public hospitals receiving "extra" State funds for treating a "disproportionate share" of publicly insured patients, our results suggest that the fixed cost shock studied here is large enough to strain the government's ability to soften the budget constraint enough to fully shield their hospitals from financial pressure. Most importantly for our analytic purposes, these results provide some evidence that SB1953 has bite. Hospitals are not simply ignoring the legislation in the hopes that the State will "bail" them out. [32]

Table V also explores the relationship between seismic risk and the probability that a hospital converts its license (e.g. from not-for-profit or public to for-profit status). We might expect not-for-profit (and possibly public) hospitals with higher fixed cost shocks to convert their licenses if this eases credit constraints. Our point estimates suggest that seismic risk may actually lower the likelihood that a not-for-profit converts to for-profit status and, based on the OLS regression, that a public converts to for-profit status. However, the standard errors are so large that we cannot rule out zero or even large positive effects of seismic risk on for-profit status conversion. Thus, we find no evidence to support the hypothesis that firms (freely) choose for-profit status to ease credit constraints.

6.3 Seismic Risk and Spending

We next, in Table VI, assess the extent to which seismic risk predicts increases in building-related expenditures. Because hospitals have some flexibility in how they account for different expenditures, we consider any spending on plant, property and equipment (PPE). Panel A shows results for the set of hospitals existing in 1997 and 2005. Results in cols (1) and (2) are based on spending levels; cols (3) and (4) are based on logs of spending.

[32] We should also note that these results are not driven by Los Angeles County, where several hospitals were damaged by the Northridge Earthquake. Estimates that exclude hospitals in Los Angeles County are virtually identical (available upon request).

As shown in cols (1) and (3), a hospital's ground acceleration factor is positively related to total PPE spending over the sample period. A one-standard deviation increase in the ground acceleration factor is associated with roughly $330 million in spending on plant, property and equipment between 1997 and 2005. The estimate in levels (col (1)) is only statistically significant at the 10 percent level and that in logs is statistically indistinguishable from zero. When we allow for differential effects of seismic risk by ownership type, the effects on spending become clearer. The main effects, which isolate the impact of seismic risk on spending by not-for-profit hospitals, imply slightly larger seismic risk effects than in the simple model: a one standard deviation increase in g is associated with PPE spending of between $190 and 270 million between 1997 and 2005, with the smaller estimate coming from the log model. Across both specifications, the interactions between g and for-profit or public ownership status are negative. Based on the magnitudes and precision of these estimates, we cannot reject zero effect of seismic risk on PPE spending by for-profit and public hospitals.

In panel B, we test the sensitivity of these estimates to the inclusion of hospitals that close or do not report because of mergers or other unobserved reasons.[33] Specifically, we set to zero any missing PPE spending values between 1997 and 2005. As expected the estimates in Panel B are slightly smaller. But, the magnitudes and pattern of results are quite similar across to those in Panel A. Not-for-profit hospitals with higher seismic risk spend hundreds of millions of dollars more on PPE over the 1997-2005 period than their for-profit or public counterparts.

These findings may capture the fact that not-for-profit hospitals have more SPC 1 buildings than their for-profit counterparts (an average of almost 2.7 compared to about 1.5 for public and for-profits combined). Not-for-profit hospitals may be farther along in their retrofitting timelines than either public or for-profit hospitals or they may have responded more quickly to the mandate.[34] Because we cannot rule out that for-profit and

[33] After a merger, hospitals have the option to retain separate reporting systems or to report as one institution.

[34] As evidence of the latter, we find that although ownership, controlling for the same covariates as in our main regressions, does not predict the likelihood that a hospital requests or obtains an extension to the seismic retrofit deadline, not-for-profit hospitals request extensions on average a half year earlier than for-profit hospitals and almost a a full year earlier than public hospitals. Interestingly, seismic risk does not predict extension requests, approval or timing. This is not too surprising given that over 80 percent of

public hospitals have readjusted their budgets in other ways (e.g. inter-temporally), we do not interpret this as evidence that the cost shock is only binding for not-for-profit hospitals. Rather we take it as the first piece of evidence that not-for-profits respond differently to this mandate than for-profit hospitals.

6.4 Services

In order to better test our models of hospital behavior, we next consider the impact of seismic risk on service provision. Because the mandate does not alter the "price" of hospital services, seismic risk and the requirements of the seismic retrofit mandate should only affect service provision to the extent that hospitals are not already profit-maximizing. Hospitals that are not simply profit-maximizing will have to reoptimize. Altruistic firms will be forced to cut back on (unprofitable) above-market quality and quantity of services. Perquisite-maximizers will be forced to increase the provision of profitable services and reduce their consumption of perquisites.

To test these theories, we first consider the overall volume of service. Table VII shows the impact of seismic risk on *changes* in patient days and discharges between 1997 and 2005. As shown in the first column, hospitals with higher seismic risk increased their patient-days over the 1997-2005 period. A one-standard deviation increase in seismic risk is associated with almost 2400 more patient-days. The next column breaks out the effect by ownership type. Patient-days clearly increase for not-for-profit hospitals with higher seismic risk. A one-standard deviation increase in seismic risk among not-for-profit hospitals is associated with about 2700 more patient-days. We cannot reject zero effect of seismic risk on overall patient days for government-owned and for-profit hospitals. That only not-for-profit hospitals with higher seismic risk increase patient days suggests that they were not profit-maximizing to begin with; the increase in volume is most consistent with perquisite maximization.

As shown in col (3), seismic risk is also associated with an increase in discharges, though the estimate is too imprecise to rule out zero effect. Breaking the estimates out by ownership type provides little additional information. One interpretation of these results is that high seismic risk not-for-profit hospitals increase length of stay rather than volume per se. In

hospitals requested an extension and 98 percent received them.

other words, if not-for-profits are increasing patient days but not discharges, then they must be increasing length of stay for those patients that are admitted. But, the large standard errors suggest some caution in making this case too strongly.

Table VIII tries to determine if the increase in patient days for not-for-profits with higher seismic risk comes through hospital expansion or more intensive use of existing services. Seismic risk is associated with slightly more licensed beds in 2005. Excluding interactions, we find that a one standard deviation increase in g is associated with about 18 more licensed beds. When we break the result out by ownership, however, we find that this result is only distinguishable from zero for government-owned hospitals. The next two columns (col (3) and (4)) consider the share of licensed beds that are actually staffed and thus available for patient use. Here we find that, even after controlling for the base year share of staffed beds, higher seismic risk is associated with a higher share of staffed beds. A one-standard deviation increase in seismic risk is associated with a roughly 3 percentage point higher share of staffed beds. The results by ownership type in col (4) reveal that only not-for-profit and public hospitals with higher seismic risk increase the share of staffed beds. Together with the results from cols (1) and (2), these findings imply that while government-owned hospitals increase both the number of beds for which they are licensed and the share that are staffed and available for patient use, not-for-profits respond primarily be increasing the staffing of existing beds. In other words, not-for-profits facing higher fixed cost shocks choose to use the physical resources at their disposal more intensively.

In Tables IX-XII we next consider changes in the volume of specific services. In Table IX we look at changes in indigent care. We focus on un-reimbursed care not care that can be reimbursed by county indigent programs. We look at changes in total inpatient indigent care days as well as inpatient GAC days. We also look separately at changes in indigent care visits to a hospital's emergency department and to a clinic. When pooling across ownership type, we find small and extremely imprecise negative relationships between g and indigent care days or visits (not shown here). When we break the effects out by ownership type, however, we find that only government-owned hospitals unambiguously respond to seismic risk by changing their provision of charity care. Specifically, a one-standard deviation increase in seismic risk is associated with 336 fewer days of indigent care. This estimate is distinguishable from zero at the 10 percent level. This effect appears to be driven by GAC days: a one-standard deviation increase in seismic risk is associated with 226 fewer indigent GAC days in public hospitals. The estimate for indigent ER visits also suggests a decline for high seismic risk public hospitals but is too imprecise to distinguish from zero. In contrast, public hospitals with higher seismic risk clearly cut free/reduced price clinic visits. A one-standard deviation increase in seismic risk is associated with about 900 fewer of these visits. How these hospitals reduce these visits is unclear in our data. They may, for example, close their doors on certain days of the week, limit the number of patients they see or do both.

These results - that public hospitals facing larger fixed cost shocks cut back on subsidized care - suggest that SB1953 has put pressure on the soft budget constraint of government-owned hospitals. That not-for-profit hospitals facing larger fixed cost shocks do not cut back on charitable is inconsistent with the predictions of the altruistic model. To help us further distinguish between the altruistic and perquisite-maximizing models of not-for-profit behavior, we next consider the provision of profitable services. Whereas welfare-maximizing firms, which overprovide quantity and quality, are predicted to cut back on profitable services, perquisite-maximizing firms should increase provision. We draw heavily on Horwitz (2005) to classify services as relatively profitable or generously reimbursed.

Table X looks at neonatal care in terms of the probability of adding a neonatal intensive care unit (NICU) as well as NICU beds, patient days and discharges. The first two columns of Table X assess the probability that hospitals add a NICU between 1997 and 2005. If anything, we find that not-for-profit hospitals with higher seismic risk are less likely to add NICUs. However, these estimates are not distinguishable from zero at conventional levels. Thus, we take these regressions as evidence that, at a minimum, not-for-profit hospitals with higher seismic risk are not adding NICUs. This is not too surprising given that higher seismic risk implies a larger financial hit from the mandate, which might make it more difficult to finance the high-tech equipment and hire the specialized staff required to run a NICU. Although not-for-profits with higher seismic risk are not adding NICUs, those with NICUs are using them more intensively. A one-standard deviation increase in seismic risk is associated with only about 1/2 an additional NICU bed but with almost 230 more NICU patient days. Importantly, this increase is specific to not-for-profits; the estimates for for-profit and public hospitals are both small in magnitude and indistinguishable from zero. The estimates for NICU discharges are positive for not-for-profit hospitals alone, although it is not statistically distinguishable from zero.

Table XI assesses the impact of seismic risk on a related service, obstetrical care. Not-for-profit hospitals with higher seismic risk increase the provision of obstetrical care. A one-standard deviation increase in seismic risk is associated with 127 more obstetrics discharges and 329 more obstetrics patient days. In contrast, these hospitals do not increase the number of beds they are licensed to use for obstetrics. Rather than expanding their service per se, they are instead using existing resources more intensively. In contrast, public hospitals with high seismic risk appear to lose obstetrics discharges and days, although the latter estimate is not distinguishable from zero at even the 10 percent level. These changes suggest that high seismic risk not-for-profits may be drawing their additional obstetrics patients from government hospitals. Estimates for for-profit hospitals are comparably small in magnitude and always statistically indistinguishable from zero.

In table XII, we next consider an unrelated type of profitable service - the use of Magnetic Resonance Imaging (MRI). We measure use as minutes provided and consider total minutes as well as inpatient and outpatient minutes separately. It is the latter type of care that should be the most profitable as it will not be reimbursed as part of a general visit. Like neonatal and obstetrics care, MRI minutes increase for not-for-profit hospitals facing higher seismic risk. A one standard deviation increase in seismic risk is associated with about 2800 more minutes or almost 35 more hours of MRI use. This increase is driven almost entirely by outpatient minutes. In contrast, we find no significant effects of seismic risk on MRI minutes for either for-profit or public hospitals. Taken together, the results from Tables X-XII, rule out purely altruistic models and lend strong support to perquisite-maximizing models of private not-for-profit hospital behavior.

7 Conclusions

Both policymakers and academics have long struggled to understand what not-for-profit hospitals do. While theories of not-for-profit hospital behavior abound, they typically lay out general motivations without specifying any formal structure. As a result, distinguishing across these theories has proven challenging. In this paper, we overcome this difficulty by embedding in a very general framework three of the leading theories of not-for-profit hospital behavior: 1) "for-profits in disguise," (2) welfare maximizers, and (3) perquisite maximizers. We derive the response of not-for-profit hospitals to a large fixed cost shock under each of these hypotheses. While for-profits in disguise may shut down in response to a large fixed cost shock, their service provision should remain otherwise unaffected. In contrast, welfare maximizers, who "overprovide" quantity and quality relative to pure profit-maximzers, will be forced to cut back on this work. In sharp contrast, perquisite-maximizers should respond by increasing the provision of profitable care and cutting back on perquisites.

We test these predictions by studying the effect of an unfunded mandate requiring all GAC hospitals in California to retrofit or rebuild in order to comply with modern seismic safety standards. We show that hospitals with higher seismic risk are more likely to shut down, irrespective of ownership type, and that not-for-profits with high seismic risk experience larger increases in spending on plant, property and equipment. Not-for-profits alone also increase their mix of profitable services - e.g. neonatal intensive care days, obstetrics discharges and MRI minutes. Government hospitals respond by decreasing the provision of charity care. As expected, for-profit hospitals do not change their service mix in response to this shock.

In the case of not-for-profit hospitals, these results are consistent with the idea of perquiste maximization and allow us to reject two of the leading theories of not-for-profit hospital behavior - "for-profits in disguise" and "pure altruism." The tax subsidies provided to not-for-profit hospitals allow them to pursue higher "quality" of services at the expense of quantity. The welfare implications of these results are, however, theoretically ambiguous and more work is needed to determine whether the welfare gains from the increases in quality (including possible technological spillovers) offset the loss in welfare cause by the decrease in quantity.

In contrast the behavior of government-owned hospitals is most consistent with welfare as firm maximand. As discussed in Hart, Shleifer and Vishny (1997), this does not necessarily imply that health care should be provided by the government since the same incentive structure that leads government owned hospitals to maximize welfare may correspond to a to-low incentive for efficient production. An separate analysis of the relationship between firm ownership structure and costs is necessary to determine whether government provision of health services is socially efficient.

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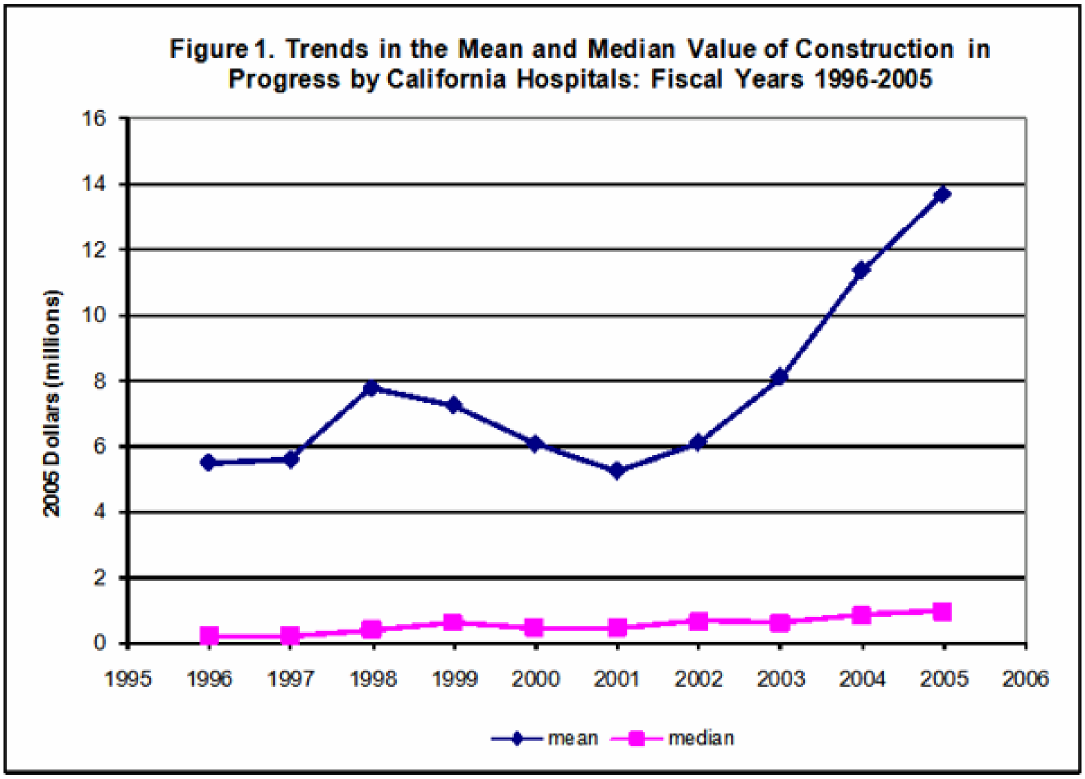


Figure 1. Trends in the Mean and Median Value of Construction in Progress by California Hospitals: Fiscal Years 1996-2005
2005 Dollars (millions)
0
2
4
6
8
10
12
14
16
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
mean
median

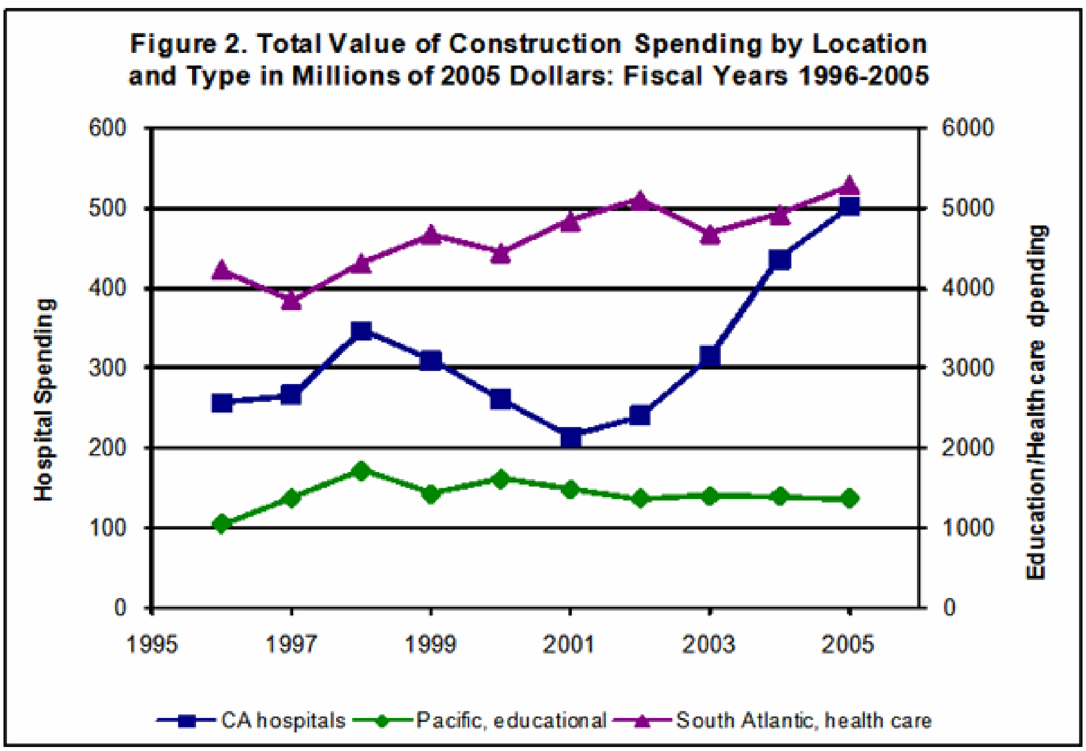


Figure 2. Total Value of Construction Spending by Location and Type in Millions of 2005 Dollars: Fiscal Years 1996-2005
Hospital Spending
Education/Health care dpending
0
100
200
300
400
500
600
1000
2000
3000
4000
5000
6000
1995
1997
1999
2001
2003
2005
CA hospitals
Pacific, educational
South Atlantic, health care

Table I
Basic Information for SB 1953 [a]

Panel A	*Key Provisions of SB 1953*
Date	*Requirement*
Jan 2001	Submit risk assessment with NPC and SPC ratings for all buildings and a compliance report.
Jan 2002	Retrofit nonstructural elements (e.g. power generators) and submit a plan for complying with structural safety requirements.
Jan 2008	Collapse hazard buildings should be retrofitted or closed. Extensions available through 2013.
Jan 2030	Retrofit to remain operational following a major seismic event.

Panel B	*Structural Performance Categories (SPC)*
Rating	*Description*
SPC 1	Pose significant risk of collapse and a danger to the public. Must be brought to level SPC2 by Jan. 1. 2008. 5-year extensions to 2013 may be granted.
SPC 2	Buildings do not significantly jeopardize life but may not be repairable following earthquake. Must be brought into compliance with SB1953 by Jan. 1 2030 or be removed from acute care services
SPC 3	May experience structural damage that does not significantly jeopardize life, but may not be repairable following an earthquake. May be used to Jan 1. 2030 and beyond
SPC 4	In compliance with structural provisions of SB1953, but may experience structural damage that may inhibit provision of services to the public following an earthquake. May be used to Jan. 1. 2030 and beyond.
SPC 5	In compliance with structural provisions of SB1953 and reasonably capable of providing service after an earthquake. May be used to Jan. 1. 2030 and beyond.

Panel C	*Non-Structural Performance Categories (NPC)*
Rating	*Description*
NPC 1	Equipment and systems to not meet any bracing requirements of SB1953.
NPC 2	By Jan. 1, 2002, communications, emergency systems, medical gases, fire alarm, emergency lighting systems in exit corridors must be braced to Part 2, Title 24 requirements
NPC 3	Meets NPC2. By Jan. 1, 2008, non-structural components in critical care, clinical labs, pharmacy, radiology central and sterile supplies must be braced to Part 2, Title 24. Fire sprinkler systems must be braced to NFPA 13, 1994, or subsequent applicable standards. May be used until Jan. 1., 2030.
NPC 4	Meets NPC 3. Architectural, mechanical, electrical systems, components and hospital equipment must be braced to Part 2, Title 24 requirements. May be used until Jan. 1., 2030.
NPC 5	Meets NPC 4. By Jan 1., 2030, must have on-site supplies of water, holding tanks for wastewater, fuel supply for 72 hours of emergency operations. May be used until Jan. 1, 2030 and beyond.

[a]Notes:

1. SPC stands for "Structural Performance Category"; NPC stands for "Non-structural Performance Category."
2. Sources: http://www.oshpd.ca.gov/fdd/sb1953/sb1953rating.pdf
3. See http://www.oshpd.ca.gov/fdd/sb1953/FinalJan2008Bul.PDF for extension information.

Table II
Summary of Predictions [a]

	Profitable Care (q)	*Uncompensated Care (u)*	*Quality (Q)*
FPID	**0**	**0**	**0**
Altruistic	**-**	**-**	**-**
Prestige	+	**0**	**-**

[a]Notes:

1. This table describes the response to a fixed cost shock predicted by each of these models.
2. 0 indicates no change, - indicates a decrease, and + indicates an increase in this type of service.

Table III
Descriptive Statistics [a]

Panel A	*Baseline Hospital Characteristics in 1996*		
	Full Sample	*Above median g*	*At or below median g*
seismic risk, g	0.475	0.660	0.324
	(0.222)	(0.131)	(0.117)
investor-owned	0.280	0.285	0.278
government-owned	0.191	0.175	0.204
belongs to a system	0.398	0.390	0.404
rural	0.085	0.005	0.159
teaching hospital	0.254	0.300	0.216
licensed beds	216	250	188
	(201)	(243)	(134)

Panel B	*Hospital Outcomes in or as of 2005*		
	Full Sample	*Above median g*	*At or below median g*
Total PPE spending	107	109	89
	(139)	(131)	(114)
closed	0.124	0.131	0.119
converted to for-profit status	0.047	0.055	0.041
Licensed beds	232	272	199
	(193)	(225)	(154)
Share beds staffed	0.840	0.808	0.865
Hospital days	50038	59048	42865
	(44786)	(53430)	(34984)
Discharges	10033	11435	8917
	(8521)	(9066)	(7909)
Indigent Care days	265	294	241
	(892)	(989)	(804)
NICU days	1926	2520	1442
	(3723)	(4345)	(3052)
Obstetrics Days	3320	3922	2829
	(4423)	(4732)	(4101)
Observations	445	200	245

[a] Notes:

1. Observations are for all hospitals reporting to OSHPD during our sample. Sample sizes for any given item or year may vary.
2. Standard deviations are given in parenthesis.
3. Dollar values are in 2005 terms and are given in millions.
4. Licensed beds are the maximum number of beds for which a hospital holds a license to operate; available beds are the number they physically have and staffed beds are the the number for which staff is on hand. See http://www.ahrq.gov/research/havbed/definitions.htm
5. In Panel B, all outcomes are for 2005 except for the closure and for-profit conversion outcomes, which measure events occurring between 1997 and 2005.

Table IV
Seismic Risk and Hospital Observables [a]

Panel A	*Neighborhood Characteristics: 1999*			
	Share Below FPL	*Share Hispanic*	*Share 5-17 Yr Olds*	*Log(Median Income)*
g	0.006	-.010	-0.027	0.032
	(0.046)	(0.096)	(0.025)	(0.150)
R-squared	0.210	0.323	0.269	0.309
Mean of Dep. Var.	0.144	0.286	0.189	10.4
Observations	472	472	472	472

Panel B	*Growth in Neighborhood Characteristics: 1989-1999*			
	Share Below FPL	*Share Hispanic*	*Share 5-17 Yr Olds*	*Percent Change Median Income)*
g	0.183	0.021	0.047	0.040
	(0.166)	(0.138)	(0.092)	(0.083)
R-squared	0.075	0.199	0.195	0.163
Mean of Dep. Var.	0.274	0.428	0.070	0.329
Observations	428	427	436	436

Panel C	*Hospital Characteristics: 1996*			
	Share Public	*Share NFP*	*Share Teaching*	*Log(Construction in Progress)*
g	0.0148	0.172	0.167	4.22
	(0.216)	(0.254)	(0.160)	(3.22)
R-squared	0.352	0.158	0.175	0.123
Mean of Dep. Var.	0.251	0.478	0.192	9.90
Observations	510	510	510	510

[a]Notes:

1. Dependent variables in Panel A and B are based on hospital ZIP code. Panel A data are from the 2000 census. Panel B data are based on changes between the 1990 and 2000 census values.
2. Dependent variables in Panel C are from OSHPD's Hospital Annual Financial Data.
3. All models include county fixed effects. Standard errors allow for an arbitrary correlation of the error terms at the ZIP code level.

Seismic Risk and Hospital Observables (Cont.) [a]

Panel D	*Hospital Characteristics: 1996*			
	Share with ER	*Share with NICU*	*Share with MRI*	*Participating in Indigent Programs*
g	0.058	-0.027	0.088	-0.060
	(0.164)	(0.239)	(0.252)	(0.218)
R-squared	0.095	0.125	0.105	0.237
Mean of Dep. Var.	0.835	0.149	0.467	0.516
Observations	535	535	535	535

[a] Notes:

1. Dependent variables in Panel D are from OSHPD's Hospital Annual Financial Data.
2. Sample size for neighborhood characteristics is determined by the availability of census data. Sample sizes for 1996 hospital characteristics are greater than those in our other tables because the number of hospitals decrease over time and, more importantly, because of the lack of controls in the regressions.
3. All models include county fixed effects. Standard errors allow for an arbitrary correlation of the error terms at the ZIP code level.

Table V
Hospital Closures and Conversions: 1997-2005 [a]

	Probability of Hospital Closure				*Probability of Conversion to For-Profit*			
	Probit (Marginal Effects) (Prob.=0.151)		*OLS (Prob.=0.136)*		*Probit (Marginal Effects) (Prob.=0.124)*		*OLS (Prob.=0.066)*	
g	0.298	0.274	0.352	0.306	0.009	-0.054	-0.176	-0.158
	(0.120)	(0.141)	(0.147)	(0.156)	(0.088)	(0.086)	(0.179)	(0.164)
g * For-Profit		0.067		0.123				
		(0.180)		(0.215)				
g * Public		0.001		0.091		0.286		-0.065
		(0.200)		(0.206)		(0.194)		(0.141)
For-Profit	0.038	0.002	0.072	0.012				
	(0.047)	(0.095)	(0.050)	(0.112)				
Public	-0.032	-0.032	-0.019	-0.064	-0.048	-0.107	-0.052	-0.019
	(0.040)	(0.088)	(0.045)	(0.129)	(0.017)	(0.051)	(0.032)	(0.066)
Multi-Site	0.012	0.012	0.004	0.003	-0.050	0.050	-0.068	0.067
	(0.029)	(0.028)	(0.036)	(0.036)	(0.026)	(0.025)	(0.036)	(0.037)
Rural	0.256	0.253	0.224	0.226	N/A	N/A	0.088	0.084
	(0.140)	(0.145)	(0.095)	(0.100)			(0.078)	(0.075)
Teaching	-0.002	-0.002	-0.009	-0.007	-0.032	-0.026	-0.046	-0.048
	(0.038)	(0.036)	(0.041)	(0.041)	(0.027)	(0.025)	(0.041)	(0.041)
Licensed Beds	-0.031	-0.030	-0.025	-0.025	-0.000	-0.000	0.002	0.002
(per 100)	(0.016)	(0.016)	(0.010)	(0.010)	(0.001)	(0.001)	(0.010)	(0.010)
Adj. R-squared	-	-	0.014	0.010	-	-	0.048	0.010
Observations	349	349	443	443	161	161	320	320

[a]Notes:

1. All regressions include the number of licensed beds in 1996 and dummies for 1996 ownership status (government-owned or for-profit with not-for-profit status excluded), 1996 rural status, 1996 teaching status, 1996 multi-hospital system status and county location. Standard errors are clustered at the city level.

Table VI
Plant Property and Equipment Spending [a]

Effect of g on PPE Spending 1997-2005 (in millions)

Panel A	*Hospitals in Continuous Operation, 1997-2005*			
	TOTAL		*Log(TOTAL)*	
Ground Acceleration Factor (g)	808	1270	0.583	1.032
	(460)	(573)	(0.698)	(0.646)
g * For-Profit		-913		-0.819
		(479)		(1.474)
g * Public		-1390		-1.442
		(678)		(0.717)
For-Profit	-473	-447	-1.340	-0.954
	(874)	(230)	(0.190)	(0.691)
Public	-591	179	-0.609	0.135
	(197)	(25.7)	(0.166)	(0.375)
Adj. R-squared	0.401	0.407	0.533	0.537
Observations	333	333	333	333

Panel B	*All Hospitals in Operation in 1997*			
	TOTAL		*Log(TOTAL)*	
Ground Acceleration Factor (g)	742	1010	-.371	.159
	(389)	(487)	(.597)	(0.170)
g * For-Profit		-641		1.09
		(342)		(1.14)
g * Public		-612		-1.33
		(528)		(0.749)
For-Profit	-267	-43.8	-1.57	-1.05
	(735)	(178)	(0.172)	(0.558)
Public	-404	-97.5	-.594	0.061
	(161)	(234)	(0.170)	(0.406)
Adj. R-squared	0.333	0.333	0.504	0.537
Observations	435	435	410	410

[a]Notes:

1. All regressions include the number of licensed beds in 1996 and dummies for 1996 ownership status (government-owned or for-profit with not-for-profit status excluded), 1996 rural status, 1996 teaching status, 1996 multi-hospital system status and county location. Standard errors are clustered at the city level.
2. Amounts for all years deflated to 2005 dollars.
3. PPE includes land purchases, building improvements, equipment spending and construction costs.
4. Panel A includes only hospitals continuously in operation between 1997 and 2005; Panel B sets missing PPE values to zero.

Table VII
Changes in Total Care: 1997-2005 [a]

	Days		*Discharges*	
g	11,376	13,540	1,321	1,402
	(6675)	(6,674)	(1,318)	(1,339)
g * For-Profit		-4,600		998
		(10,179)		(1,603)
g * Public		-6,820		-1,337
		(11,060)		(2,308)
For-Profit	-4,675	-2,468	-1,284	-1,768
	(2,060)	(5,223)	(424)	(933.5)
Public	-11,189	-7,640	-1208	-525.9
	(3,286)	(6,241)	(637)	(1,410)
Multi-Site	-1,093	-933.9	380	100.7
	(1,760)	(1,774)	(348)	(371.4)
Rural	-7,247	-7,940	-1,464	-1,679
	(2,952)	(3,244)	(726)	(792.8)
Teaching	5,715	5,629	380	363.3
	(1977)	(1,945)	(348)	(358.4)
Licensed Beds	1,207	1,210	-251	-246.3
(per 100)	(626)	(639.0)	(187)	(190)
Adj. R-squared	0.186	0.187	0.156	0.158
Observations	368	368	368	368

[a] Notes:

1. Patient days and discharges are from OSHPD's Inpatient Hospital Discharge Data files.
2. All regressions include the number of licensed beds in 1996 and dummies for 1996 ownership status (government-owned or for-profit with not-for-profit status excluded), 1996 rural status, 1996 teaching status, 1996 multi-hospital system status and county location. Standard errors are clustered at the city level.

Table VIII
Licensed and Staffed Beds, 2005 [a]

	Licensed Beds		*Share Staffed*	
g	85.6	53.5	0.142	0.147
	(40.5)	(50.2)	(0.077)	(0.088)
g * For-Profit		16.8		-0.144
		(71.4)		(0.136)
g * Public		149.4		0.116
		(79.2)		(0.105)
For-Profit	-16.8	-25.2	-0.053	0.017
	(15.4)	(33.2)	(0.029)	(0.065)
Public	1.95	-75.1	- 0.020	-0.079
	(17.0)	(35.0)	(0.024)	(0.061)
Multi-Site	-29.6	-31.7	-0.016	-0.015
	(15.9)	(16.9)	(0.022)	(0.022)
Rural	-61.6	-42.2	0.027	0.050
	(20.0)	(20.5)	(0.051)	(0.050)
Teaching	31.4	32.8	-0.051	-0.051
	(14.8)	(14.3)	(0.025)	(0.025)
Licensed Beds	73.0	72.7	-0.008	-0.009
(per 100)	(8.49)	(8.30)	(0.004)	(0.000)
Adj. R-squared	365	365	364	364
Observations	0.79	0.82	0.30	0.42

[a]Notes:

1. All regressions include the number of licensed beds in 1996 and dummies for 1996 ownership status (government-owned or for-profit with not-for-profit status excluded), 1996 rural status, 1996 teaching status, 1996 multi-hospital system status and county location. Standard errors are clustered at the city level.
2. Licensed beds are the total number of beds a hospital may have. Staffed beds are the number of beds in the hospital for which a hospital has assigned staff personnel.
3. In columns 3 and 4, the regressions include controls for the 2001 share of available or staffed beds. We use 2001 because it is the earliest year for which this data on staffed beds are available.

Table IX
Changes in Uncompensated Care : 2002-2005 [a]

	Total Indigent Days	*Indigent GAC Days*	*Indigent ER Visits*	*Clinic Visits*
g	379.6	213.8	119.8	1,083
	(369.4)	(347.2)	(600.7)	(960.7)
g * For-Profit	-72.6	-61.61	84.72	-1,099
	(327.1)	(307.7)	(743.0)	(1,123)
g * Public	-1,978	-1,291	-2,217	-5,360
	(915.7)	(668.3)	(1,554)	(2,570)
For-Profit	166.0	116.1	114.3	139.2
	(171.0)	(155.0)	(328.2)	(729.9)
Public	1,048	683.1	1,241	1,899
	(546.7)	(400.6)	(890.1)	(1,121)
Multi-Site	-46.73	-27.57	-38.79	496.0
	(84.62)	(71.75)	(143.7)	(487.5)
Rural	-357.5	-220.5	-629.4	-362.1
	(205.8)	(146.7)	(331.9)	(359.5)
Teaching	81.19	98.27	67.05	-10.81
	(140.9)	(113.3)	(196.3)	(485.2)
Licensed Beds	36.86	35.13	-0.111	22.31
(per 100)	(31.72)	(30.21)	(53.34)	(60.40)
Adj. R-squared	0.020	0.026	0.102	0.052
Observations	364	364	364	364

[a]Notes:

1. All regressions include the number of licensed beds in 1996 and dummies for 1996 ownership status (government-owned or for-profit with not-for-profit status excluded), 1996 rural status, 1996 teaching status, 1996 multi-hospital system status and county location. Standard errors are clustered at the city level.
2. blah blah

Table X
Neonatal Intensive Care Units (NICU) [a]

	Prob. Adding NICU 1997-2005		*Change 2002-2005*		
	Probit (Marginal Effects) *(P = 0.117)*	*OLS* *(P = 0.091)*	*NICU Beds*	*Days*	*Discharges*
g	-0.179	-0.189	2.45	1,084	61.6
	(0.113)	(0.126)	(1.41)	(435)	(46.7)
g * For-Profit	0.166	0.201	-0.073	-900	-112
	(0.180)	(0.205)	(1.85)	(454)	(52.1)
g * Public	0.088	0.091	-1.91	-860	-91.7
	(0.135)	(0.141)	(1.43)	(4545)	(62.5)
For-Profit	-0.084	-0.121	0.343	349	47.4
	(0.067)	(0.109)	(1.065)	(239)	(28.2)
Public	-0.048	-0.068	0.692	331	65.6
	(0.042)	(0.084)	(0.750)	(231)	(35.9)
Multi-Site	-0.018	-0.026	-0.245	-116.366	19.264
	(0.026)	(0.042)	(0.720)	(149.455)	(18.450)
Rural	-0.082	-0.083	0.626	15.968	-21.893
	(0.016)	(0.038)	(0.445)	(136.742)	(15.794)
Teaching	-0.029	-0.040	0.931	172.533	32.002
	(0.022)	(0.040)	(0.564)	(190.397)	(20.231)
Licensed Beds	0.002	0.004	-0.104	-33.03	-10.33
(per 100)	(0.007)	(0.001)	(0.144)	(45.24)	(3.734)
R-squared	–	0.13	0.07	0.08	0.14
Observations	342	445	364	365	365

[a] Notes:

1. All regressions include the number of licensed beds in 1996 and dummies for 1996 ownership status (government-owned or for-profit with not-for-profit status excluded), 1996 rural status, 1996 teaching status, 1996 multi-hospital system status and county location. Standard errors are clustered at the city level.

Table XI
Obstetrics [a]

	Changes in Obstetrics: 2002-2005			
	Total Discharges	*Service Discharges*	*Days of Care*	*Licensed Beds*
g	605	650	1,565	-1.42
	(273)	(364)	(711)	(7.84)
g * For-Profit	-1,642	-309	-538	3.01
	(599)	(506)	(926)	(6.76)
g * Public	-187	-603	-2,944	-3.58
	(420)	(471)	(1,520)	(7.12)
For-Profit	45	315	185	-0.303
	(257)	(243)	(547)	(4.11)
Public	739	455	1,264	2.25
	(307)	(243)	(719)	(3.39)
Multi-Site	42.3	-54.0	-125	-1.23
	(98.8)	(165)	(254)	(1.56)
Rural	-288	200	-737	-3.46
	(207)	(166)	(454)	(2.77)
Teaching	247	-266	454	3.44
	(117)	(140)	(265)	(1.78)
Licensed Beds	-36.2	-26.2	-7.61	-0.389
(per 100)	(20.9)	(24.6)	(60.2)	(0.318)
R-squared	0.15	0.11	0.11	0.07
Observations	365	365	365	365

[a]Notes:

1. All regressions include the number of licensed beds in 1996 and dummies for 1996 ownership status (government-owned or for-profit with not-for-profit status excluded), 1996 rural status, 1996 teaching status, 1996 multi-hospital system status and county location. Standard errors are clustered at the city level.

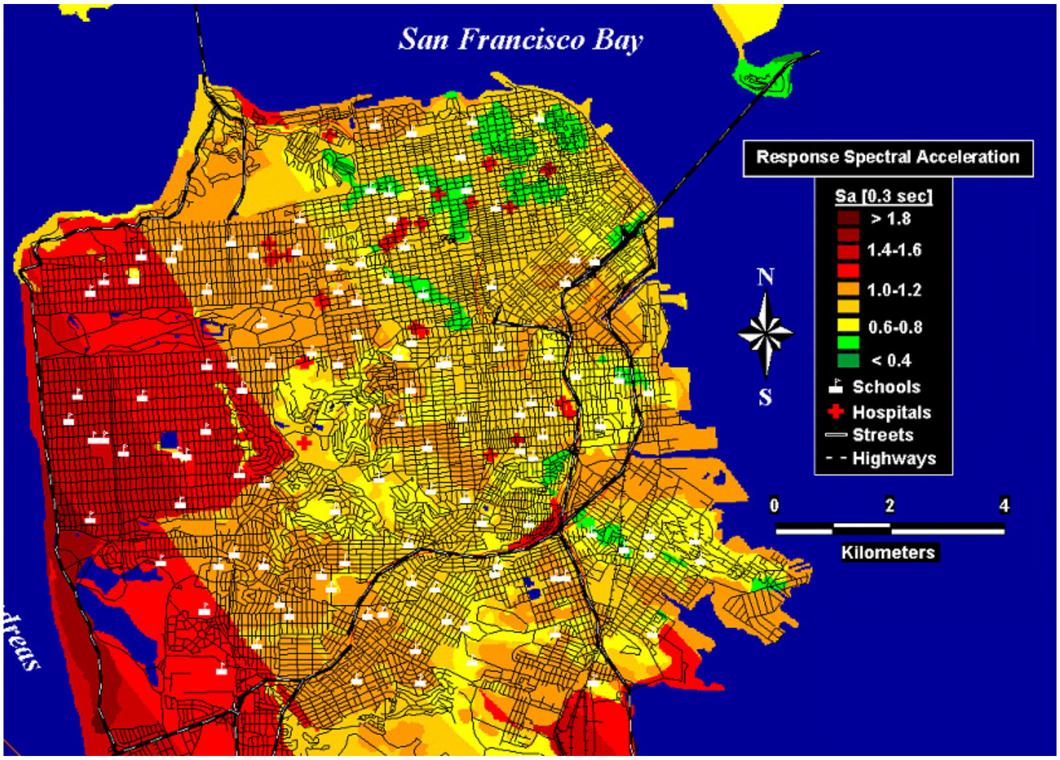
Table XII
MRI Minutes [a]

	MRI Changes 2002-2005		
	Total Minutes	*Inpatient Minutes*	*Outpatient Minutes*
g	14,291	4,6823	9,609
	(7878)	(4,833)	(5,016)
g * For-Profit	-6,868	-2,536	-4,150
	(6,979)	(4,408)	(4,328)
g * Public	-12,393	-4,912	-7,481
	(10,750)	(4,817)	(7,847)
For-Profit	7,290	4,859	2,431
	(3,968)	(2,461)	(2,353)
Public	6,147	3,315	2,831
	(5,257)	(2,404)	(3,851)
Multi-Site	-4,390	-3,555	-765
	(1,892)	(1,396)	(1,006)
Rural	-935	1,656	-2,652
	(3,353)	(1,332)	(2,404)
Teaching	4,424	2,345	2,079
	(1,802)	(1,202)	(1,058)
Licensed Beds	953	627	332
(per 100)	(1,314)	(179)	(230)
R-squared	0.24	0.14	0.20
Observations	365	365	365

[a]Notes:

1. All regressions include the number of licensed beds in 1996 and dummies for 1996 ownership status (government-owned or for-profit with not-for-profit status excluded), 1996 rural status, 1996 teaching status, 1996 multi-hospital system status and county location. Standard errors are clustered at the city level.

Appendix Figure 1: A map of expected ground acceleration in the event of an earthquake similar to the great quake of 1906.



Source: U.S. Geological Survey