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Can Amputation Save the Hospital? The Impact of the Medicare Rural Flexibility Program on Demand and Welfare
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ABSTRACT

This paper seeks to understand the impact of the Medicare Rural Hospital Flexibility (Flex) Program on rural resident hospital choice and welfare. The Flex program created a new class of hospital, the Critical Access Hospital (CAH), which receives more generous reimbursement in return for limits on capacity and length of stay. A hospital that converted to CAH status would see its inpatient admissions drop by a mean of 5.4%, of which almost all was driven by factors other than capacity. The program increased consumer welfare if it reduced the closure rate by at least 4 percentage points.

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1 Introduction

Embedded in the Balanced Budget Act of 1997 is a provision that establishes the Medicare Rural Hospital Flexibility (Flex) Program. The Flex program establishes a new class of hospitals under the Medicare program, Critical Access Hospitals (CAH), to which hospitals can convert. Hospitals converting to CAH status must comply with a number of restrictions including limits on their capacity (25 beds or less) and on their patients' average length of stay.[1] In return for accepting these constraints, hospitals with CAH status receive cost-based reimbursements from Medicare that are typically more generous than those under the standard prospective payment system (PPS). The overarching purpose of the Flex program is to improve and sustain access to quality healthcare services for rural residents. One important avenue through which the program seeks to achieve this goal is through increasing the financial stability of rural hospitals which, in turn, is intended to spur quality improvement and reduce the likelihood of closure.

In the 15 years since its implementation, the Flex program has left a large imprint on the structure of rural hospital markets and cost of rural health care. Currently, over 1,300 rural hospitals (25 percent of all U.S. hospitals and over half of rural hospitals) have converted to CAH status. The Flex program caused hospitals to shed significant amounts of capacity so that they could qualify for CAH conversion. In 1996, 14 percent of rural hospitals had 25 beds or less, while that figure rose to 50 percent by 2005. Of the hospitals that converted to CAH status in 2006, 98% had more than 25 beds in 1996. The mean capacity of eventual converters decreased from 42 beds in 1996 to 22 beds in 2005. The program has also been costly: it is estimated that Medicare's payments to hospitals with CAH status have increased by 35% (MedPAC, 2005). Yet it has enjoyed wide and bipartisan support, with recent proposals for expansion.[2]

[1] The initial legislation required hospitals with CAH status to be distant from other hospitals, but this requirement could be waived if states deemed the hospital a necessary provider.

[2] For example, The Critical Access Hospital Flexibility Act of 2009 (H.R. 668), would base capacity

The scale of the Flex program, its costliness, and its impact on the size distribution of rural hospitals, all suggest that a policy evaluation of the consequences of the Flex program is an important exercise to undertake. An interesting tension is embedded in the Flex program and it is a tension that can be found in other large scale, federal programs.[3] In order to convert to CAH status, hospitals generally reduced their capacity and altered their service offerings. The lower capacity and constraints on length of stay may deter patients from seeking treatment at CAHs. However, to the extent the Flex program plausibly forestalled some exit, it increased (or at least prevented a larger decrease in) access to hospital services for rural residents. This dimension of the Flex program likely increased consumer surplus. Thus, given the possible effects of the Flex program, its net impact on rural residents is ambiguous.

In this paper we seek to understand the impact of the Flex program on several dimensions of rural resident welfare. Using detailed patient discharge data, we first examine the impact of CAH conversion on the patient population. This allows us to assess the impact of conversion on average patient severity, the number of inpatient services, the distribution of diagnoses, and the distribution of insurance arrangements. We then estimate parameters of the hospital choice utility function and calculate the impact of conversion on the patient demand for the hospital. We do this across all patients and then we drill down to evaluate the impact of conversion across patients with different health insurance arrangements and diagnoses. Our data span the pre- and post CAH conversion eras enabling us to use a difference-in-difference identification strategy.[4] Finally, we use the parameter estimates from the demand model to quantify the welfare impact of CAH conversion by calculating the reduction in the hospital exit rate that would be necessary to offset the static welfare impact of conversion.

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calculations on occupied beds effectively raising the bed capacity threshold, and H.R. 487, also introduced in 2009, would let again let states waive the 35-mile requirement for CAH designation. Both enjoyed bipartisan support

[3]For example, agricultural price supports linking government support to the amount produced.

[4]Our data begin in 1998 just after the Flex program was passed but very few hospitals had converted to CAH status at the beginning of our sample period.

We construct our data set from several different sources. The principal data set is patient discharge records for the states of Colorado, Iowa, North Carolina, Oregon, Washington, West Virginia and Wisconsin spanning the years 1998-2005. These states were selected because of their large rural populations and large number of CAH conversions. The discharge data contain the identity of the hospital from which the patient was discharged as well as resident zip code, demographics, diagnoses and health insurance source. We link these data to information on hospitals characteristics from the American Hospital Association (AHA) and the Center for Medicare and Medicaid Services's (CMS) Healthcare Cost Report Information system (HCRIS). Finally, we merge in data on CAH status and conversion dates from the Flex Monitoring Team. Our data set contains over 7 million patient observations.

Prior to conversion, CAHs were different than non-converting hospitals. CAHs treated fewer patients, they offered fewer services, and their patients were less severely ill, travelled shorter distances, and were more likely to be Medicare enrollees. After the conversion and with some exceptions, the patient characteristics of CAHs did not significantly change. After conversion the average number of services for which patients received care modestly declined, and CAHs saw a shift in the distribution of the diagnoses of their patients.

The structural demand estimates indicate that CAH conversion reduced the value of the hospital for inpatient treatment which led to a decline in patient volume. Overall, the drops in volume occurred systematically across payor and diagnosis. For instance, converting hospitals, on average, experienced a 6% decline in Medicare patients compared to a 5% decline in their privately insured admissions. Most diagnoses saw a drop in the range of 3-5%. Some outliers include a relatively large decline of 8.7% for acute myocardial infarction patients and a relatively small decline of 2.8% for pneumonia patients. Consistent with this, Lutfiyya et al. (2007) found that quality of pneumonia for CAHs is higher than urban hospitals but for all other measures of quality of care CAH hospitals performed more poorly.

CAH conversion can affect patient utility through at least two different pathways. First, bed size restrictions may directly affect hospital demand. For example, reductions in the number of beds may result in the hospital becoming capacity constrained. Second, independent of bed size restrictions, the CAH designation may impact the attractiveness of the hospital. For example, CAHs also receive cost based reimbursements for outpatient services and CAHs may emphasize those services. In addition, restrictions on length of stay may cause the hospital to drop services. We decompose the decrease in demand into these two components. We find that virtually all of the decline in demand from conversion is driven by factors that are unrelated to bed size reductions. This is true across the entire patient population but generally holds for patients with different insurance arrangements and different conditions.

Finally, we use our estimates from the hospital choice model to explore the policy tension in the Flex program. The multinomial logit (MNL) parameters imply that CAH conversion reduces patient utility. However, if the Flex program averted a sufficient number of hospital closures, this effect could overcome the reduction in consumer surplus associated with conversion. We calculate the reduction in the exit rate necessary for the Flex program to increase consumer surplus. We find that the Flex program increases consumer surplus if it forestalled the closure of at least 4% of converting hospitals. As a point of comparison, over the period 1999-2005, we observe exit by 1.3% of rural hospitals and 2.3% for non-rural hospitals.[5]

The paper proceeds as follows. Immediately below we discuss the related literature. In Section 2 we describe the institutional features of the Flex program. Section 3 describes our data and provides summary statistics. Section 4 presents our empirical model. Section 5 presents the estimates of the impact of the Flex program on hospital demand and performs the welfare analysis. Section 6 concludes.

[5] Based on authors' calculations.

Related literature

Despite the importance of the Flex program, there have been few national level evaluations of the program and even fewer papers that employ credible identification to assess the program's impact. In preliminary analysis using zipcode level data from Medicare's Health Services Area File (HSAF), Gowrisankaran et al. (2011) found that conversion to CAH status led to a precipitous decline in inpatient demand. However, further analysis revealed that the data likely contain non-random measurement error which likely explains the magnitudes of the estimated decline.

Recently, Joynt et al. (2011) document that CAHs are less likely to have intensive care units, cardiac catheterization labs and electronic medical records than other U.S. hospitals. Furthermore, they find that patient outcomes are worse at CAHs relative to all other hospitals. Joynt et al. (2011, p. 51) also refer to a number of recent studies finding negative to mixed impacts of CAH conversion on quality of care. Lutfiyya et al. (2007) find that rural CAHs perform significantly worse than urban hospitals in 7 out of 12 hospital quality indicators. Using data from Iowa, Li et al. (2007) find that CAH conversion had a mixed impact on patient safety outcomes. The above papers identify the impact of conversion using cross-sectional information. We complement this body of research by accounting for the likely endogeneity of CAH conversion using panel data and by comparing only rural hospitals. As we show here, CAHs are meaningfully different from non-CAH prior to their conversion thus cross sectional analysis is prone to biased inferences regarding the causal relationship between CAH status and hospital performance.

A different literature analyzes financial aspects of the Flex program. Stensland et al. (2003) and Stensland et al. (2004) study the financial effects of CAH conversion and find that conversion led to an increase in Medicare revenue and profit margins. Casey and Moscovice (2004) study the quality improvement initiatives of two CAHs after conversion, and conclude that the cost-based payments help the hospitals to fund activities that would improve quality of care such as additional staff, staff training and new medical equipment.

Finally, McNamara (1999) studies the pre-Flex program impact of rural hospitals closures on consumers' surplus and finds that the average compensating variation for the closure of the nearest rural hospital is about $19,500 (1988 dollars) per sample hospitalization.

2 The Flex Program

The Medicare Rural Hospital Flexibility Program was authorized by section 4201 of the Balanced Budget Act of 1997 (BBA).[6] Designated CAHs receive cost-based Medicare reimbursements for inpatient, outpatient post-acute (swing bed) and laboratory services. Currently these payments are set to 101% of average accounting costs. The legislation required hospitals to be 35 miles from a primary road and 15 miles by a secondary road to the nearest hospital. However, this distance requirement was not initially binding. Hospitals could (and often did) get the restriction waived by having themselves declared a necessary provider by the state. Most CAHs are less than 25 miles from a neighboring hospital. In 2006, the distance requirement became binding. The initial 1997 BBA legislation specified that CAHs could have a maximum of 15 acute inpatient beds and 25 total beds including swing beds, and the length of stay was limited to a maximum of 4 days. A swing bed is used to provide post-acute care. Although the legislation did not specify the intent of these limitations, the likely purpose was to limit the financial exposure of the government and to limit the CAHs to treat low acuity conditions for quality of care reasons.

CAHs are required to provide inpatient, laboratory, emergency care, and radiology services. One of the goals of the Flex program is to maintain emergency department access for rural residents. Although they have an important role in providing emergent care, CAHs must restrict their average length of stay to less than 96 hours. For these reasons (among

[6] Much of the information in the section is culled from MedPAC (2005), which contains much more background than we provide.

others), CAHs must develop agreements with an acute care hospital related to patient referral and transfer, communication, and emergency and non-emergency patient transportation. The CAH may also have an agreement with their referral hospital for quality improvement or choose to have that agreement with another organization. Lastly, the BBA provides resources for hospitals to hire consultants to project revenues and costs under the Flex program to determine whether a conversion strategy would be optimal for the hospital given its objectives.

The program's rules have been modified several times since its inception. Table 1 summarizes the important legislative and regulatory changes in the program. The most important of these changes are: 1) The Balanced Budget Reconciliation Act (BBRA) of 1999 changed the length of stay requirement and allowed states to designate hospitals in Metropolitan Statistical Areas 'rural' for CAH classification; 2) The Budget Improvement and Protection Act of 2000 extended cost-based reimbursements to patients in swing beds; 3) The Medicare Prescription Drug, Improvement and Modernization Act (MMA) of 2003 increased the acute inpatient limit from 15 to 25 acute patients and increased the payments from 100 to 101 percent of costs. Allowing the treatment of post-acute care patients to be reimbursed on a cost basis dramatically increased the profitability of caring for those patients. According to MedPAC (2005), "The shift from receiving SNF rates for post-acute patients to receiving estimated costs (which assume post-acute routine costs equal acute routine costs) resulted in a dramatic increase in post-acute care payments from $259 per day before conversion to $1,016 per day after conversion."[7] These changes to the Flex program provide variation in the benefits to CAH conversion which we can exploit within the study period.

Since the intent of the CAH policy is to maintain access to hospital care for rural residents, it is useful to examine the change in rural hospital structure since the implementation of the policy. We define rurality using Rural-Urban Commuting Areas (RUCA) version 2.0.[8] Out

[7]p. 163

[8]These measures are developed collaboratively by the Health Resources and Service Administration, the

Table 1: Relevant Policy Changes for CAH

Legislation	Key Aspects of CAH Legislation and Regulation
BBA 1997	• Flex program established. • Hospitals should operate no more than 15 acute beds and no more than 25 total beds, including swing beds. • All patients' length of stay (LOS) limited to 4 days. • Only government and NFP hospitals qualify. • Hospitals must be distant from nearest neighboring hospital, at least 35 miles by primary road and 15 by secondary road. • States can waive the distance requirement by designating "necessary providers."
BBRA 1999	• LOS restriction changes to an average of 4 days. • States can designate any hospital to be "rural" allowing CAHs to exist in MSAs. • FP hospitals allowed to participate.
BIPA 2000	• Payments for MDs "on call" are included in cost-based payments. • Cost-based payments for post-acute patients in swing beds.
MMA 2003	• Inpatient limit increased from 15 to 25 patients. • Psychiatric and rehabilitation units are allowed and do not count against the 25 bed limit. • Payments are increased to 101 percent of cost. • Starting in 2006, states can no longer waive the distance requirement.

Source: MedPAC (2005)

of the 4,779 hospitals in the U.S. in 1994, 49.3% (or 2,355 total) are rural. Figure 1 shows the rate of CAH conversion and the fraction of CAHs among rural hospitals.[9]

Figure 1 shows the rate of CAH conversion among all rural, general acute care hospitals in the U.S. Conversion rates were very low until 1999.[10] Starting in 2000 and through 2004, roughly 150 hospitals per year converted to CAH status. We believe that the delay between the enactment of BBA in 1997 and the timing of conversion is due to the complexity and uncertainty in the application process, which requires large amounts of paperwork, inspection

Office of Rural Health Policy, the Department of Agriculture's Economic Research Service, and the WWAMI Rural Health Research Center.

[9]All facts and figures in this section are derived from the linked AHA, HCRIS and Flex Monitoring Team data discussed in more detail in Section 3.

[10]A few conversions occurred prior to 1997 due to pilot programs.

visits and CMS approval.[11] By 2005, over 40% of rural hospitals and 25% of all U.S. hospitals had adopted CAH status. Conversion rates declined after 2006, when the minimum distance requirements became mandatory (see MedPAC, 2005).

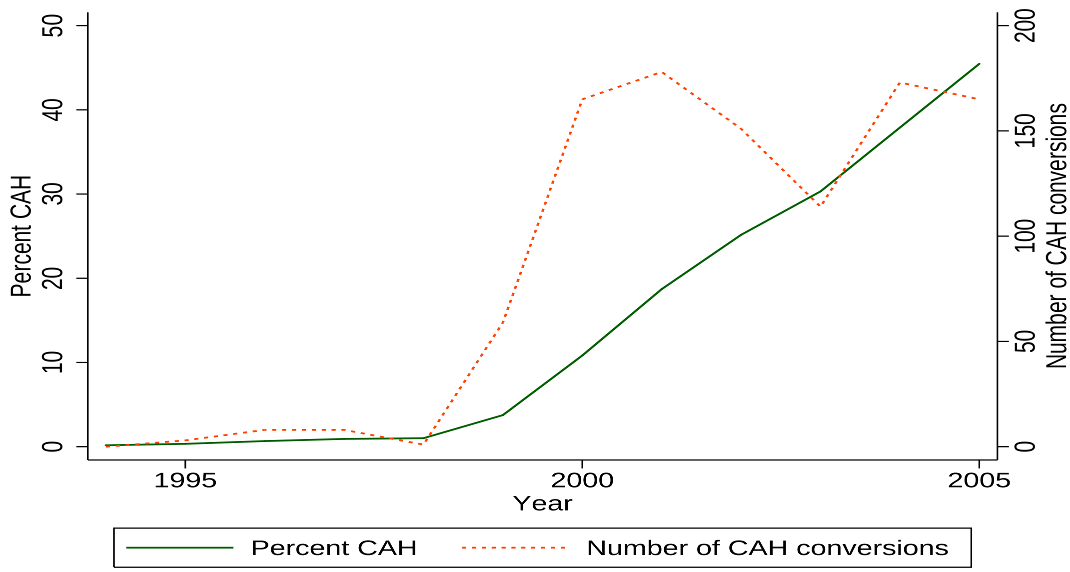

Figure 1: Conversion rates and percent CAH among U.S. rural hospitals

Figure 2 shows a histogram of rural bed sizes for hospitals in 1996 and 2005, with the maximum truncated to 125.[12] The movement to CAHs has also been accompanied by large drops in the bed size of rural hospitals. In 1996, the median bed size was 54. By 2005, the median bed size had dropped to 36 while the mean bed size went from 72 to 56. Even more striking is that many hospitals dropped in bed size to exactly 25 – the upper-limit of the level allowed by the Flex program. By 2005, 21% of rural hospitals had exactly 25 beds.

[11]For example, in the state of Washington, the application process has 18 steps, detailed at http://www.ruralcenter.org/sites/default/files/Flowchart.pdf .

[12]The sample for our main analysis extends only from from 1999 to 2005 due to a lack of discharge data from earlier years, but we have hospital characteristic data going back to 1996.

Figure 2: Size of rural hospitals, 1996 and 2005

3 Data

To construct the principal, analytical dataset, we link together information from from several sources. The primary data is state inpatient discharge (SID) information. The SID data, which were acquired through the Agency for Healthcare Quality and Research's Health Care Utilization Project, are discharge level information for virtually the universe of patients admitted to a hospital in that state. Each observation contains information on the discharging hospital, patient's home zip code, age, gender, primary payor, dates of admission and discharge, Diagnostic Related Group (DRG), principal diagnosis and procedure codes. The DRGs are clusters of related diagnoses that use similar resources. Medicare uses DRGs to determine prospective payment for admissions to non-CAHs. Roughly, the hospital is paid the base rate times the DRG weight plus some adjustments. We also merge in the DRG weight information.

We focus on seven states: Colorado, Iowa, North Carolina, Oregon, Wisconsin, Washington State and West Virginia. These states were selected because they have sizable rural populations and a large number of CAH conversions. Within these states, we extract the sample of patients residing in rural areas. We focus on rural residents as the goal of the Flex program is to improve health care access to those residents. The Colorado, Iowa, Washington State and Wisconsin data span 1998 to 2005, the North Carolina and Oregon data are available from 2000 to 2005, and the West Virginia data begin in 2001 and end in 2005.[13] Within these states, our analysis sample is patients residing in rural zip codes.

We characterize rurality of patients using the Rural-Urban Commuting Area Codes (RUCA), version 2.0. These measures of rurality are based on the size of cities and towns and their functional relationships as identified by work commuting flows, and have been used by CMS to target other rural policies, such as the ambulance payments. CMS considers all zip codes that have RUCA greater or equal to four to be rural, and we adopt the same criterion in this paper.

We link in data from the American Hospital Association (AHA), Healthcare Cost Report Information System (HCRIS), the Census Bureau and the Flex Monitoring Team to the SID information. From the AHA we pull in information on the hospital location's latitude and longitude and from the HCRIS data we link in hospital bed size information.[14] Zip code centroid latitude and longitude data are pulled from the Census Bureau. Data on the timing of CAH conversion comes from the Flex Monitoring Team.[15] In addition, the Flex Monitoring Team data contains accurate information on the number of beds for the hospitals that converted.

CAH conversion may affect the range of services offered by the hospital as well as altering the types of providers working in the hospital. These types of effects suggest that CAH conversion will differentially affect patient choice according to their diagnoses. The

[13]To be included in the sample, a hospital must have at least 100 discharges over the 1998 to 2008 time frame.

[14]The AHA also has information on bed size but the HCRIS data appears to be more accurate.

[15]The Flex Monitoring Team is a collaborative effort of the Rural Health Centers at the Universities of Minnesota, North Carolina and Southern Maine, under contract with the Office of Rural Health Policy. The Flex Monitoring Team monitors the performance of the Medicare Rural Hospital Flexibility Program (Flex Program), with one of its objectives being the improvement of the financial performance of CAH.

detail in the patient discharge data allow us to analyze the impact of CAH conversion by specific diagnoses, Major Diagnosis Category (MDC), and by types of insurance (Medicare and Privately Insured).[16] MDCs are formed by combining the principal diagnosis codes into one of the 25 mutually exclusive categories corresponding to single organ system or etiology and, in general, are associated with a particular medical specialty.

Our data set contains over 7 million patient discharges. Because of the size of the data set, it is impractical to estimate the parameters for some of our demand models. Therefore, in order to generate parameter estimates in a reasonable amount of time and maintain precision, we take random draws of patients so that the sample used to estimate the parameters has approximately 10 million hospital/patient observations.[17]

The summary statistics for the sample years 1998 and 2005 are presented in Table 2.[18] The percentage of patients admitted to a CAH facility increased from essentially zero to 15% by 2005. Approximately half of the patients were admitted to the hospital closest to their home. Patients traveled 33.7 km to the hospital in 1998 and the average distance travelled in our data declined slightly by 2005. There was a large decline in the percentage of privately insured patients and the percentage of Medicare patients rose two percentage points. The average size of rural hospitals declined over this period.

4 Empirical Model

We model the discrete hospital choice decision of the patient conditional on deciding to receive inpatient treatment. Each period t, there is a set of patients $\mathbf{I_t} = \{1, \ldots, I_t\}$. Individual

[16]Medicaid was coded inconsistently in the data for some states.

[17]We selected 10% of the entire sample, 25% of the Medicare population and privately insured population, 50% of obstetrics and circulatory MDC and 25% of the 'other' MDC category.

[18]In 1998 we have data on only 5 of the 7 states in our sample and for that reason differences in means between 1998 and 2005 reflect differences in the composition of states rather than underlying trends. Hospitals in the states that are added to the sample around 2000 are bigger. We therefore separately report summary statistics for only those states for which the data were available from 1998 on.

Table 2: Summary Statistics

	1998		2005	
Variable	Mean	S.D.	Mean	S.D.
Hospital Characteristics– Entire Sample				
Number of Beds	107.0	107.9	110.9	133.87
CAH	.002	.049	.420	.494
Not-for-profit	.631	.483	.634	.482
For-profit	.040	.197	.054	.226
Admissions per Hospital	1,483.7	4,317.5	2,072.7	6,098.7
Number of Hospitals	420	–	500	–
Hospital Characteristics – For Hospitals in States in Sample for Entire Period				
Number of Beds	107.0	107.9	95.66	113.51
CAH	.002	.049	.490	.500
Not-for-profit	.631	.483	.649	.477
For-profit	.040	.197	.040	.197
Admissions per Hospital	1,483.7	4,317.5	1,730.3	6,852.4
Number of Hospitals	420	–	396	–
Patient Characteristics				
Admitted CAH	.0006	.000	.155	.362
Age	50.1	28.8	51.4	28.0
Female	.582	.493	.583	.493
Length of Stay	4.01	5.21	4.15	5.41
DRG Weight	1.15	1.13	1.19	1.19
Number of Diagnoses	4.77	2.72	5.82	2.78
Bed Size of Admitting Hosp.	121.1	124.4	160.0	185.0
Distance to Admitting Hosp. (km)	33.7	29.7	32.6	29.0
Closest	.483	.500	.481	.500
Private Insurance	.372	.483	.303	.460
Medicare	.439	.496	.456	.498
Medicaid	.114	.318	.171	.377
Patient Obs	623,146		1,036,361	

patients denoted by $i \in \mathbf{I_t}$ seek inpatient treatment for their illnesses. Patients differ by their diagnoses, demographics, insurance status, and location. Each patient (potentially in consultation with their physician) observes the characteristics of the available hospitals and makes a discrete choice among all available hospitals in order to maximize her ex ante utility. The patient choice set is all hospitals within 85 km of her location. Patients can also select the outside option which corresponds to choosing a hospital outside of this radius.

More precisely, patient i's utility of an inpatient admission to hospital j with diagnosis d is given by,[19]

$$u_{ijtd} = \xi_{jd} + w_{ijtd}\beta + v_{ijtd}. \tag{1}$$

Where ξ_{jd} is the hospital time-invariant unobserved effect, w_{ijtd} is a vector of hospital/patient characteristics. The utility shock, v_{ijtd}, is a mean zero shock and follows an *i.i.d.* Type I extreme value distribution. Patients select the hospital in their choice set that generates the highest utility. The utility of the outside good (admission to a hospital greater than 85 km away) is normalized to 0.

We include a parsimonious set of variables in w_{ijtd} that capture the impact of conversion on patient preferences. Table 3 lists the variables included in w_{ijtd}. The impact of CAH conversion on patient utility is captured through the CAH indicators and their interactions as well as through the impact on bed size in so far as that is impacted by conversion. We include interactions of distance and an indicator for whether the hospital ever converts, and an indicator of whether the hospital was the closest to the patient to control for pre-conversion differences between CAH and non-CAHs.[20]

Let $\delta_{ijdt} = \xi_{jd} + w_{ijtd}\beta$ denote the "mean utility" from being admitted to hospital j. Given the extreme value assumption on the errors, we can write the choice probabilities for

[19]In practice, the patient's choice of hospital is also influenced by the patient's physician preferences over hospitals. Under the assumption that the physician acts as an agent of the patient, the parameter estimates reflect patient preferences.

[20]We explored whether to include higher-order trends interacted with and indicator for whether the hospital ever converted and found that the coefficients on the high-order terms were very small and insignificant.

Table 3: Variables in utility function

Variables		
CAH status	Distance (km)	Distance^2
Bed size	DRG Weight × Beds	Closest hospital
Distance × Beds	Distance × Closest	CAH Status × Distance
CAH Status × Closest	Ever CAH × Distance	Ever CAH × Closest
Ever CAH × Trend	Year Indicators	

Note: "Ever CAH" is an indicator for whether the hospital ever converted to CAH status.

patients as

$$Pr_{ijdt} = \frac{\exp(\delta_{ijdt})}{1 + \sum_{k \in C_{it}} \exp(\delta_{ikdt})} \tag{2}$$

where C_{it} denotes patient i's choice set.

Price does not enter the patient's utility. There are two reasons for this. First, hospital prices for our broad set of hospitals is not available. Second, a majority of rural patients are covered by Medicare and do not face any price variation. While the privately insured patients may face some cost sharing arrangements, the net amount of cost sharing is very low.

Given the distributional assumption on υ_{ijtd}, it is straightforward to estimate the parameters using maximum likelihood. The consumer utility parameters will be identified from the geographic variation in patient and hospital locations and the extent to which consumers choose hospitals based on characteristics such as distance, CAH status, and hospital size. Because we allow for hospital fixed-effects, the effects of CAH status and bed size changes will be identified from the difference-in-difference. In contrast, if CAH conversion is correlated with unobservable hospital characteristics – which is likely given the high correlation with observable characteristics – failure to include hospital fixed-effects will bias the parameter estimates. Even with hospital fixed effects, it is possible that our coefficient estimates reflect time-varying changes in hospital attributes that correlate with conversion to CAH status.

However, we seek to rule out this explanation by including a falsification test of patient utility on future CAH status.

We are also interested in evaluating the heterogeneity in the impact of treatment at CAHs across patients. Conversion implies that hospitals must abide by limitations on the number of available beds and the average length-of-stay. Reducing capacity may diminish the scope economies of the hospital and as a consequence they may focus on more common, lower acuity conditions. If this is the case, then patients with more complex illnesses could be made worse off by CAH conversions as hospitals shed high acuity, low prevalence services. In contrast, patients requiring urgent care may be less sensitive to the level of service provision and more sensitive to distance, and hence less affected by conversion to CAH status (and therefore benefit from the program if it prevents exit). Because some conditions such as acute myocardial infarctions (AMIs) both require urgent care but also often necessitate complex medical treatments, the impact of the Flex program for patients with these illnesses is even more ambiguous. In addition, the impact of conversion may differ by the type of health insurance as CAH conversion changes the reimbursements for Medicare patients but does not directly affect payments for the privately insurance population. To account for heterogeneous impacts of conversion across patients, we estimate separate specifications for different populations defined by insurance status, specific diagnoses and MDC.

We focus on five specific diagnoses: AMI, heart failure, hip fracture, pneumonia and stroke. These diagnoses were chosen because in-hospital mortality is high and thus they are important conditions to monitor and with the exception of hip fracture they are relatively common afflictions. The conditions are defined using the principal ICD-9CM[21] diagnoses field in listed in the discharge data. We also analyze the seven most common MDCs: circulatory system, digestive system, injuries, mental diseases, musculoskeletal system, obstetrics/newborns and respiratory system and group the remaining MDCs into the 'other'

[21] International Classification of Diseases, Ninth Revision, Clinical Modification

category.

4.1 The Impact of Conversion on Patient Volume

We calculate the impact of CAH conversion on the volume of discharges using the parameter estimates from the MNL model. To do this calculation, we compare the change in expected volume of the CAH from converting.[22] That is, we are calculating the average treatment effect on those hospitals that select into treatment (conversion).

Given the parameter estimates, the expected volume of patients as a function of CAH status and bed size is given by

$$EVol_{jt}(CAH_{jt}, Beds_{jt}) = \sum_{i=1}^{I} Pr_{ijdt}. \tag{3}$$

We calculate the mean impact of hospital j's CAH conversion (for the converters) as:

$$\Delta_{jt}^{CAH} = EVol_{jt}(CAH_{jt} = 1, Beds_{jt}) - EVol_{jt}(CAH_{jt} = 0, Beds_{jt}^{pre-CAH}) \tag{4}$$

where $Beds_{j}^{pre-CAH}$ is the beds size of the hospital prior to conversion. Since patients choose among hospitals, effect also depends on whether characteristics of other hospitals change. To isolate the impact of CAH conversion of a hospital, we calculate the impact on volume under both scenarios. We first look at the overall effect by calculating the effect of conversion when all converting hospitals convert simultaneously. We then calculate the effect holding the characteristics of the other hospitals constant.

[22] We allow beds to adjust to the new level at the same time as conversion to CAH status. We found that beds played a very minor role in these results.

4.2 Welfare Analysis

A focus of this paper is on quantifying the welfare impact of the Flex program. This program imposes an implicit policy trade-off. Hospitals receive more generous payments but must agree to generally binding constraints on their capacity and average length-of-stay. Statically, these constraints almost surely weakly reduce consumer welfare. A principal policy goal of the program is that the increased payments will provide financial stability and reduce the number of rural hospital exits. Reducing hospital exit likely increases consumer surplus. The net impact of the program on consumers depends on whether the gain of forestalled hospital exit outweighs the welfare loss from the loss of utility from CAH conversion.

Given the utility parameter estimates in (1), it is relatively straightforward to construct the consumer surplus loss from CAH conversions. We can use these estimates to explore the welfare consequences of the program under different counterfactuals which make explicit the policy trade-offs of the program. The multinomial logit specification implies the following closed form solution for the consumer surplus as shown in Small and Rosen (1981):

$$CS_{it} = \ln \sum_{j=0}^{J} \exp(\delta_{ijt}) \tag{5}$$

The loss in welfare from the requirements placed on converting hospitals is given by

$$\Delta CS_t = \sum_{i} (CS_{it}^{NoCAH} - CS_{it}) \tag{6}$$

where where CS_t^{NoCAH} calculates consumer surplus setting the CAH indicators equal to 0 and the bed size to pre-conversion levels (for converting hospitals).

Finally, in order to get a sense of the welfare impact of the Flex program, we compare the welfare effects of CAH conversion, ΔCS_t, to the consumer surplus loss from hospital exit. To do this, we compare ΔCS_t to the consumer surplus loss from different, counterfactual exit rates but with no hospitals having CAH status, as would exist in the absence of the Flex program. For this counterfactual, we assume that each hospital has an equal probability of exit and simulate different hospital exit rates from 0 to 15%. For each exit rate, we calculate the expected consumer surplus using (5).

5 Results

5.1 Summary Evidence of the Impact of CAH Conversion

Table 4 presents summary statistics in 1998 and 2005 for the rural hospitals in our sample broken down by those institutions that eventually converted during our sample time frame and for those hospitals that did not.[23] There are two important themes that emerge from these statistics. First, converting hospitals are very different than non-converting hospitals along several dimensions prior to their conversion. Second, conversion reduces the relative number of patients.

Converting hospitals were significantly smaller (measured by admissions and bed size) prior to their conversion than non-converting hospitals. These hospitals had, on a patient-weighted basis, 69% fewer beds (46 v. 150) than hospitals that did not convert. Future CAHs also treated approximately 63% fewer patients than non-converting hospitals prior to their conversion. Converting hospitals offered fewer services as measured by the number of unique DRGs treated. On average, future CAH's patients were diagnosed with 59 unique DRGs while non-converters' patients spanned 101 unique DRGs.[24]

In addition to the converters and non-converters differing in size and span of services in the first year of our sample, the characteristics of the patient populations meaningfully

[23] Here we limit the analysis to patients admitted to hospitals that are continuously in our sample from 1998 to 2005.

[24] The fewer unique DRGs could also be a consequence of the size of the patient population. However, controlling for the number of patients, future converters patients spanned significantly fewer DRGs.

differed between these two hospital classes. Patients admitted to hospitals that were to become CAHs had 30% shorter mean length-of-stays and and a 39% lower average DRG weight. Future CAHs treated relatively more Medicare and less privately insured patients. The more generous payments that come with CAH conversion only apply to Medicare patients and thus it is not surprising that converting hospitals admit more Medicare patients prior to conversion. Patients admitted to non-converting hospitals, on average, traveled much further (42 v. 17 km) and were much more likely to bypass a closer hospital on their path to the admitting hospital. For hospitals that would eventually convert, 75% of their patients were admitted to the closest hospitals, while for the non-converters, only 35% of their patients were they being admitted to their closest hospital.

Not only are converting hospitals meaningfully different than non-converting hospitals prior to their conversion, the summary statistics also suggest that conversion affected the size of the hospital and the distribution of the patient population (along a few dimensions) relative to non-converting hospitals. Not surprisingly, the mean bed size of the converting hospital dropped by approximately 50%. The volume of patients was virtually unchanged after CAH conversion while non-converters saw a large increase in their volumes. Converting hospitals experienced a modest decline in the number of services provided while non-converting hospitals showed a large increase in the number of unique DRGs over this period.[25]

In Table 5 we present the distribution of diagnoses and MDCs for converting and non-converting hospitals for the first and last year of our sample. Prior to conversion, CAHs treated a greater percentage of patients with pneumonia and heart failure and less patients with AMI. CAHs also had a greater percentage of their patient load in the Digestive Track and Respiratory MDC and smaller percentage in the Mental Health and Musculoskeletal MDC than non-converters in 1998. Interestingly, after converting CAHs experience a large relative

[25]Again, it is possible that the relative decline in number of unique DRGs is driven by the decline in volume. We have estimated the impact of CAH status on the mean number of diagnoses in a fixed effects framework controlling for the volume of patents and this finding is robust.

Table 4: Patient Characteristics – By 2005 CAH Status

Variable	1998 Mean	1998 S.D.	2005 Mean	2005 S.D.
CAH in 2005				
Number of Hospitals	171		171	
Mean Admissions	775	533	773	525
Bed Size of Admitting Hosp.	45.8	16.1	24.1	2.60
Age	52.2	30.5	54.4	30.4
Female	.60	.49	.62	.49
Length of Stay	3.27	3.68	3.25	3.77
Length of Stay > 4 Days	.20	.40	.18	.39
DRG Weight	.88	.59	.87	.56
DRG Weight > 1.5	.10	.30	.085	.28
Number of Unique DRGs	60.1	33.0	57.8	31.3
Number of Diagnoses	4.61	2.67	5.37	2.76
Distance to Admitting Hosp.	16.9	18.7	17.1	19.0
Closest	.75	.44	.75	.43
Private Insurance	.33	.47	.27	.44
Medicare	.49	.50	.52	.50
N	132,626		132,129	
Not CAH in 2005				
Number of Hospitals	166		166	
Mean Admissions	2,098	5,637	3,046	7,574
Bed Size of Admitting Hosp.	149.5	139.6	129.1	144.4
Age	49.6	28.2	51.4	27.8
Female	.57	.50	.57	.49
Length of Stay	4.35	5.77	4.21	5.87
Length of Stay > 4 Days	.29	.45	.26	.44
DRG Weight	1.26	1.28	1.33	1.34
DRG Weight > 1.5	.22	.42	.26	.44
Number of Unique DRGs	107.6	80.8	114.2	83.2
Number of Diagnoses	4.87	2.75	5.76	2.81
Distance to Admitting Hosp.	41.6	30.8	45.3	31.4
Closest	.35	.48	.32	.47
Private Insurance	.39	.50	.35	.48
Medicare	.42	.49	.44	.50
N	397,167		443,720	

Note: Mean admissions are unweighted across hospitals. Hospitals in sample are those that are in the data for all years. Patients are only counted if they reside in the same state as the hospital of admission.

decline in AMI patients (45%) and a modest rise in pneumonia patients. Correspondingly, there is a notable decline in the Circulatory System MDC for CAHs.

Table 5: Distribution of Specific Diagnoses and MDCs – By 2005 CAH Status

	CAH in 2005		Not CAH in 2005	
	1998	2005	1998	2005
Specific Diagnoses				
AMI	.020	.011	.025	.025
Heart Failure	.041	.040	.025	.025
Hip Fracture	.0027	.0029	.0020	.0020
Pneumonia	.077	.087	.036	.034
Stroke	.029	.022	.028	.023
MDCs				
Circulatory	.15	.13	.17	.17
Digestive	.12	.11	.086	.088
Injury	.011	.010	.012	.014
Musculoskeletal	.060	.065	.11	.12
Mental Health	.027	.018	.054	.034
Obstetrics	.23	.23	.21	.20
Respiratory	.15	.16	.088	.093
Other	.25	.28	.26	.28

In sum, CAHs were different from non-CAHs prior to their conversion. Conversion led to a large decline in mean bed size, a decline in their relative volume, a relative reduction in the number of services offered and a reduction in the number of patients with high severity illnesses, despite the emergency room requirement.

5.2 MNL Demand Estimates

The summary statistics presented above suggested that conversion reduced hospital demand. Of course, these reduced form estimates are not robust to shifts in population or changes in the characteristics of other hospitals which could plausibly be correlated with CAH conversion. In this section we estimate parameters of the utility function for inpatient hospital choice for rural residents from the MNL model discussed in Section 4. This allows us to quantify the impact of CAH conversion and capacity changes, as well as to perform welfare analysis on the impact of the Flex program.

Our specifications include hospital fixed effects, a dummy for CAH status, measures of capacity, and interactions of CAH status with measures of distance. Because Table 5 shows that CAHs draw from a more local pool than other hospitals prior to conversion, we include interactions between hospitals that convert at some point in our sample and measures of distance. We call hospitals that convert at some point "Ever CAH." We also include an interaction of Ever CAH and a time-trend to allow for the possibility that these hospitals had a declining utility over time. Thus, our results should be interpreted as pertaining to the impact of CAH treatment on hospitals that ultimately converted. Any inference to hospitals that did not convert should be made with caution.

Table 6 presents the parameter estimates for the entire sample, the Medicare population, and the privately insured population. (Tables 9 and 10 in the Appendix provide MNL parameter estimates for specific conditions and MDCs.) The coefficient estimates closely align with expectations and the results from the hospital choice literature. Increasing distance to the hospital reduces utility but the impact is concave. Patients also have a strong preference for the hospital that is closest to them and the more severely ill the patient is (as measured by the DRG weight) the greater is their utility from larger hospitals. For both the sample as a whole and private pay patients, patient utility for hospitals that eventually converted was declining prior to conversion: the coefficients on Ever CAH $\times$ Trend is negative and significant. However, for Medicare enrollees, this parameter is not significantly different from zero.

We may be concerned that our coefficients on CAH status reflects other contemporaneous trends relating to those hospitals other than CAH status. In order to investigate this assumption, we estimated specifications with an indicator for conversion to CAH status in

Table 6: MNL Parameter Estimates

	Patient Sample		
	All	Medicare	Private
Distance×100	-9.46***	-10.5***	-8.80***
	(0.0392)	(0.0384)	(0.0362)
Distance^2×10000	1.67***	2.53***	1.09***
	(0.0432)	(0.042)	(0.0395)
Closest Hospital	0.385***	0.465***	0.283***
	(0.00736)	(0.00731)	(0.00682)
Bed Size×1000	-0.761***	-1.16***	-0.162
	(0.128)	(0.130)	(0.109)
Beds×Dist×100000	2.96***	3.38***	2.60***
	(0.0771)	(0.0771)	(0.0686)
Beds×DRG Weight×10000	8.66***	9.87***	8.79***
	(0.0879)	(0.0875)	(0.0808)
CAH status×100	0.238	2.82	0.734
	(2.80)	(2.62)	(2.66)
CAH×Dist×1000	-2.18***	-2.67***	-1.21**
	(0.559)	(0.517)	(0.539)
CAH×Closest×100	-4.64**	-10.1***	-7.15***
	(2.23)	(2.08)	(2.16)
Ever CAH×Dist×100	1.12***	1.13***	1.25***
	(0.0399)	(0.0385)	(0.0362)
Ever CAH×Closest	0.617***	0.709***	0.594***
	(0.0156)	(0.0152)	(0.0143)
Ever CAH×Trend×100	-1.40***	-0.390	-2.40***
	(0.27)	(0.26)	(0.25)
Patients × Choices	10,414,483	11,473,575	12,375,764

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

Note: Standard errors are in parentheses. Specifications also include hospital fixed effects and year fixed effects.

two years. In all cases, the inclusion of lead CAH indicators did not dramatically change the coefficients on the existing variables on CAH status. In some cases, some lead CAH indicators were marginally significant, and in other cases, not significant. We take from this exercise that these hospitals and markets may have had other time-varying factors, but that CAH conversion likely did have a causal impact.

The interactions between CAH status and bed size with the different variables imply that it is difficult to determine magnitudes from the coefficient estimates in Table 6. For this reason, we use the MNL parameter estimates to calculate the mean impact of conversion on the number of admissions. Table 7 presents this information by insurance type and specific disease, and Table 8 presents the same information by MDC. Here we calculate the percentage change in 2005 volume for CAHs that is attributable to their conversion, based on the MNL coefficient estimates. These tables have two columns corresponding to different approaches to calculating the change in volume. The first column presents the percentage change in volume assuming that all CAHs converted simultaneously. The second column calculates the change in volume from conversion assuming that no other hospital converted. These simulations all assume that bed size is set to 25. In all cases, we found that bed size by itself had a negligible impact on volume.[26] Hence, we do not separately report the effects of bed size on volume.

Tables 7 and 8 show that CAH conversion significantly reduced patient volume and those reductions differ across payor class, diagnoses, and MDC. Across all patients, CAH conversion reduces admissions, on average, by 5.4% holding the characteristics of all hospitals fixed at their pre-CAH conversion levels. If all converting hospitals converted, CAHs' volume would decrease by 4.7%. In general, the difference between the two approaches to calculating the impact of CAH conversion is small – approximately one percentage point.

The impact of conversion differs by the principal payor and specific condition. On average, conversion reduces the demand for Medicare patients approximately 6% and 5% for

[26]For instance, for the sample with all patients, the change in beds to 25 increased volume slightly by 0.3%.

privately insured patients. Across the specific diagnoses, the largest reduction from conversion occurred in AMI patients and the smallest reduction was for pneumonia patients. These results aligns with the goals of the program to direct more acutely ill patients requiring more aggressive medical interventions away from CAHs. Most AMI patients are treated with reperfusion therapy, such as percutaneous coronary intervention (PCI) or clot busting drugs. PCI requires the presences of cardiac catheterization lab and the procedure is performed by an interventional cardiologist neither of which are available to most CAHs. Of course, the treatment of AMI is time sensitive and it is possible that rural AMI patients are traveling further to receive care because of CAH conversion. Across MDCs, there is also significant variation in the volume response to conversion. The largest conversion response is for Injuries (a 14% decline) and the smallest decline is for the Respiratory MDC (3.5% decline).

In sum, CAH conversion reduces the value that patients place on converting hospitals. There is some heterogeneity in the impact across patients with different health insurance arrangements and diagnoses, with the biggest outliers being conditions of pneumonia, AMI, and the MDC of injuries. It is possible that the negative impact of CAH conversion is driven by the negative perception of quality of treatment in converted hospitals due to the findings in the medical literature (e.g. Joynt et al. (2011) and Lutfiyya et al. (2007)). Our results show that these findings are confirmed by patient choice data taking into account the heterogeneity of hospitals prior to conversion.

To understand the net impact of the Flex program requires comparing this static welfare loss to any potential consumer surplus gained from the program forestalling exit. We explore that question next.

5.3 Welfare Effects of the Flex Program

One of the principal goals of the Flex program is to prevent rural hospital exit. As we have shown above, conversion to CAH status reduces patient utility. In our first welfare

Table 7: Predicted Percentage Change in Volume from Conversion to CAH Status

Sample	Converting All CAHs Simultaneously	Converting Holding Other Hospitals Fixed
All	-4.66	-5.40
Medicare	-5.20	-6.02
Private	-4.53	-4.93
	Specific Diagnoses	
AMI	-8.15	-8.67
Heart Failure	-3.93	-4.96
Pneumonia	-1.99	-2.80
Hip Fracture	-3.95	-5.06
Stroke	-4.61	-5.18

Note: "CAH Effect" is the impact of conversion with bed size set at pre-conversion levels.

Table 8: Predicted Percentage Changes in Volume from Conversion by MDC

Sample	Converting All CAHs Simultaneously	Converting Holding Other Hospitals Fixed
Circulatory	-6.64	-7.31
Digest	-3.39	-3.90
Injuries	-12.18	-14.19
Musculoskeletal	-5.38	-5.28
Mental Diseases	-4.24	-4.93
Obstetrics	-4.69	-5.11
Respiratory	-2.89	-3.54
Other	-7.30	-8.87

Note: "CAH Effect" is the impact of conversion with bed size set at pre-conversion levels.

analysis, we quantify the loss in welfare from CAH conversion using a distance metric. The policy tension in the Flex program is between the increase in consumer surplus attributable to maintaining access to these hospitals by preventing exit and the decrease in consumer surplus associated with CAH conversion. In our second welfare analysis, we calculate the reduction in entry rates necessary for the Flex program to increase rural resident welfare.

We first compute the distance that yields the same utility in (1) given our estimates for a non-CAH with a capacity of 42 beds (the mean size of hospitals prior to conversion) and a CAH of otherwise the same characteristics. Specifically, we find the change in distance, $\Delta dist$, that make patient indifferent between admission to a CAH and a non-CAH for a given set of hospital characteristics. That is, we find the $\Delta dist^*$ that solves $\hat{u}(CAH = 1, dist, Beds = 25) = \hat{u}(CAH = 0, dist - \Delta dist^*, Beds = 42)$ where $\hat{u}$ is the fitted utility values given the MNL estimates.

Because preferences are nonlinear in distance, we examine two cases: a hospital that is 10km away from a given patient and a hospital that is located 25km away from a patient's home. In the first case, on average, patients are indifferent between the hospital converting to CAH status and the hospital moving .87 km closer to their home. In the second case, patients would be indifferent between the hospital converting and moving it 1.4 km closer to their home. That is, according to this distance metric the welfare loss from conversion is modest but meaningful.

To implement our second and principal welfare analysis, using our parameter estimates of (1) from the entire sample, we calculate the mean consumer surplus under different hospital exit rates for hospitals that converted. As we are interested in comparing the welfare under the Flex program to the counterfactual in which the Flex program was not enacted, we assume there are no CAHs and converting hospitals are assigned their pre-conversion capacity. We assume that the likelihood of exit is random across CAHs for a given exit rate.[27] In this

[27]Because we assume exit is random across CAHs, the results from this exercise can be viewed as a conservative estimate of the necessary exit rate reduction as the likely exiters will also likely be the hospitals

exercise we also calculate the mean distance to the closest hospital and average distance traveled to the chosen hospital. We then compare the consumer surplus and distance measures under the different exit rates to those values under the Flex program.[28]

The results from this welfare analysis are presented in Figure 3. In the figure, we graph the percentage change consumer surplus, closest hospital and distance to chosen hospital relative to those values under the Flex program. The results in Figure 3 highlight the policy tension in the Flex program. The break-even point for consumer surplus is an exit rate of approximately .04. If the Flex program reduced the exit rate for converters by .03 or less, the program reduced rural patient welfare. Of course, the converse holds as well. If the Flex program prevented more than 4% of converting hospitals from exiting then the program was consumer surplus improving. Determining the counterfactual exit rate is challenging and requires solving for exit decisions by firms in the absence of the Flex program, which in turn requires modeling the dynamic oligopoly interactions of hospitals. This is a task beyond the scope of this paper but one we take up in companion work (Gowrisankaran et al. (2010)).

The impact of the Flex program on travel time to the chosen hospital is less dramatic than its impact on consumer surplus. Of course, for all non-zero exit rates, the Flex program will result in a reduction in the mean distance to the closest hospital, and for all exit rates above .01 the Flex program reduces the mean distance to the chosen hospital. The impact of the Flex program on distance to hospital chosen is less dramatic than that to nearest hospital. This stems from the fact that patients are willing to travel longer distance to avoid CAHs.

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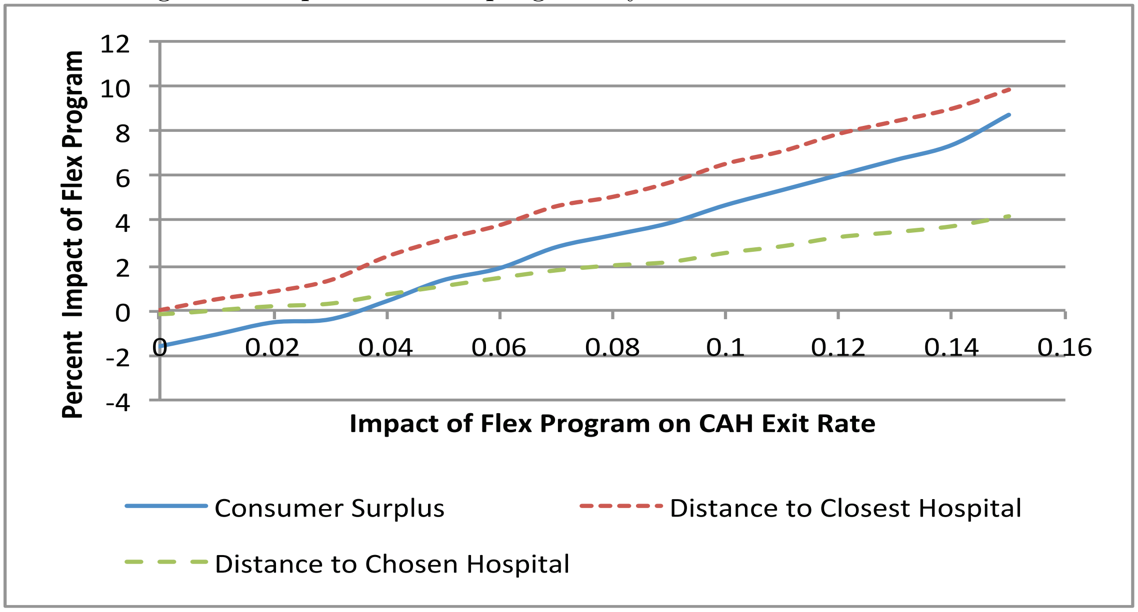
that are the least valued from the patient's perspective.

[28]The exit rate for CAHs is less than 1% (Gowrisankaran et al., 2010).

Figure 3: Impact of CAH program by Counterfactual Exit Rate



6 Conclusions

This paper estimated the impact of the Medicare Rural Flexibility Program on the demand for inpatient services. We find that patients are willing to travel significant distances to avoid visiting a Critical Access Hospital that faces length of stay restrictions and consequently specializes in a limited range of services. The reduction of bed capacity to fulfill the CAH bed limit of 25 beds appears to have affected patient choice only in a minor fashion. We examine to what extent the impact of CAH conversion varies by condition and type of health insurance arrangement. The results suggest that while the magnitude of the CAH effect varies by condition, CAH conversion reduces the desirability of a hospital across most conditions and health insurance arrangements. We calculate that the welfare loss from CAH conversion will offset only if the counterfactual exit rate is .04. However, changes in the quality of care provided by these hospitals may swamp the dimensions of welfare we consider here. In future research, we examine the quality consequences of the Flex program. Finally, Gowrisankaran et al. (2010) specify a dynamic oligopoly model with hospital exit and conversion to CAH status. The aim is to compute counterfactual equilibrium market structures to examine the impact of eliminating and modifying the Flex program on access to hospitals and patient welfare.

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7 Appendix

Table 9: MNL Parameter Estimates – Specific Diagnoses

	AMI	Heart Failure	Pneumonia	Hip Fracture	Stroke
Distance×10	-0.797***	-1.31***	-1.56***	-1.35***	-1.04***
	(0.00881)	(0.00795)	(0.00750)	(0.0330)	(0.00817)
$Distance^2 \times 10000$	-0.377***	-3.82***	6.26***	4.64***	1.87***
	(0.0967)	(0.0889)	(0.0793)	(0.357)	(0.091)
Closest Hospital	0.772***	0.367***	0.152***	0.342***	0.558***
	(0.0185)	(0.0139)	(0.0121)	(0.0614)	(0.0155)
Bed Size×1000	-3.42***	-2.50***	-0.918***	-2.39**	-0.895***
	(0.267)	(0.268)	(0.263)	(1.18)	(0.265)
Beds×Dist×100000	4.62***	4.56***	3.37***	5.25***	4.63***
	(0.156)	(0.161)	(0.168)	(0.646)	(0.154)
Beds×DRG×1000	1.25***	0.881***	0.658***	1.07***	0.536***
	(0.0148)	(0.0184)	(0.0208)	(0.0646)	(0.0174)
CAH status×100	-10.1	0.652	4.63	7.66	-6.04
	(7.74)	(4.95)	(3.75)	(19.8)	(6.17)
CAH×Dist×1000	-0.699	-0.256	-1.44*	-4.29	-1.05
	(1.56)	(0.995)	(0.743)	(3.96)	(1.23)
CAH×closest×100	-3.47	-16.2***	-12.2***	-6.43	-1.92
	(6.30)	(3.81)	(2.82)	(15.5)	(4.91)
Ever CAH×Dist×100	0.362***	1.40***	1.80***	1.49***	1.12***
	(0.100)	(0.0789)	(0.0644)	(0.312)	(0.0862)
Ever CAH×Closest	0.742***	0.639***	0.532***	0.641***	0.719***
	(0.0402)	(0.0286)	(0.0221)	(0.116)	(0.0335)
Ever CAH×Trend×1000	-81.4***	-11.1**	0.268	21.8	-6.64
	(6.17)	(5.16)	(4.28)	(20.3)	(5.50)
Patients × Choices	2,429,930	3,235,314	4,344,669	1,914,86	2,664,897

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

Note: Standard errors are in parentheses. Specifications also include hospital fixed effects and year fixed effects.

Table 10: MNL Parameter Estimates – MDCs

	Circulatory system	Digestive system	Injuries	Mental diseases	Musculoskeletal system	Respiratory system	Other
Distance×100	-9.39***	-11.5***	-9.83***	-6.49***	-8.25***	-13.0***	-9.74***
	(0.0441)	(0.0432)	(0.112)	(0.0682)	(0.0404)	(0.0425)	(0.0476)
$\text{Distance}^2 \times 10000$	1.06***	2.83***	2.11***	0.920***	1.42***	4.11***	1.96***
	(0.0491)	(0.0474)	(0.125)	(0.0707)	(0.0431)	(0.0467)	(0.0524)
Closest Hospital	0.559***	0.367***	0.523***	0.398***	0.418***	0.313***	0.435***
	(0.00871)	(0.00769)	(0.0209)	(0.0140)	(0.00782)	(0.00727)	(0.00911)
Bed Size×1000	-2.58***	-0.497***	-1.06***	4.23***	-0.248**	-1.37***	-1.22***
	(0.137)	(0.147)	(0.382)	(0.201)	(0.129)	(0.145)	(0.158)
Beds×Dist×100000	4.27***	3.79***	3.66***	-0.718***	1.98***	3.64***	3.68***
	(0.0814)	(0.0892)	(0.216)	(0.117)	(0.0747)	(0.089)	(0.091)
Beds×DRG Weight×1000	1.15***	0.496***	0.488***	0.516***	0.627***	0.768***	0.628***
	(0.00737)	(0.00935)	(0.0254)	(0.0701)	(0.0116)	(0.00921)	(0.0113)
CAH Status×100	6.85*	-0.818	8.64	-28.8***	9.93***	1.59	6.04*
	(3.50)	(2.74)	(8.77)	(6.62)	(3.45)	(2.52)	(3.44)
CAH×Dist×1000	-3.54***	-0.512***	-5.14***	-0.900	-2.38***	-0.979*	-5.01***
	(0.709)	(0.550)	(1.70)	(1.21)	(0.664)	(0.503)	(0.681)
CAH×Closest×100	-13.7***	-7.24***	-25.4***	43.2***	-16.5***	-10.1***	-11.1***
	(2.82)	(2.16)	(7.03)	(5.54)	(2.82)	(1.94)	(2.75)
Ever CAH×Dist×100	0.889***	1.45***	1.64***	1.09***	0.786***	1.47***	1.27***
	(0.0492)	(0.0415)	(0.119)	(0.0699)	(0.0449)	(0.0402)	(0.0494)
Ever CAH×Closest	0.746***	0.6.09***	0.812***	0.790***	0.877***	0.581***	0.710***
	(0.0194)	(0.0155)	(0.0481)	(0.0348)	(0.0189)	(0.0145)	(0.0197)
Ever CAH×Trend×100	-4.40***	60.9***	-2.11***	6.43***	-1.71***	-1.77***	0.695**
	(0.325)	(1.55)	(0.821)	(0.56)	(0.305)	(0.267)	(0.333)
Patients × Choices	8,9751,17	9,813,739	1,310,445	4,1686,76	9,582,748	1,117,3801	7,019,073

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

Note: Standard errors are in parentheses. Specifications also include hospital fixed effects and year fixed effects.