Optimal Provision of Hospital Obstetric Units: Welfare, Health, and Geographic Disparities

Thomas Yu*

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Abstract

I study *OB provision*: hospitals' static decisions to operate obstetric (OB) units and participate in the hospital OB care market. OB provision rates are lower among rural hospitals than urban hospitals and declining overall, raising concerns about access to care and geographic disparities. What are the welfare and health consequences of OB provision, how are they geographically distributed, and which policies targeting OB provision are optimal? My empirical setting is Arkansas in 2022. Combining data on births and medical claims from the Arkansas All-Payer Claims Database, I estimate a static entry model of the hospital OB care market to recover each hospital's fixed cost, variable profit, demand-based quality, and health-based quality. Then, I simulate the effects of counterfactual OB provision and policies. In terms of social welfare, marginal OB provision from market-wide policies has positive choice set expansion effects (concentrated among rural mothers), but also negative fixed cost effects. In terms of maternal and infant health, marginal OB provision has a wide range of net health effects. Optimal policies involve targeted incentives for high-quality hospitals and restrictions for low-quality hospitals.

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1 Introduction

Obstetric (OB) care, or medical care related to pregnancy and childbirth, is largely provided in hospital OB units. Mothers in rural parts of the United States often must travel great distances to hospitals with OB units, raising concerns about access to care. The average distance to the nearest OB hospital is 17.3 miles for birthing mothers living in rural counties, as opposed to 7.3 miles for those living in urban counties (Fontenot et al., 2024).

What drives this disparity? Beyond geographic variation in the number of hospitals, an equally important and less studied source of variation is in whether those hospitals have OB units. I study *OB provision*: hospitals' static decisions to operate OB units and participate in the hospital OB care market. In 2010, 57% of hospitals in rural counties had OB units, as opposed to 70% of hospitals in urban counties; by 2022, these figures dropped to 48% and 64%, respectively (Kozhimannil et al., 2024). In other words, OB provision rates are lower among rural hospitals than urban hospitals by an increasingly wide margin, and they are declining overall.

Some existing public policies encourage OB provision. For example, Arkansas's 2025 "Healthy Moms, Healthy Babies" Act increased Medicaid payments for hospital OB care, with the goal of incentivizing hospitals to operate OB units and making it easier for mothers to receive such care (Lyon, 2025). Meanwhile, other policies discourage OB provision. For example, seventeen states have level-of-care regulations, which categorize hospitals according to staffing and capacity criteria and restrict hospitals from performing certain OB services unless they reach a minimum level (Vladutiu et al., 2020). Hospitals must satisfy the Level I criteria to operate OB units at all, potentially reducing OB provision.

In this paper, I answer the following questions: what are the welfare and health consequences of OB provision, how are they geographically distributed, and which policies targeting OB provision are optimal? Focusing on the hospital OB care market in Arkansas in 2022, I quantify how each hospital's OB provision affects both social welfare and maternal and infant health. Then, I evaluate welfare and health under market-wide policies and characterize optimal targeted policies.

OB provision can have three effects on social welfare: a choice set expansion effect (additional options that some mothers may prefer) which increases welfare, a fixed cost effect (fixed cost paid by the entrant) which decreases welfare, and a marginal cost effect (marginal costs paid by the entrant instead of incumbents) which may increase or decrease welfare depending on the entrant's relative marginal cost. The net welfare effect may be positive or negative. An unregulated market may have too little or too much OB provision relative to the social welfare maximizing outcome.

I consider maternal and infant health separately from social welfare for two reasons. First,

I find suggestive evidence that mothers do not fully internalize the health-based quality of OB hospitals (e.g., due to imperfect information), so revealed-preference welfare estimates may not fully capture the value of health. Second, changes in maternal and infant health may generate large-scale externalities (e.g., through public health spending). OB provision can have two health effects: a redirection effect (redirecting mothers toward the entrant away from incumbents) which may improve or worsen health depending on the entrant's relative health-based quality, and a travel distance effect (reducing travel distances) which may improve health if care is time-sensitive. The net health effect may be positive or negative.

I combine two datasets from the Arkansas All-Payer Claims Database. The first dataset contains characteristics of all Arkansas births in 2022, including chosen OB hospitals and maternal and infant health. The second dataset contains characteristics from medical claims for Medicaid-insured and commercially-insured Arkansas residents in 2022, including payments, out-of-pocket spending, and insurers. I supplement these datasets with data from the American Hospital Association Annual Survey on characteristics of all hospitals, including OB provision, and data from the U.S. Census Bureau on local demographics.

I estimate a static entry model of the hospital OB care market in Arkansas in 2022. First, hospitals make OB provision decisions. Then, commercial prices are set by bargaining between commercial insurers and OB hospitals. Mothers choose OB hospitals to receive care from. Finally, maternal and infant health is determined. I recover expectations of fixed cost, variable profit, demand-based quality, and health-based quality for each hospital. Then, I simulate the effects of counterfactual OB provision and policies.

I consider market-wide policies, such as Medicaid subsidies that encourage OB provision and level-of-care regulations that discourage OB provision. First, I evaluate social welfare. Marginal OB provision has positive choice set expansion effects (concentrated among rural mothers), but also negative fixed cost effects. Second, I evaluate maternal and infant health. The redirection effect is important, but the travel distance effect is not. There is wide variation in health-based quality, so there is a wide range of redirection effects, and thus net health effects, of marginal OB provision. Some marginal entrants improve health, while others worsen health. Finally, I consider targeted policies. Optimal policies involve targeted incentives for high-quality hospitals and restrictions for low-quality hospitals.

The remainder of this section reviews the related literature. Section 2 outlines a stylized model and presents descriptive evidence to characterize the welfare and health effects of OB provision. Section 3 introduces my empirical setting of Arkansas in 2022 and discusses my data. Section 4 outlines a model of the hospital OB care market. Section 5 describes how I estimate the model and presents estimation results. Section 6 presents findings from simulated counterfactual OB provision and policies. Section 7 concludes.

1.1 Related Literature

First, this paper is related to the literature on the effects of hospital and OB unit closures. For example, Capps et al. (2010) find that hospital closures increase social welfare, while Alexander and Richards (2023) find negative spillovers in other markets. Most closely related to this paper, Fischer et al. (2024) find that OB unit closures have negligible to slightly positive effects on maternal and infant health. The findings from these papers are informative about the effects of market participation for hospitals that have experienced closures, but they are not sufficient to evaluate market-wide policies. I use a structural model to estimate both welfare and health effects of OB provision for all hospitals (including those that have not experienced OB unit closures), and I evaluate both market-wide and targeted policies. To connect my findings to closures, encouraging OB provision (e.g., with Medicaid subsidies) is equivalent to preventing OB unit closures, and discouraging OB provision (e.g., with level-of-care regulations) is equivalent to inducing OB unit closures.

Second, this paper is related to the literature on optimal firm entry. A well-established theoretical literature shows that an unregulated market may have too few or too many participating firms relative to the social welfare maximizing outcome (Mankiw & Whinston, 1986; Spence, 1976). Some empirical papers have evaluated welfare effects of entry; for example, Berry et al. (2016) find excessive entry in the local radio market. I consider a new market (hospital OB care) and evaluate both welfare and health effects of market participation.

Third, this paper is related to the literature on provider quality measurement in health care. A challenge in identifying provider quality is endogeneity of provider choice: a patient's provider choice may be correlated with their unobserved pre-existing health. I follow a common strategy in this literature of constructing a distance-based instrument for provider choice (Einav et al., 2025; Geweke et al., 2003; Olenski & Sacher, 2024). I consider a new application of provider quality measurements: designing policies targeting market participation to direct patients toward high-quality providers away from low-quality providers.

Fourth, this paper is related to the literature on structural models of hospital markets. My model of the hospital OB care market is most similar to that of Gowrisankaran et al. (2015) in which insurers and networks are taken as exogenous and prices are set by bargaining between insurers and hospitals. I extend the model by adding an OB provision stage.

Fifth, this paper is related to the literature on fixed cost estimation in entry models. A challenge in identifying fixed costs is selection of participating firms: participants are likely to have lower unobserved fixed cost shocks than non-participants, so expectations conditional on participation are problematic. I follow the strategy of Eizenberg (2014) of assuming worst-case lower and upper bounds on fixed costs to construct unconditional expectations. I apply this strategy to identify and estimate fixed costs in the hospital OB care market.

2 Stylized Model and Descriptive Evidence: Welfare and Health Effects of OB Provision

In this section, I outline a stylized model that illustrates the welfare and health effects of OB provision in a simple theoretical environment. Then, I present descriptive evidence of the empirical importance of such effects in the hospital OB care market.

2.1 Stylized Model

There is a continuum of mothers of measure 1 distributed uniformly between two hospitals. At one end, Hospital A (the incumbent) has an OB unit. At the other end, Hospital B (the entrant) may or may not have an OB unit. An OB unit has fixed cost $FC > 0$. Hospital A's OB unit has marginal cost $MC_A > 0$, and Hospital B's OB unit (if it has one) has marginal cost $MC_B > 0$. The price of OB care is $p > \max\{MC_A, MC_B\}$.

Each mother chooses to receive care from her preferred OB hospital, and there is no outside option. Mothers incur costs from price and travel distance.[1] In addition, mothers value maternal and infant health, which improves with higher OB hospital quality and may worsen with greater travel distance.

I allow for imperfect information by assuming mothers have the following beliefs about health (which may or may not be correct): OB hospitals have the same quality, and travel distance does not affect health. Thus, mothers do not perceive changes in their welfare related to maternal and infant health.

Welfare Effects To focus on welfare, suppose mothers' beliefs about health are correct, so maternal and infant health is constant. I show that the net welfare effect of OB provision may be positive or negative, and an unregulated market may have too little or too much OB provision relative to the social welfare maximizing outcome.

At first, suppose only Hospital A has an OB unit. All mothers choose Hospital A. Because prices are transfers and maternal and infant health is constant, social welfare (i.e., the sum of mothers' and hospitals' welfare) consists of total travel costs, fixed costs, and marginal costs. In other words, social welfare is

$$\text{Social Welfare}_{\text{A only}} = -\text{Travel Costs}_{\text{A only}} - FC - MC_A \tag{1}$$

[1] In reality, mothers don't pay the full price of OB care because of insurance. In this stylized model, mothers' choices can be interpreted as joint mother-insurers' choices, and mothers' welfare as joint mother-insurers' welfare.

Then, suppose Hospital B has an OB unit as well. The half of mothers located nearer to Hospital B than to Hospital A switch to choosing Hospital B. Social welfare is

$$\text{Social Welfare}_{\text{A and B}} = -\text{Travel Costs}_{\text{A and B}} - 2\text{FC} - (\text{MC}_\text{A} + \text{MC}_\text{B})/2 \tag{2}$$

The change in social welfare due to Hospital B's OB provision is

$$\Delta\text{Social Welfare} = \underbrace{(-\Delta\text{Travel Costs})}_{>0} + \underbrace{(-\text{FC})}_{<0} + \underbrace{(\text{MC}_\text{A} - \text{MC}_\text{B})/2}_{>0 \text{ or } <0} \tag{3}$$

where $\Delta\text{Travel Costs} = \text{Travel Costs}_{\text{A and B}} - \text{Travel Costs}_{\text{A only}}$.

Hospital B's OB provision can have three effects on social welfare: a *choice set expansion* effect (an additional option that half of the mothers prefer) which increases welfare, a *fixed cost* effect (fixed cost paid by Hospital B) which decreases welfare, and a *marginal cost* effect (marginal costs paid by Hospital B instead of Hospital A) which may increase or decrease welfare depending on Hospital B's marginal cost relative to Hospital A. The net welfare effect may be positive or negative.

Consider the outcome from a social planner deciding whether to operate an OB unit at Hospital B to maximize social welfare. The social planner's OB provision decision is

$$\text{Prov}_{\text{Planner}} = \begin{cases} 1 & \text{if } -\Delta\text{Travel Costs} + (\text{MC}_\text{A} - \text{MC}_\text{B})/2 > \text{FC} \\ 0 & \text{if } -\Delta\text{Travel Costs} + (\text{MC}_\text{A} - \text{MC}_\text{B})/2 < \text{FC} \end{cases} \tag{4}$$

Alternatively, consider an unregulated market in which Hospital B privately decides whether to operate an OB unit to maximize its own profit. Let π_B be Hospital B's variable profit. Hospital B's private OB provision decision is

$$\text{Prov}_{\text{Private}} = \begin{cases} 1 & \text{if } \pi_\text{B} > \text{FC} \\ 0 & \text{if } \pi_\text{B} < \text{FC} \end{cases} \tag{5}$$

On the one hand, the unregulated market has too little OB provision relative to the social welfare maximizing outcome (Hospital B does not operate an OB unit while the social planner would) if $\pi_\text{B} < \text{FC} < -\Delta\text{Travel Costs} + (\text{MC}_\text{A} - \text{MC}_\text{B})/2$. On the other hand, it has too much OB provision (Hospital B operates an OB unit while the social planner would not) if $-\Delta\text{Travel Costs} + (\text{MC}_\text{A} - \text{MC}_\text{B})/2 < \text{FC} < \pi_\text{B}$.

Another way to express welfare effects is in terms of externalities. Out of the change in social welfare, Hospital B internalizes its own profit. Thus, the net externality generated by

Hospital B's private OB provision decision is

$$\text{Net Externality} = \Delta\text{Social Welfare} - (\pi_B - \text{FC}) \tag{6}$$

$$= \underbrace{(-\Delta\text{Travel Costs})}_{>0} + \underbrace{(\text{MC}_A - \text{MC}_B)/2}_{>0 \text{ or } <0} + \underbrace{(-\pi_B)}_{<0} \tag{7}$$

Hospital B's OB provision can generate three externalities: a positive market expansion externality (an additional option that half of the mothers prefer), an ambiguously-signed marginal cost externality (marginal costs paid by Hospital B instead of Hospital A), and a negative business stealing externality (diverting variable profits to Hospital B). If the net externality is positive, it is possible for there to be too little OB provision. If the net externality is negative, it is possible for there to be too much OB provision.

Health Effects Now, suppose mothers' beliefs about health are incorrect. Unbeknownst to mothers, OB hospitals may have differing quality, and travel distance may affect health. The previous welfare analysis still holds when only considering perceived changes in mothers' welfare. However, OB provision can now also cause unperceived changes in mothers' welfare due to its effect on maternal and infant health.

Again, consider the following comparison. At first, only Hospital A has an OB unit, so all mothers choose Hospital A. Then, Hospital B has an OB unit as well, so the half of mothers located nearer to Hospital B than to Hospital A switch to choosing Hospital B.

Hospital B's OB provision can have two effects on maternal and infant health. First, it can have a *redirection* effect (redirecting mothers toward Hospital B away from Hospital A), which may improve or worsen health depending on Hospital B's quality relative to Hospital A. Second, it can have a *travel distance* effect (reducing travel distances), which may improve health if care is time-sensitive. The net health effect, and thus unperceived effect on mothers' welfare, of Hospital B's OB provision may be positive or negative.

2.2 Descriptive Evidence

Evidence of Welfare Effects I examine how OB provision is related to commercial and Medicaid market sizes, as measured for each hospital by the numbers of commercially-insured and Medicaid-insured 19–44 year old women within 10 miles.[2]

[2]I group uninsured women into the Medicaid category. Most uninsured women would qualify for Medicaid under the more generous eligibility rules for pregnant women.

I consider the following probit regression. For each hospital j,

$$\Pr\left(\text{Open OB Unit}_j\right) = \Phi\left(\beta_1 \ln\left(\text{Commercial 19–44yo Women}_j\right) + \beta_2 \ln\left(\text{Medicaid 19–44yo Women}_j\right) + \boldsymbol{\gamma}'\mathbf{y}_j\right) \tag{8}$$

where $\mathbf{y}_j$ are hospital characteristics, including log population within 10 miles excluding 19–44 year old women, population shares by income bin within 10 miles, and log distance to the nearest other OB hospital.

I apply maximum likelihood estimation. My sample is all general hospitals in the U.S. in 2022, limited to those that either have open OB units or formerly had OB units at some point in 1995–2021. I do so separately for two samples: private (non-profit and for-profit) hospitals and public hospitals. Table 1 shows the results expressed as average marginal effects.

Table 1: OB Provision vs. Market Size

	E[ΔPr(Open OB unit)]	
	(1)	(2)
Ln commercial 19–44yo women	0.10**	0.18**
	(0.04)	(0.06)
Ln Medicaid 19–44yo women	0.07	0.14**
	(0.04)	(0.05)
Hospital type	Private	Public
Num. obs.	2937	780
Pseudo R^2	0.20	0.19

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$. Source: AHA Annual Survey and U.S. Census Bureau. Sample: general hospitals in the U.S., observed in 2022, that had OB units in 1995–2022. Controls: state indicators, teaching hosp, crit access hosp, non-OB beds, non-OB doctors, log pop excl 19–44yo women, pop shares by inc bin, log dist to nearest other OB hosp. Demographics from census tracts within 10mi. Robust std. errors.

OB provision among private hospitals has a stronger positive relationship with commercial market size than with Medicaid market size. This is consistent with commercial mothers being more profitable to treat than Medicaid mothers, and private hospitals making OB provision decisions to maximize their own profits.

Compared to private hospitals, OB provision among public hospitals responds even stronger to both commercial and Medicaid market sizes. This is consistent with public hospitals internalizing a positive welfare effect of OB provision that scales with the numbers of commercial and Medicaid mothers. For example, a plausible explanation is that both commercial and Medicaid mothers benefit from additional OB hospitals, and public hospitals internalize mothers' welfare. In that case, the choice set expansion effect is important.

Although private and public hospitals have different objectives, they are both more likely

to operate OB units if their variable returns (which scale with market size) are larger. This suggests that they make OB provision decisions by weighing variable returns against positive fixed costs. Thus, the fixed cost effect is important.

Evidence of Health Effects Fischer et al. (2024) use a difference-in-differences design to estimate the effects of OB unit closures on maternal and infant health. They find negligible to slightly positive health effects on average. This suggests that mothers who would otherwise receive care from hospitals whose OB units close may be redirected to higher-quality OB hospitals. Thus, the redirection effect is important.

In addition, Fischer et al. (2024) find no evidence of negative health effects from OB unit closure-driven increases in the distances mothers must travel to receive OB care. This suggests that the travel distance effect is not important.

3 Setting and Data: Arkansas in 2022

3.1 Setting

My empirical setting is Arkansas in 2022. Arkansas is a highly rural state: among its population of around 3 million people, 45% live in rural areas, more than double the nationwide rural share (U.S. Census Bureau, 2024). In addition, Arkansas has poor maternal and infant health. Its maternal mortality rate (35.3 per 100,000 births) is 90% higher than the national average, and its infant mortality rate (8.2 per 1,000 births) is 46% higher than the national average (March of Dimes, 2025). Thus, health effects are especially salient in this setting.

I exclude three counties from my setting because they are parts of metropolitan areas centered in other states: Crittenden County (part of the Memphis metropolitan area) and Miller and Little River Counties (parts of the Texarkana metropolitan area).

My setting includes 37 hospitals with open OB units and 17 hospitals that formerly had OB units at some point in 1995–2021. Figure 1 shows the locations of these hospitals along with local population density. Although Arkansas's overall population density is low, it includes a few dense urban areas, most notably the Central Arkansas (Little Rock) metropolitan area and the Northwest Arkansas (Fayetteville–Springdale–Rogers) metropolitan area. Hospitals are generally clustered in urban areas and disperse in rural areas. Some areas (especially urban ones) have multiple OB hospitals, suggesting limited scope for OB provision in these areas to have positive welfare and health effects. Other areas (especially rural ones) have only one nearby OB hospital, or even none at all despite the presence of former OB hospitals. In these areas, OB provision could have important positive welfare and health effects.

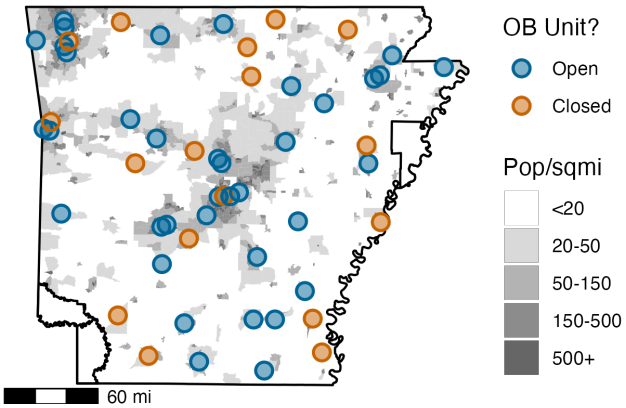


Figure 1: Hospitals in Arkansas in 2022

Source: AHA Annual Survey and U.S. Census Bureau. Sample: general hospitals in Arkansas (except Crittenden, Miller, and Little River Counties), observed in 2022, that had OB units in 1995–2022. Pop densities from census block groups.

Figure 2 shows the history of OB provision in my setting in 1995–2022. There is little action on the extensive margin (openings and closures of hospitals). There are a few extensive margin-driven increases in OB provision (two openings of new hospitals with OB units) and no intensive margin-driven increases in OB provision (zero additions of OB units to existing hospitals). OB provision has steadily decreased, almost entirely due to OB unit closures.

3.2 Data

I combine two datasets from the Arkansas All-Payer Claims Database. The first dataset contains characteristics of all Arkansas births in 2022, including chosen OB hospitals and maternal and infant health. The second dataset contains information from medical claims for Medicaid-insured and commercially-insured Arkansas residents in 2022, including payments, out-of-pocket spending, and insurers.

I merge these two datasets using the following procedure. First, I identify each birth's corresponding insurance enrollee: I match on a person identifier (encrypted combination of mother's name, mother's date of birth, and mother's sex), and I match dates of birth with dates of insurance coverage. Second, I identify each birth's corresponding medical claims: I match dates of birth with dates of service, I match hospitals in the birth data with associated National Provider Identifiers in the claim data, and I filter claims to only those with labor and delivery-related diagnosis or procedure codes.

There are two reasons why a birth may not match with any claims. First, the claim data are not comprehensive. Mothers may be missing if they pay entirely out-of-pocket, are uninsured,

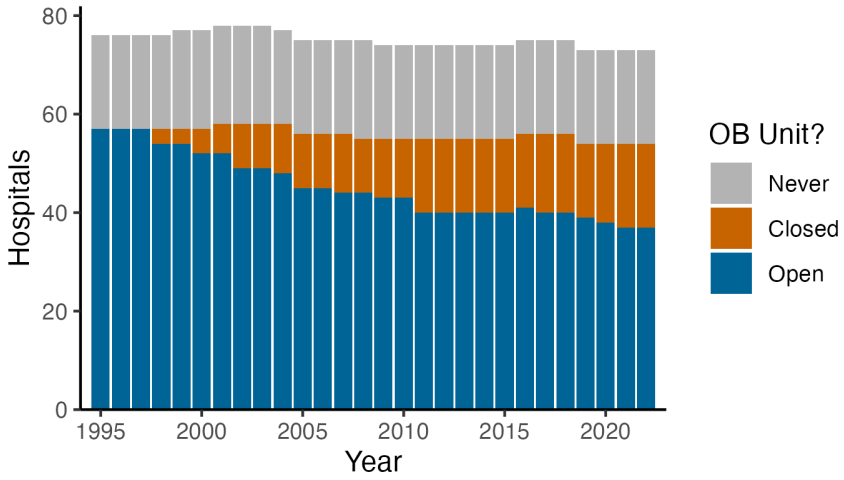


Figure 2: History of OB Provision in Arkansas

Source: AHA Annual Survey. Sample: general hospitals in Arkansas (except Crittenden, Miller, and Little River Counties).

or are insured by entities that are not required to report to the All-Payer Claims Database (e.g., commercial employer-sponsored self-insured plans, plans with fewer than 2,000 enrollees, or the Veterans Affairs system). Second, the match between datasets may not be perfect due to imprecision in mothers' names or other data collection errors.

I supplement these datasets with data from the American Hospital Association (AHA) Annual Survey on characteristics of all hospitals, including OB provision, and data from the U.S. Census Bureau on local demographics.

There are around 30,000 births in my setting, and their summary statistics are shown in Table 2. Most mothers are commercially-insured, a large fraction are Medicaid-insured, and a few are neither (e.g., uninsured). The uninsured share is lower than in the general population because of the more generous Medicaid eligibility rules for pregnant women. The three groups have similar average ages, average travel distances, planned caesarean section rates, maternal complication rates, and infant complication rates. I observe claims for 51% of commercial births and 78% of Medicaid births. Commercial births on average have high payments, with a notable fraction paid by mothers out-of-pocket. Medicaid births have lower payments, with zero out-of-pocket spending for mothers.

I highlight three considerations related to my data. First, I drop the following observations from my sample. I drop mothers whose home locations are outside of my setting. For multiple births (e.g., twins or triplets), I drop births after the first-occurring ones. Finally, I drop births that occur in out-of-network hospitals or in locations other than OB hospitals (e.g., home births), both of which are rare.

Table 2: Summary Statistics

	Commercial	Medicaid	Other
Age (yr)	28.5	25.9	27.7
Travel distance (mi)	16.5	17.0	15.3
Planned c-section	0.22	0.22	0.21
No maternal complications	0.98	0.99	0.98
No infant complications	0.97	0.95	0.95
Matched to claims	0.51	0.78	0
Payment ($)	8,141	3,960	–
Out-of-pocket ($)	1,574	0	–
Num. obs.	17,962	12,565	1,242

Second, I classify some Medicaid insurers as commercial for the purposes of analysis. Arkansas residents who are ineligible under the traditional Medicaid threshold, but are eligible under the expanded threshold, are covered by the "Arkansas Health and Opportunity for Me" (ARHOME) program, which uses Medicaid funds to provide recipients with commercial insurance. Another Arkansas Medicaid program is the "Provider-Led Arkansas Shared Savings Entities" (PASSE) program, which provides managed care to disabled recipients. I classify ARHOME and PASSE plans as commercial because, like commercial insurance, they have limited networks and negotiated prices.

Third, distances between mothers and hospitals are imputed expected distances. Mothers' home locations are observed at the county level. From the U.S. Census Bureau data, I observe populations of women by age bin at the census block group level. For each mother, I use her county and age to construct her probability of living in each census block group and impute her expected distances to hospitals.

4 Model of the Hospital OB Care Market

In this section, I outline a model of the hospital OB care market in Arkansas in 2022 that predicts both market outcomes and maternal and infant health. In Stage 1, fixed cost shocks are realized, and then hospitals make OB provision decisions. In Stage 2, demand and marginal cost shocks are realized, and then commercial prices are set by bargaining between commercial insurers and OB hospitals. Stage 3 is separated into two steps. In Stage 3a, utility shocks are realized, and then mothers choose OB hospitals to receive care from. In Stage 3b, maternal and

infant health is determined.

I proceed through the stages in reverse order, outlining the structure of each stage and how its parameters are identified. I begin by describing Stage 3a, OB hospital demand, and Stage 3b, maternal and infant health. Next, I describe Stage 2, commercial price setting. Finally, I describe Stage 1, OB provision. Mothers are indexed by $i \in I$, insurers are indexed by $m \in M$, and hospitals are indexed by $j \in J$. **Bold** characters represent vectors.

4.1 OB Hospital Demand

In Stage 3a, utility shocks are realized, and then mothers choose OB hospitals to receive care from. Prior to this step, hospitals have made OB provision decisions, and commercial prices have been set.

Each mother is insured by either a commercial insurer or Medicaid. Mother i's insurer, denoted $m(i)$, is taken as exogenous. Let J^{OB} denote the subset of hospitals that have OB units, J_m denote the subset that are in-network for insurer m, and J_m^{OB} denote the subset that are in both. All hospitals are in-network for Medicaid, and networks are taken as exogenous.

Let r_i denote the intensity of resource use for mother i's birth, normalized to be 1 on average. Each in-network insurer-OB hospital pair mj has a price p_{mj}, and let $\mathbf{p}_m$ denote insurer m's entire vector of prices. I assume the payment for mother i's birth is $r_i p_{m(i)j}$. In other words, p_{mj} is the price per unit of birth intensity.[3] In addition, each mother has a coinsurance rate c_i that determines the fraction she pays out-of-pocket. r_i and c_i are taken as exogenous.

Finally, each mother's home location is taken as exogenous. Let Dist_{ij} denote the distance between mother i's home and hospital j.

Each mother chooses the in-network OB hospital that gives her the highest utility, and there is no outside option. I assume mother i's utility from choosing OB hospital j is

$$u_{ij} = \underbrace{-\alpha c_i r_i p_{m(i)j} - \beta_1 \text{Dist}_{ij} - \beta_2 \text{Dist}_{ij}^2 + \boldsymbol{\gamma}' \mathbf{z}_{ij} + \xi_j}_{\delta_{ij}} + \epsilon_{ij} \tag{9}$$

where $\mathbf{z}_{ij}$ are interacted mother-hospital characteristics and ϵ_{ij} is an i.i.d. utility shock with a standard Gumbel distribution that is independent of all mother-hospital characteristics.

I further parameterize hospital j's *demand-based quality* ξ_j as

$$\xi_j = \boldsymbol{\zeta}' \mathbf{y}_j + e_j \tag{10}$$

[3] I recover r_i and p_{mj} from my data as follows. For each birth, I observe $\text{Payment}_i = r_i p_{mj}$. I estimate a linear regression of $\ln \text{Payment}_i$ on mother characteristics and insurer-OB hospital indicators. Then, the coefficients on the indicators are $\ln p_{mj}$, and the component of log payment explained by mother characteristics is $\ln r_i$.

where $\mathbf{y}_j$ are hospital characteristics and e_j is an i.i.d. demand shock with $e_j \mid \mathbf{y}_j \sim \mathrm{N}\left(0, \sigma_e^2\right)$.

Given this structure, before ϵ_{ij} shocks are realized, the probability that mother i chooses OB hospital j (as a function of in-network OB hospitals $J_{m(i)}^{\mathrm{OB}}$ and prices $\mathbf{p}_{m(i)}$) is

$$s_{ij}\left(J_{m(i)}^{\mathrm{OB}}, \mathbf{p}_{m(i)}\right) = \frac{\delta_{ij}\left(\mathbf{p}_{m(i)}\right)}{\sum_{k \in J_{m(i)}^{\mathrm{OB}}} \delta_{ik}\left(\mathbf{p}_{m(i)}\right)} \tag{11}$$

and her expected utility is

$$\mathrm{EU}_i\left(J_{m(i)}^{\mathrm{OB}}, \mathbf{p}_{m(i)}\right) = \ln\left(\sum_{j \in J_{m(i)}^{\mathrm{OB}}} \exp\left(\delta_{ij}\left(\mathbf{p}_{m(i)}\right)\right)\right) \tag{12}$$

Mother i's willingness-to-pay (WTP) for in-network OB hospital j is defined as

$$\mathrm{EU}_i\left(J_{m(i)}^{\mathrm{OB}}, \mathbf{p}_{m(i)}\right) - \mathrm{EU}_i\left(J_{m(i)}^{\mathrm{OB}} \setminus j, \mathbf{p}_{m(i)}\right) \tag{13}$$

Identification of OB Hospital Demand Parameters The parameters to identify are α, β_1, β_2, $\boldsymbol{\gamma}$, $\boldsymbol{\zeta}$, and σ_e. For all mothers $i \in I$ and OB hospitals $j \in J^{\mathrm{OB}}$, I observe c_i, r_i, $p_{m(i)j}$, Dist_{ij}, $\mathbf{y}_j$, $\mathbf{z}_{ij}$, $J_{m(i)}^{\mathrm{OB}}$, and $\mathbf{1}\left(i \text{ chooses } j\right)$.

For a candidate set of values for α, β_1, β_2, $\boldsymbol{\gamma}$, and $\left\{\xi_j\right\}_{j \in J^{\mathrm{OB}}}$, the log likelihood is

$$\ln L\left(\alpha, \beta_1, \beta_2, \boldsymbol{\gamma}, \left\{\xi_j\right\}_{j \in J^{\mathrm{OB}}}\right) = \sum_{i \in I} \sum_{j \in J^{\mathrm{OB}}} \left[\mathbf{1}\left(i \text{ chooses } j\right) \cdot \ln s_{ij}\left(\alpha, \beta_1, \beta_2, \boldsymbol{\gamma}, \left\{\xi_j\right\}_{j \in J^{\mathrm{OB}}}\right)\right] \tag{14}$$

The log likelihood is uniquely maximized at the true values, which identifies α, β_1, β_2, $\boldsymbol{\gamma}$, and $\left\{\xi_j\right\}_{j \in J^{\mathrm{OB}}}$. Then, applying ordinary least squares to Equation 10 for the subset of OB hospitals identifies $\boldsymbol{\zeta}$, and the variance of implied e_j shocks identifies σ_e.

4.2 Maternal and Infant Health

In Stage 3b, maternal and infant health is determined. Prior to this step, hospitals have made OB provision decisions, commercial prices have been set, and mothers have chosen OB hospitals.

Let Health_i denote a measure of maternal and infant health associated with mother i,

normalized so higher values indicate better health. I assume Health_i is determined by

$$\begin{aligned}\text{Health}_i = &\sum_{j\in J}\left[\mathbf{1}\left(i \text{ chooses } j\right)\cdot\lambda_j\right] \\ &+\eta_1\underbrace{\sum_{j\in J}\left[\mathbf{1}\left(i \text{ chooses } j\right)\cdot \text{Dist}_{ij}\right]}_{\text{Dist}_i}+\eta_2\underbrace{\sum_{j\in J}\left[\mathbf{1}\left(i \text{ chooses } j\right)\cdot \text{Dist}_{ij}^2\right]}_{\text{Dist}_i^2} \\ &+\boldsymbol{\kappa}'\underbrace{\sum_{j\in J}\left[\mathbf{1}\left(i \text{ chooses } j\right)\cdot \mathbf{z}_{ij}\right]}_{\mathbf{z}_i}+\boldsymbol{\mu}'\mathbf{x}_i+\nu_i\end{aligned} \tag{15}$$

where $\mathbf{z}_{ij}$ are interacted mother-hospital characteristics, $\mathbf{x}_i$ are mother characteristics, and ν_i is an i.i.d. shock with $\text{E}\left[\nu_i\mathbf{x}_i\right]=0$.

I further parameterize hospital j's *health-based quality* λ_j as

$$\lambda_j = \boldsymbol{\rho}'\mathbf{y}_j + u_j \tag{16}$$

where $\mathbf{y}_j$ are hospital characteristics and u_j is an i.i.d. health shock with $\text{E}\left[u_j\mathbf{y}_j\right]=0$.

Identification of Maternal and Infant Health Parameters The parameters to identify are η_1, η_2, $\boldsymbol{\kappa}$, $\boldsymbol{\mu}$, and $\boldsymbol{\rho}$. For all mothers $i\in I$ and OB hospitals $j\in J^{\text{OB}}$, I observe Dist_{ij}, $\mathbf{x}_i$, $\mathbf{y}_j$, $\mathbf{z}_{ij}$, $\mathbf{1}\left(i \text{ chooses } j\right)$, and Health_i. In addition, s_{ij} is identified from the OB hospital demand stage.

In Equation 15, endogeneity arises because ν_i may be correlated with $\mathbf{1}\left(i \text{ chooses } j\right)$, Dist_i, Dist_i^2, and $\mathbf{z}_i$. The following example illustrates the source of endogeneity. Suppose mothers with worse pre-existing health have a stronger preference for high-quality hospitals, and mother i is choosing between two OB hospitals: high-quality Hospital A and low-quality Hospital B. If mother i has unobservably worse pre-existing health (lower ν_i), then she has an unobservably stronger preference for Hospital A (higher $\epsilon_{i\text{A}}$) and thus a higher expected value of $\mathbf{1}\left(i \text{ chooses A}\right)$. If Hospital A is farther away than Hospital B, then mother i also has higher expected values of Dist_i and Dist_i^2. If Hospital A is non-profit while Hospital B is for-profit, then mother i also has higher expected values of elements of $\mathbf{z}_i$ associated with a non-profit indicator. This illustrates how ν_i may be correlated with $\mathbf{1}\left(i \text{ chooses } j\right)$, Dist_i, Dist_i^2, and $\mathbf{z}_i$, and this correlation is driven by ϵ_{ij} shocks.

I require instruments that are plausibly assumed to be correlated with $\mathbf{1}\left(i \text{ chooses } j\right)$, Dist_i, Dist_i^2, and $\mathbf{z}_i$ but uncorrelated with ν_i. I construct such instruments by replacing $\mathbf{1}\left(i \text{ chooses } j\right)$ with s_{ij}, its expected value before ϵ_{ij} shocks are realized. In other words, an instrument for $\mathbf{1}\left(i \text{ chooses } j\right)$ is s_{ij}, an instrument for Dist_i is $\sum_{j\in J}\left(s_{ij}\cdot\text{Dist}_{ij}\right)$, an instrument for Dist_i^2 is $\sum_{j\in J}\left(s_{ij}\cdot\text{Dist}_{ij}^2\right)$, and instruments for $\mathbf{z}_i$ are $\sum_{j\in J}\left(s_{ij}\cdot\mathbf{z}_{ij}\right)$.

To have identifying variation, these instruments must be shifted by exogenous mother characteristics excluded from $\mathbf{x}_i$. The key source of such variation comes from mothers' home locations (as long as $\mathbf{x}_i$ does not include home location indicators), which shift mothers' choice sets. For example, all else equal, a mother whose only nearby OB hospital is Hospital A is more likely to choose Hospital A than a mother with other nearby options. A mother who lives near OB hospitals in general is expected to travel less distance than a mother who does not. A mother whose nearest OB hospitals are all a particular type (e.g., non-profit) is more likely to choose that type than a mother whose nearest OB hospitals are not.

Using these instruments and applying two-stage least squares to Equation 15 for the subset of OB hospitals identifies η_1, η_2, $\boldsymbol{\kappa}$, $\boldsymbol{\mu}$, and $\{\lambda_j\}_{j \in J^{\text{OB}}}$. Then, applying ordinary least squares to Equation 16 for the subset of OB hospitals identifies $\boldsymbol{\rho}$.

4.3 Commercial Price Setting

In Stage 2, demand and marginal cost shocks are realized, and then commercial prices are set by bargaining between commercial insurers and OB hospitals. Prior to this stage, hospitals have made OB provision decisions. Utility shocks ϵ_{ij} are not yet realized, but insurers and hospitals have expectations about OB hospital demand.

I begin by describing the objective of a commercial insurer. Let I_m denote the subset of mothers insured by insurer m. Each commercial insurer positively values its enrollees' expected utility but negatively values their expected payments net of out-of-pocket spending. Commercial insurer m's value (as a function of its in-network OB hospitals J_m^{OB} and prices $\mathbf{p}_m$) is

$$V_m\left(J_m^{\text{OB}}, \mathbf{p}_m\right) = \tau \sum_{i \in I_m} \text{EU}_i\left(J_m^{\text{OB}}, \mathbf{p}_m\right) - \sum_{i \in I_m} \sum_{j \in J_m} \left[s_{ij}\left(J_m^{\text{OB}}, \mathbf{p}_m\right) \cdot (1 - c_i)\, r_i\, p_{mj}\right] \tag{17}$$

where τ is the relative weight on enrollees' utility. The net value that commercial insurer m receives from including in-network OB hospital j in its network is

$$V_m\left(J_m^{\text{OB}}, \mathbf{p}_m\right) - V_m\left(J_m^{\text{OB}} \setminus j, \mathbf{p}_m\right) \tag{18}$$

Next, I describe the objective of an OB hospital. Let M_j^{com} denote the subset of commercial insurers that OB hospital j contracts with (i.e., commercial insurers with hospital j in their networks). OB hospital j's expected commercial variable profit (as a function of its contracted commercial insurers M_j^{com}, those insurers' in-network OB hospitals $\{J_m^{\text{OB}}\}_{m \in M_j^{\text{com}}}$, and those

insurers' prices $\{\mathbf{p}_m\}_{m\in M_j^{\text{com}}}$) is

$$\pi_j^{\text{com}}\left(M_j^{\text{com}}, \{J_m^{\text{OB}}\}_{m\in M_j^{\text{com}}}, \{\mathbf{p}_m\}_{m\in M_j^{\text{com}}}\right) = \sum_{m\in M_j^{\text{com}}} \sum_{i\in I_m} \left[s_{ij}\left(J_m^{\text{OB}}, \mathbf{p}_m\right) \cdot r_i \left(p_{mj} - \text{MC}_{mj}\right)\right] \quad (19)$$

where MC_{mj} is the marginal cost per unit of birth intensity. The expected net profit that OB hospital j receives from contracting with commercial insurer m is

$$\sum_{i\in I_m} \left[s_{ij}\left(J_m^{\text{OB}}, \mathbf{p}_m\right) \cdot r_i \left(p_{mj} - \text{MC}_{mj}\right)\right] \quad (20)$$

I further parameterize marginal cost MC_{mj} as

$$\text{MC}_{mj} = \boldsymbol{\phi}'\mathbf{w}_{mj} + \upsilon_{mj} \quad (21)$$

where $\mathbf{w}_{mj}$ are insurer-hospital characteristics and υ_{mj} is an i.i.d. marginal cost shock with $\upsilon_{mj} \mid \mathbf{w}_{mj} \sim \text{N}\left(0, \sigma_\upsilon^2\right)$.

Finally, I describe the result of Nash-in-Nash bargaining between commercial insurers and OB hospitals. Each commercial price maximizes the exponentiated product of the commercial insurer's net value and the OB hospital's expected net profit, conditional on other prices. Each commercial price p_{mj} maximizes the objective

$$\begin{aligned}\text{NB}_{mj}\left(p_{mj} \mid \mathbf{p}_{m,-j}\right) = &\left[V_m\left(J_m^{\text{OB}}, \mathbf{p}_m\right) - V_m\left(J_m^{\text{OB}} \setminus j, \mathbf{p}_m\right)\right]^b \\ &\left[\sum_{i\in I_m}\left[s_{ij}\left(J_m^{\text{OB}}, \mathbf{p}_m\right) \cdot r_i\left(p_{mj} - \text{MC}_{mj}\right)\right]\right]^{1-b}\end{aligned} \quad (22)$$

where b is the bargaining weight of commercial insurers relative to OB hospitals.

Given this structure, each commercial price p_{mj} satisfies

$$\begin{aligned}p_{mj} = &\text{MC}_{mj} - \\ &\left[\sum_{i\in I_m}\left(\frac{\partial s_{ij}}{\partial p_{mj}} r_i\right) - \left(\frac{b}{1-b}\right)\left(\frac{\partial V_m / \partial p_{mj}}{V_m\left(J_m^{\text{OB}}, \mathbf{p}_m\right) - V_m\left(J_m^{\text{OB}} \setminus j, \mathbf{p}_m\right)}\right)\right]^{-1} \sum_{i\in I_m}\left(s_{ij} r_i\right)\end{aligned} \quad (23)$$

4.4 OB Provision

In Stage 1, fixed cost shocks are realized, and then hospitals make OB provision decisions. Demand shocks e_j and marginal cost shocks υ_{mj} are not yet realized, but hospitals have expectations about OB hospital demand, marginal costs, and commercial prices. Medicaid prices are

taken as exogenous.

If a hospital has an OB unit, then it receives not only commercial variable profit, but also Medicaid variable profit. Let mcd $\in M$ denote Medicaid. Hospital j's expected Medicaid variable profit is

$$\pi_j^{\text{mcd}} = \sum_{i \in I_{\text{mcd}}} \left[s_{ij}\left(J_{\text{mcd}}^{\text{OB}}, \mathbf{p}_{\text{mcd}}\right) \cdot r_i \left(p_{\text{mcd},j} - \text{MC}^{\text{mcd}} \right) \right] \tag{24}$$

where MC^{mcd} is the marginal cost per unit of birth intensity for Medicaid births.

I assume hospitals play a pure-strategy subgame perfect equilibrium in their OB provision decisions. Let $\text{Prov}_j \in \{0, 1\}$ denote hospital j's decision, where 1 reflects operating an OB unit and 0 reflects not operating an OB unit. Given other hospitals' decisions $\mathbf{Prov}_{-j}$, hospital j does operate an OB unit if its expected variable profit net of fixed cost is positive and does not if it is negative. In other words,

$$\text{Prov}_j \mid \mathbf{Prov}_{-j} = \begin{cases} 1 & \text{if } \text{E}\left[\pi_j^{\text{com}} + \pi_j^{\text{mcd}} \mid \mathbf{Prov}_{-j}\right] - \text{FC}_j > 0 \\ 0 & \text{if } \text{E}\left[\pi_j^{\text{com}} + \pi_j^{\text{mcd}} \mid \mathbf{Prov}_{-j}\right] - \text{FC}_j < 0 \end{cases} \tag{25}$$

where FC_j is fixed cost.

I further parameterize fixed cost FC_j as

$$\text{FC}_j = \psi + \omega_j \tag{26}$$

where ω_j is an i.i.d. fixed cost shock with bounded support and $\text{E}\left[\omega_j \mid \mathbf{y}_j\right] = 0$.

I assume demand shocks e_j, health shocks u_j, marginal cost shocks v_{mj}, and fixed cost shocks ω_j are independent of each other.

Identification of OB Provision Parameters The parameters to identify are MC^{mcd} and $\boldsymbol{\psi}$. For all mothers $i \in I$ and hospitals $j \in J$, I observe r_i, $p_{m(i)j}$, $\mathbf{y}_j$ and Prov_j. In addition, s_{ij} and π_j^{com} are identified from the OB hospital demand and commercial price setting stages.

I assume the support of fixed cost is in the observed support of expected variable profit. In other words, each hospital j satisfies

$$\text{FC}_j \in \left[\inf_{k \in J} \left(\text{E}\left[\pi_k^{\text{com}} + \pi_k^{\text{mcd}} \mid \mathbf{Prov}_{-k}\right] \right), \sup_{k \in J} \left(\text{E}\left[\pi_k^{\text{com}} + \pi_k^{\text{mcd}} \mid \mathbf{Prov}_{-k}\right] \right) \right] \tag{27}$$

This assumption is equivalent to the following statement: any hospital would enter if its expected variable profit were equal to the highest observed amount, and no hospital would not enter if its expected variable profit were equal to the lowest observed amount.

This assumption, along with the OB provision condition in Equation 25, implies that each

FC_j has lower and upper bounds

$$L_j = \begin{cases} \inf_{k \in J} \left(\mathrm{E}\left[\pi_k^{\text{com}} + \pi_k^{\text{mcd}} \mid \mathbf{Prov}_{-k} \right] \right) & \text{if } \text{Prov}_j = 1 \\ \mathrm{E}\left[\pi_j^{\text{com}} + \pi_j^{\text{mcd}} \mid \mathbf{Prov}_{-j} \right] & \text{if } \text{Prov}_j = 0 \end{cases} \tag{28}$$

$$U_j = \begin{cases} \mathrm{E}\left[\pi_j^{\text{com}} + \pi_j^{\text{mcd}} \mid \mathbf{Prov}_{-j} \right] & \text{if } \text{Prov}_j = 1 \\ \sup_{k \in J} \left(\mathrm{E}\left[\pi_k^{\text{com}} + \pi_k^{\text{mcd}} \mid \mathbf{Prov}_{-k} \right] \right) & \text{if } \text{Prov}_j = 0 \end{cases} \tag{29}$$

Then, the parameterization in Equation 26 implies that each hospital j satisfies

$$\psi + \omega_j - L_j \geq 0 \tag{30}$$

$$\psi + \omega_j - U_j \leq 0 \tag{31}$$

Let $\tilde{\mathbf{y}}_j$ be instruments that are plausibly assumed to be correlated with OB provision but mean-independent of ω_j. Then,

$$\mathrm{E}\left[\psi - L_j \mid \tilde{\mathbf{y}}_j \right] \geq 0 \tag{32}$$

$$\mathrm{E}\left[\psi - U_j \mid \tilde{\mathbf{y}}_j \right] \leq 0 \tag{33}$$

ψ is partially identified as being in the set of values that satisfy the moment inequalities in Equations 32 and 33 for all values of $\tilde{\mathbf{y}}_j$.

For intuition, ψ (the overall level of fixed costs) is identified by how OB provision varies with expected variable profit: if fixed costs are higher, then higher expected variable profits are needed to justify OB provision. As instruments in $\tilde{\mathbf{y}}_j$, I include hospitals' binned expected variable profits. This shrinks the identified set by ruling out the possibility that more profitable hospitals have different fixed cost shocks than less profitable hospitals.

5 Estimation and Results

5.1 Estimation of OB Hospital Demand Parameters

First, I estimate the parameters in the utility equation (Equation 9): coefficients on out-of-pocket spending, distance, distance squared, and interacted mother-hospital characteristics, as well as each OB hospital's demand-based quality. I include the following interacted mother-hospital characteristics: distance times birth intensity, distance squared times birth intensity, payer type (i.e., non-profit, for-profit, or public) times birth intensity, a teaching hospital indicator times birth intensity, and a critical access hospital indicator times birth intensity.

Using the log likelihood expressed in Equation 14, I apply maximum likelihood estimation. My sample is all births with claim data. Table 3 shows the estimated coefficients of interest, and Figure 3a shows the distribution of estimated demand-based quality.

Table 3: OB Hospital Demand Coefficients

	Coefficient	Std. error
Out-of-pocket ($1k)	−0.005	(0.006)
Distance (mi)	−0.11***	(0.0005)
Distance^2	0.0004***	(0.000005)
Distance × intensity	0.11***	(0.005)
Distance^2 × intensity	−0.0003***	(0.00004)
Non-profit hosp × intensity	−0.51***	(0.15)
For-profit hosp × intensity	−0.88***	(0.16)
Teaching hosp × intensity	0.61***	(0.14)
Crit access hosp × intensity	1.73***	(0.43)
Num. obs.	18,798	

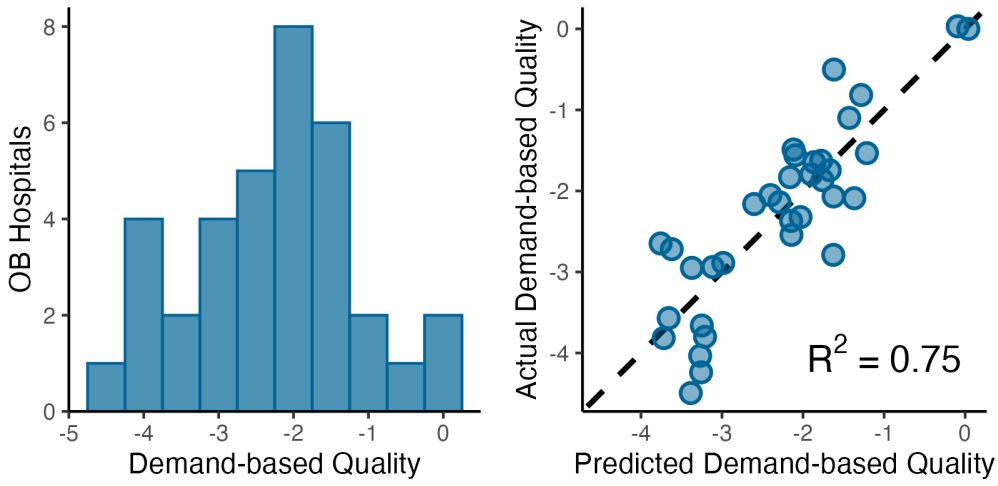
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$. All variables are demeaned.

Mothers do not respond to out-of-pocket spending, potentially due to imperfect information about counterfactual out-of-pocket spending at different OB hospitals. They do respond negatively to distance, and this response is smaller in magnitude for mothers with more intensive births. Mothers with more intensive births have weaker preferences for non-profit and for-profit hospitals (as opposed to public hospitals), a stronger preference for teaching hospitals, and a stronger preference for critical access hospitals. Finally, variation in demand-based quality is important. In terms of utility, a one-unit decrease in demand-based quality is equivalent to around 9 miles of additional distance.

Second, I apply ordinary least squares to estimate the coefficients on hospital characteristics in the demand-based quality equation (Equation 10). I include the following characteristics: payer type, a teaching hospital indicator, a critical access hospital indicator, non-OB physicians, non-OB beds, log county population density, and log county population shares by income bin. I use these estimates to infer expected demand-based quality for all hospitals, including non-OB hospitals that are out-of-sample. Figure 3b shows the in-sample fit of expected demand-based quality to actual demand-based quality among OB hospitals.

5.2 Estimation of Maternal and Infant Health Parameters

My primary measure of maternal and infant health is an indicator for no maternal or infant complications. In alternative specifications, I consider maternal and infant complications



(a) Distribution (b) Expected vs. Actual

Figure 3: Demand-based Quality of OB Hospitals

separately. I include the following maternal complications: unplanned hysterectomy, admission to intensive care, perineal laceration, ruptured uterus, transfusion, and unplanned operations. I include the following infant complications: infant death, infant injury, meconium staining, seizures, antibiotics, and surfactant replacement.

First, I estimate the parameters in the health equation (Equation 15): coefficients on distance, distance squared, interacted mother-hospital characteristics, and mother characteristics, as well as each OB hospital's health-based quality. I include the same interacted mother-hospital characteristics as when estimating OB hospital demand. I include the following mother characteristics: demographic variables (e.g, age, race, education), pre-existing health variables (e.g., previous births, diabetes, hypertension), prenatal visits, gestational age, a cephalic presentation indicator, a planned caesarean section indicator, log home county population density, log home county population shares by income bins, and insurer indicators.

Using the instruments described in Section 4.2, I apply two-stage least squares. My sample is all births with claim data. Table 4 shows the estimated coefficients of interest under my primary and alternative specifications, and Figure 4a shows the distribution of estimated health-based quality under my primary specification.

Distance does not affect maternal and infant health, which is consistent with the findings of Fischer et al. (2024). Interacted mother-hospital characteristics do not affect health either. However, variation in health-based quality is important.

Second, I apply ordinary least squares to estimate the coefficients on hospital characteristics in the health-based quality equation (Equation 16). I include the same hospital characteristics as when estimating the demand-based quality equation. I use these estimates to infer expected

Table 4: Maternal and Infant Health Coefficients

	No comp	No mat comp	No inf comp
	(1)	(2)	(3)
Distance (mi)	−0.0011	−0.0004	−0.0008
	(0.0006)	(0.0003)	(0.0006)
Distance^2	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)
Distance × intensity	−0.0007	0.0000	0.0000
	(0.0021)	(0.0010)	(0.0020)
Distance^2 × intensity	−0.0000	−0.0000	−0.0000
	(0.0001)	(0.0000)	(0.0001)
Non-profit hosp × intensity	−0.1687	0.1153	−0.3476
	(0.2278)	(0.1207)	(0.2016)
For-profit hosp × intensity	−0.0884	0.1128	−0.2595
	(0.2123)	(0.1166)	(0.1852)
Teaching hosp × intensity	0.1579	0.0801	0.1244
	(0.1039)	(0.0555)	(0.0948)
Crit access hosp × intensity	−0.0685	−0.0484	0.0445
	(0.2114)	(0.1247)	(0.1816)
Num. obs.	18798	18798	18798

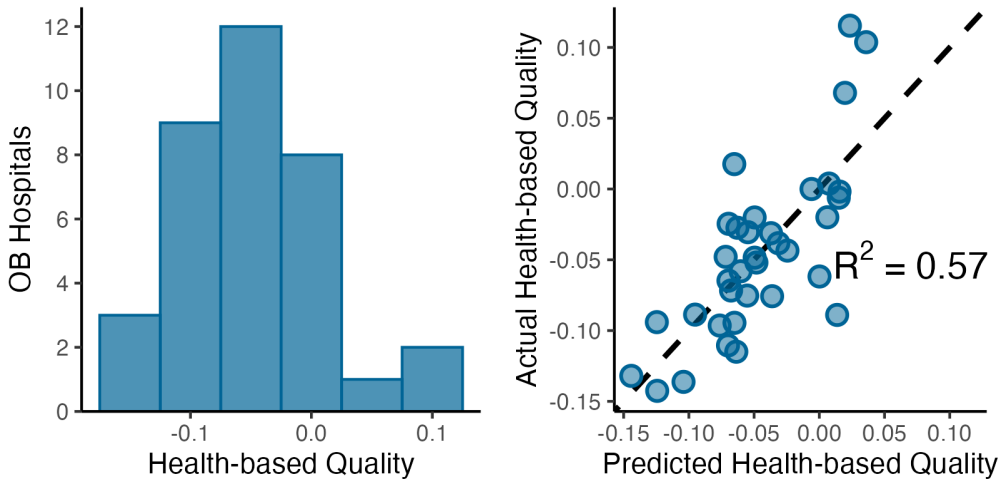
$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$. All variables are demeaned. Robust std. errors. For brevity, coefficients on mother characteristics are not reported.

health-based quality for all hospitals, including non-OB hospitals that are out-of-sample. Figure 4b shows the in-sample fit of expected health-based quality to actual health-based quality among OB hospitals.

Health-based vs. Demand-based Quality I consider whether mothers fully internalize the health-based quality of OB hospitals in their choices. This can be answered by evaluating the relationship between health-based and demand-based quality, which is shown in Figure 5 for OB hospitals. The correlation is not strong, suggesting that health-based quality is not fully internalized. This may be due to mothers having imperfect information about the health-based quality of different OB hospitals. Thus, revealed-preference welfare estimates may not fully capture the value of health, which motivates me to consider health separately from welfare.

5.3 Estimation of Commercial Price Setting Parameters

I calibrate parameters related to variable profits. This includes the parameters in the commercial price setting framework described in Section 4.3 (the weight on enrollees' utility, insurers'



(a) Distribution (b) Expected vs. Actual

Figure 4: Health-based Quality of OB Hospitals

relative bargaining weight, and commercial marginal costs), as well as Medicaid marginal cost. I calibrate these parameters to set OB hospitals' average variable profit margins to 10%, which is close to reported profit margins for hospital OB care.

5.4 Estimation of OB Provision Parameters

I estimate ψ (the overall level of fixed costs) in Equation 26. For a candidate value of ψ, I compute the empirical analogs of the left-hand sides of the moment inequalities in Equations 32 and 33 by averaging over hospitals. My estimate of the identified set is the set of candidate values that satisfy those moment inequalities for all values of my instruments (binned expected variable profits). My estimated set, in thousands of dollars, is [88, 129].

6 Counterfactual OB Provision and Policies

For each hospital, I quantify how its OB provision affects both social welfare and maternal and infant health by comparing simulated counterfactual outcomes if it had an OB unit with outcomes if it did not. Although I measure these effects for all hospitals, I pay special attention to *marginal entrants*: hospitals whose expected variable profits fall within my estimated set of the overall level of fixed costs. These hospitals are close to the margin between operating and not operating an OB unit, so their OB provision is most susceptible to be changed by counterfactual policies, such as Medicaid subsidies that encourage OB provision and level-of-care regulations that discourage OB provision.

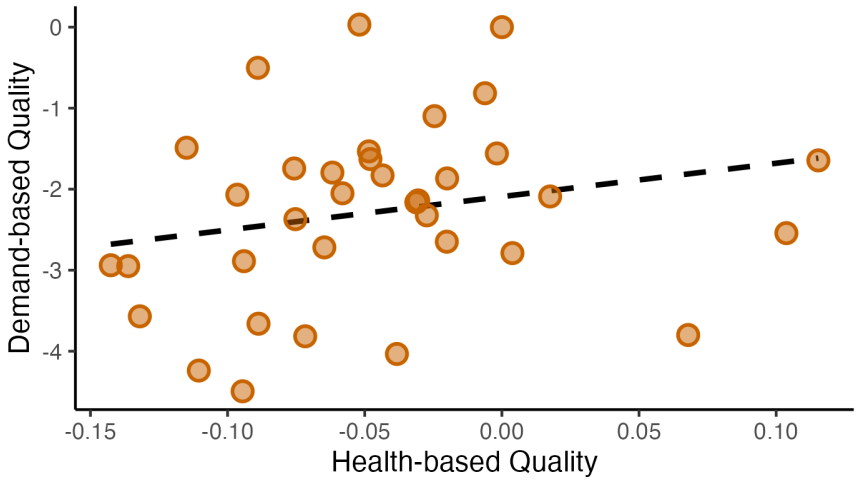


Figure 5: Health-based vs. Demand-based Quality of OB Hospitals

Figure 6 shows the relationship between expected variable profits and effects of OB provision on mothers' welfare.

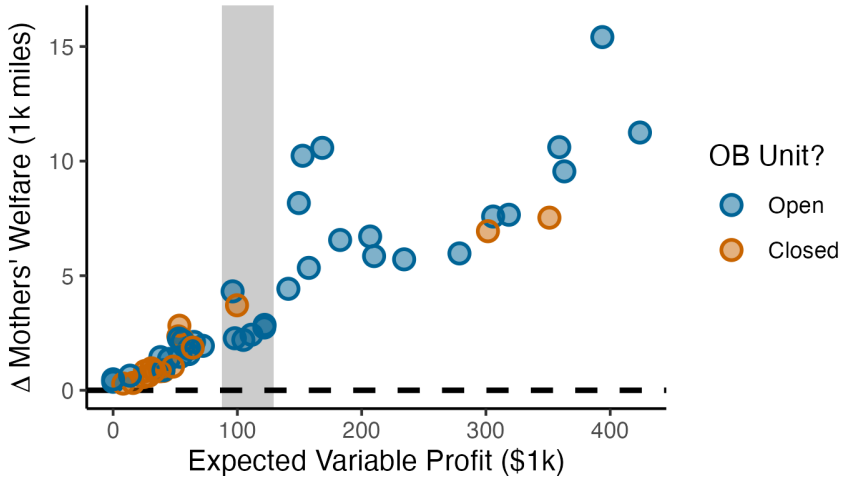


Figure 6: Effects of OB Provision on Mothers' Welfare

Each point is a hospital. For each hospital, I measure variable profit and Δ mothers' welfare holding the OB provision of other hospitals constant. The gray area indicates the overall level of fixed costs. Hospitals in the gray area are marginal entrants.

Because OB hospital demand does not respond to out-of-pocket spending, but it does respond to distance, I measure mothers' welfare in units of miles. All hospitals would increase mothers' welfare if they were to operate OB units, but there is wide variation in magnitudes. In general, more profitable hospitals generate greater welfare gains. Among marginal entrants, the increase in mothers' welfare due to OB provision ranges from around 2,000 to 4,000 miles of welfare. Marginal entrants are mostly rural hospitals, so this welfare gain is concentrated among rural

mothers. This is my estimate of the positive choice set expansion effect.

However, OB provision also comes with a social welfare cost. Each OB unit has a fixed cost of $88,000 to $129,000. This is my estimate of the negative fixed cost effect. Roughly, this implies that marginal OB provision comes with a social welfare cost of around $20 to $60 per mile of mothers' welfare generated.

The policy implications of this trade-off depend on how mothers value distance, how policymakers weigh mothers' welfare relative to hospital profits, and how policymakers consider distributional consequences across geography. For example, if mothers highly value distance, if policymakers place a high weight on mothers' welfare, or if policymakers seek to close rural-urban disparities in access to care, then marginal OB provision can be beneficial and policies that encourage OB provision can be desirable.

Figure 7 shows the relationship between expected variable profits and effects of OB provision on maternal and infant health.

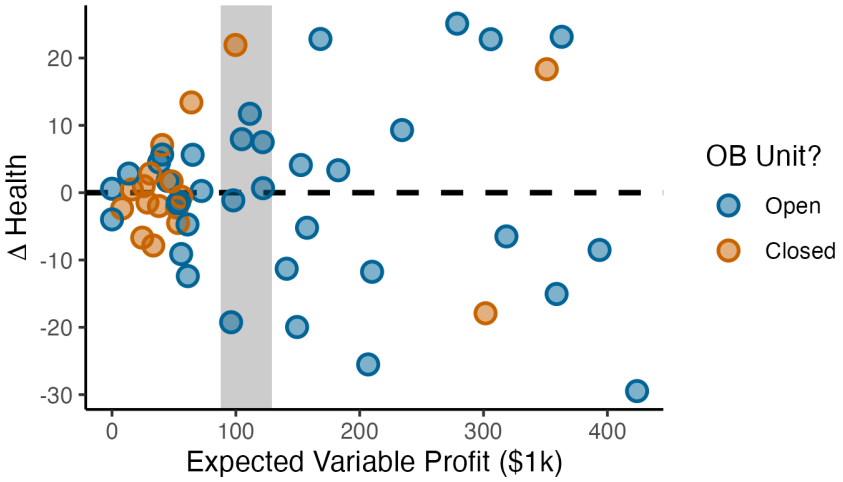


Figure 7: Effects of OB Provision on Maternal and Infant Health

Each point is a hospital. For each hospital, I measure variable profit and Δ health holding the OB provision of other hospitals constant. The gray area indicates the overall level of fixed costs. Hospitals in the gray area are marginal entrants.

Because distance does not affect maternal and infant health, these net health effects are entirely driven by the redirection effect. OB provision redirects mothers toward the entrant away from incumbents, which can improve health if the entrant is relatively high-quality or worsen health if the entrant is relatively low-quality. Accordingly, there is a wide range of net health effects. Among marginal entrants, net health effects range from –20 to +20 (in units of expected births without complications). In other words, some marginal entrants improve health, while others worsen health.

This wide range suggests that there is scope for targeted policies to achieve better outcomes

than market-wide policies. Optimal policies involve targeted incentives for high-quality hospitals and restrictions for low-quality hospitals. Because I predict health-based quality using hospital characteristics, my results are suggestive as to how such policies can be designed.

7 Conclusion

In this paper, I study OB provision: hospitals' static decisions to operate obstetric (OB) units and participate in the hospital OB care market. What are the welfare and health consequences of OB provision, how are they geographically distributed, and which policies targeting OB provision are optimal?

OB provision can have three effects on social welfare: a positive choice set expansion effect, a negative fixed cost effect, and an ambiguously-signed marginal cost effect. I consider maternal and infant health separately from welfare because mothers may not fully internalize the health-based quality of OB hospitals, and because health may generate large-scale externalities. OB provision can have two effects on maternal and infant health: an ambiguously-signed redirection effect and a positive travel distance effect.

My empirical setting is Arkansas in 2022. Combining data on births and medical claims from the Arkansas All-Payer Claims Database, I estimate a static entry model of the hospital OB care market to recover expectations of fixed cost, variable profit, demand-based quality, and health-based quality for each hospital. Then, I simulate the effects of counterfactual OB provision and policies.

I consider market-wide policies, such as Medicaid subsidies that encourage OB provision and level-of-care regulations that discourage OB provision. In terms of social welfare, marginal OB provision has positive choice set expansion effects (concentrated among rural mothers), but also negative fixed cost effects. The resulting policy implications depend on how mothers value distance, how policymakers weigh mothers' welfare relative to hospital profits, and how policymakers consider distributional consequences across geography.

In terms of maternal and infant health, the redirection effect is important, but the travel distance effect is not. There is wide variation in health-based quality, so there is a wide range of net health effects of marginal OB provision. Optimal policies involve targeted incentives for high-quality hospitals and restrictions for low-quality hospitals.

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