

# **Fluctuations in Short-term Demand: Implications for Hospital Admission and Discharge Behavior**

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# Outline

- I. Background and motivation.
- II. What is new in this research?
- III. Empirical issues and summary of results.
- IV. Elements of theoretical model.
- V. Results: Hypotheses from theory and empirical evidence.
- VI. Conclusion.  
Presentation will focus on intuition and flavor of results.

# Background:

- Stochastic demand is a key feature of hospital operations.
- Implications for costs, capacity requirements
- Examples: Cost of empty beds, impact of variance in demand/occupancy on hospital costs.
- Anti-trust Framework: Implications for hospital competition, mergers, acquisitions, closures, expansions.
- Forecasting hospital demand.

Motivation: Fluctuations in demand may have direct implications for hospital behavior.

- Capacity constraints may affect hospital admission and discharge behavior.
- Hospital may have to be selective in which patients it will admit.
- Hospital may have to be selective in which inpatients may remain.
- Existing literature does not deal with these issues and their implications.

# What is new in our research?

- First paper to examine impact of short-term fluctuations in demand on hospitals' admission and discharge behavior. Focus on capacity issues.
- Develops theoretical framework that provides testable hypotheses.
- Tests hypotheses using Oregon discharge data from December 1, 1997 to November 30, 1998 (Office of Health Policy and Research).

# Key technical innovations:

- Develop a test that permits us to detect discriminatory admissions practices towards patients with different types of insurance.
  - no need to control for underlying differences in health and treatment seeking behavior of patients from different plans.
- Develop a simple proxy measure for the additional hospital resources that would ordinarily be used in the treatment of current inpatients.

# Empirical issues:

- How do we detect times when hospitals have insufficient capacity?
- Occupancy rarely exceeds bed capacity (18 times out of more than 20,000 hosp days in our data).
- Capacity constraints apply whenever the quantity of any input necessary in treatment is insufficient for the patients the hospital would like to treat.
- Is capacity a hospital-wide, chain-wide, or market-wide phenomenon?

Solution: Different approaches to identifying days when hospitals may have inadequate capacity.

We use several approaches.

- We report results that arise when:
  - Assume that each hospital serves a market comprising all hospitals within a 15 mile radius.
  - Identify the 20% highest and lowest occupancy days in a hospital's market as, respectively, high and low demand days for that hospital.
  - Postulate that hospital has sufficient capacity on low demand days, but may face capacity constraints on high demand days.

# Summary of empirical results:

- Patients admitted on high demand days tend to have greater resource requirements in treatment than those admitted on days when demand is low.
- Patients discharged on high demand days leave earlier than expected when compared to those discharged on days when demand is low.
- Evidence of discrimination in admissions against OHP/Medicaid patients.
- Important differences in discharge patterns of patients with different types of insurance.

# Main elements of theoretical model.

- Hospital patients differ in resource requirements in treatment. (LOS and intensity of treatment)
  - >e.g., Medicare's DRG relative weights
- We do not examine issues of appropriateness or efficiency in treatment.

# Model– Payment for treatment.

- Hospital treats patients from different insurance plans (plans X and Y).
- Plan X pays more than plan Y.
- Payment hospital receives for treating a patient is proportionate to the patient's resource requirements in treatment.

# Model—Hospital preferences.

- Between two patients with same insurance but different resource requirements in treatment, the hospital prefers to treat the one whose requirements are greater.
- Between two patients with same resource requirements but different insurance, the hospital prefers to treat the one with the better paying insurance.

# Reality check:

- Hospital behavior arises from a combination of hospital policies and physician decisions.
- Hospital behavior may not be uniform across departments.

## Crux of theoretical results regarding the effects capacity constraints have on hospital behavior:

- When the hospital does not have enough capacity to treat all patients, it is forced to restrict admissions of some patients.
- It may also be forced to discharge some patients early.
- When the hospital does not have enough capacity, treatment of patients from low paying plans is affected more than the treatment of patients from high paying plans.

# Main hypotheses resulting from theoretical analysis and corresponding empirical evidence.

- For all patients, regardless of insurance type, mean resource requirements will be higher when admissions are affected by insufficient capacity.

Mean DRG relative-weight of those admitted on:

High-Demand Days-> 1.143

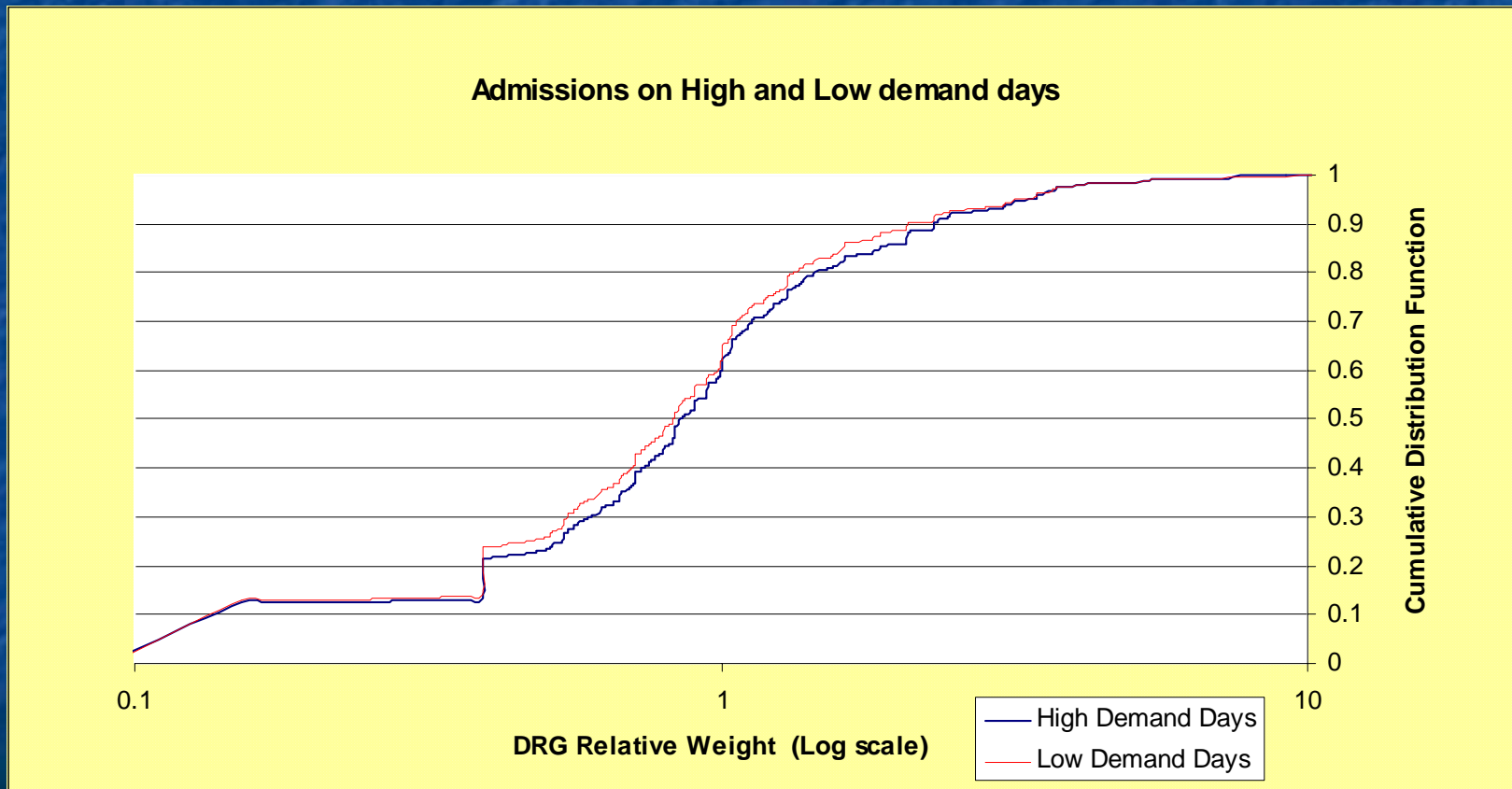
Low-Demand Days-> 1.087

- For patients with all types of insurance, proportion of patients with low resource requirements will be higher on low demand days.

-See this by looking at the distribution of hosp admissions over resource requirements (CDF).

All CDFs have begin value 0 and end value 1.

# CDF of admissions on high and low demand days– all patients.



# Behavior towards patients with different types of insurance:

Assumption: The hospital values profit. If patients from different plans have identical treatment requirements and care seeking behavior, then

- the hospital will discriminate against patients from plans that do not cover marginal cost of treatment even when hospital has spare capacity.
- the hospital will discriminate against patients from the lower paying plans when capacity is insufficient.

# How can we detect such discrimination?

- If patients from different plans have identical treatment requirements and care seeking behavior, then
  - average resource requirement in treatment is higher for admitted patients from lower paying plans.

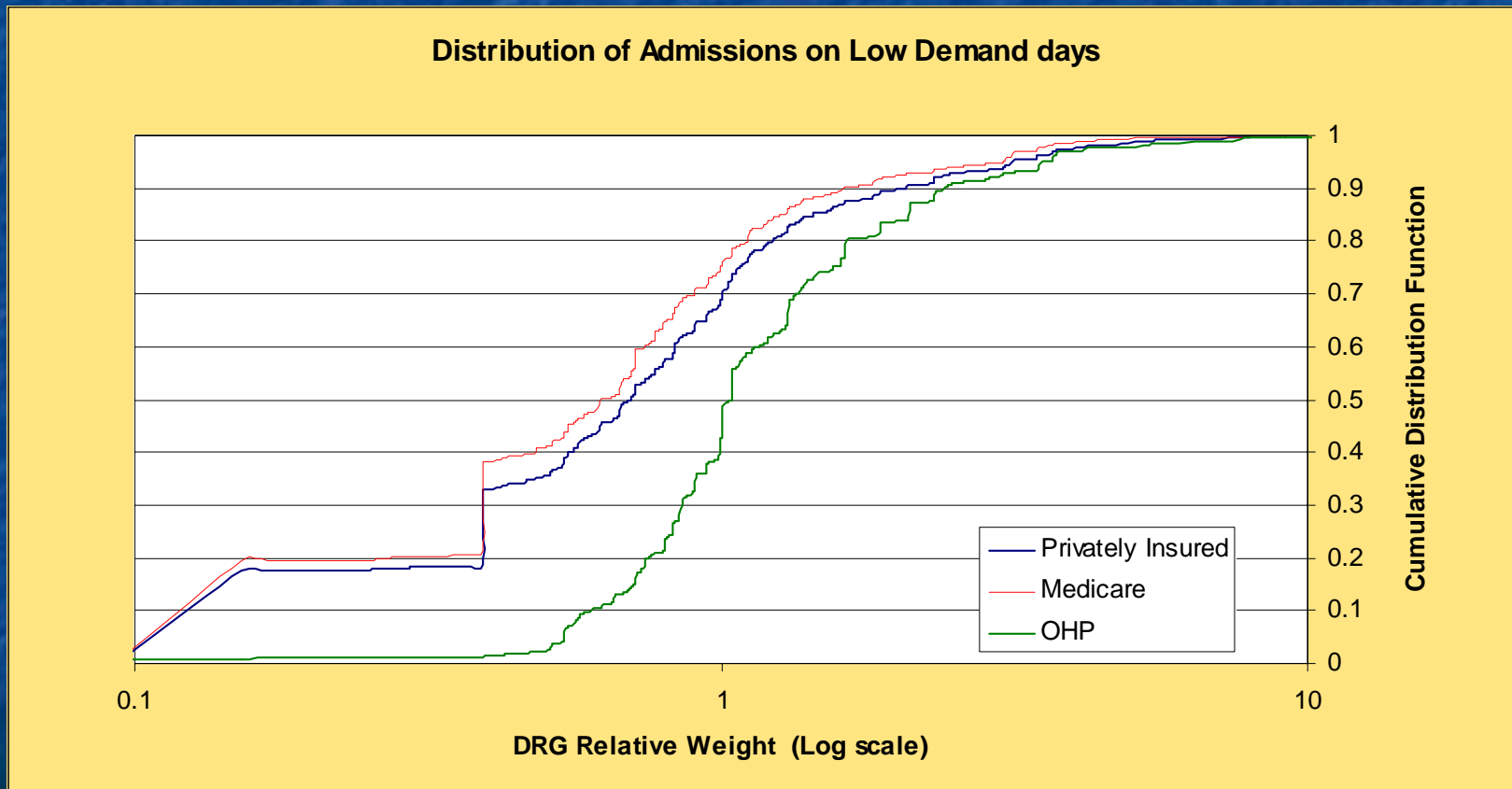
Mean DRG relative-weight of those admitted:

|                    | Private | Medicare | OHP   |
|--------------------|---------|----------|-------|
| High-Demand Days-> | 1.037   | 0.902    | 1.464 |
| Low-Demand Days->  | 0.997   | 0.866    | 1.397 |

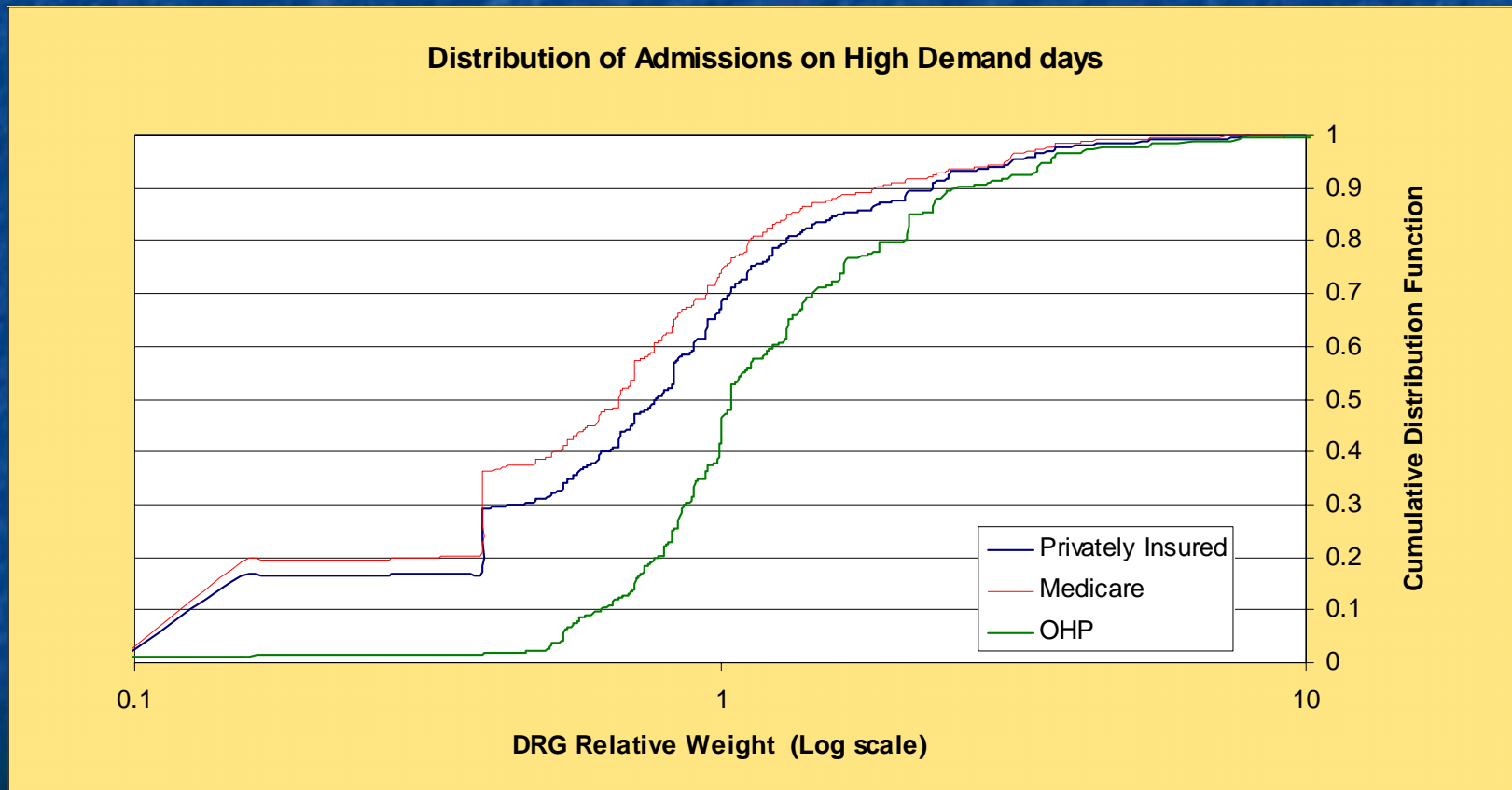
## Detect discrimination from distribution of admitted patients:

- If patients from different plans have identical treatment requirements and care seeking behavior, then
  - the proportion of admitted patients with low resource requirements in treatment is greater for patients from higher paying plans on both high and low demand days. That is, examine distributions of patients admitted on high and low demand days (CDFs).

# CDF of admissions on Low demand days.



# CDF of admissions on High demand days.



# Do the results so far constitute evidence of discrimination?

- We can't be sure.
- Patients from different plans may have different treatment requirements and care seeking behavior.

# How can we detect discrimination when different plans enroll different types of patients?

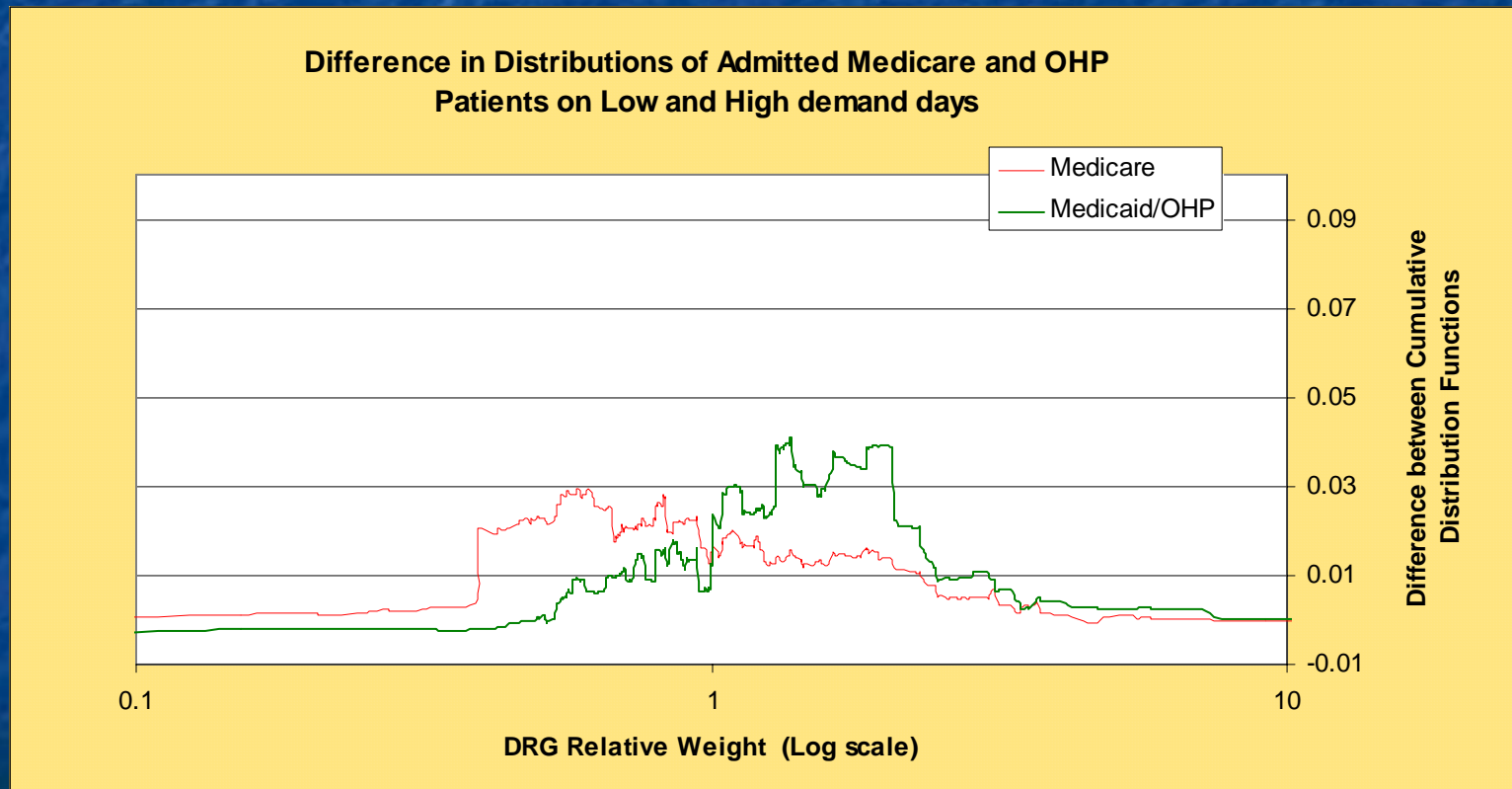
- If the hospital does not discriminate, patients affected by capacity constraints have similar treatment requirements regardless of their health plan.

=>Specifically, maximum impact of capacity constraints is felt at higher level of treatment requirements by patients from lower paying plans.

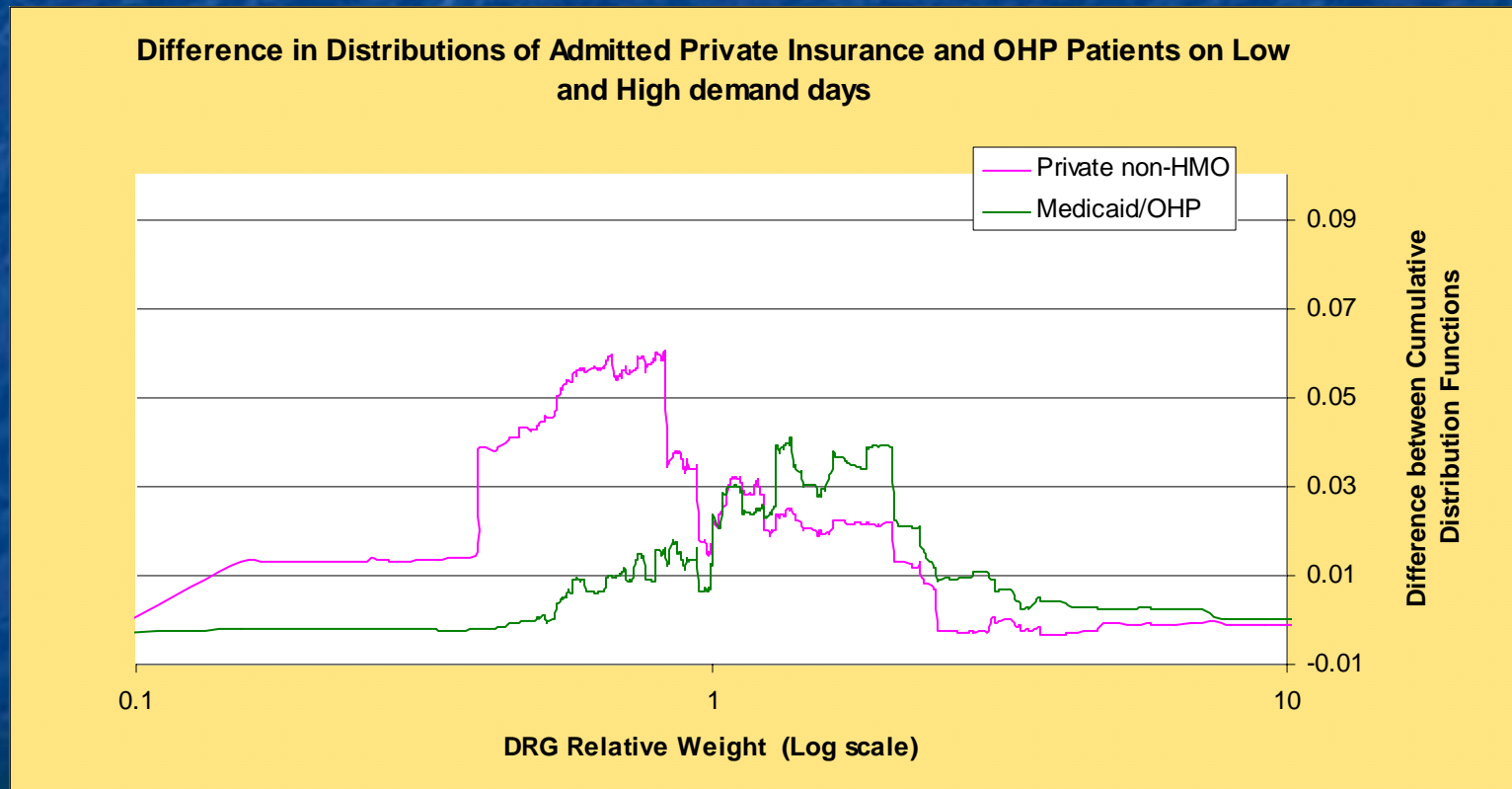
DRG relative-weight where difference between CDFs on high and low demand day is maximized:

|                         | Private | Medicare | OHP   |
|-------------------------|---------|----------|-------|
| DRG RW where diff max-> | 0.828   | 0.584    | 1.377 |

# Medicare and OHP: Difference in distribution of admissions between high and low demand days.



# Private Ins. and OHP: Difference in distribution of admissions between high and low demand days.



## Analyzing discharge behavior:

- Expected remaining length of stay (*ERLOS*) based on DRG and elapsed length of stay.
- Large *ERLOS* at discharge implies earlier than expected discharge.

Mean *ERLOS* of those discharged:

|                    | Private | Medicare | OHP   |
|--------------------|---------|----------|-------|
| High-Demand Days-> | 3.022   | 3.415    | 4.052 |
| Low-Demand Days->  | 2.822.  | 3.044    | 3.791 |

# Conclusion:

- Examine impact of fluctuations in demand on hospital admission and discharge behavior.
- Patients admitted on high demand days have higher resource requirements than those admitted on low demand days.
- Patients discharged on high demand days are discharged earlier relative to expectations than those discharged on low demand days.
- Differences in treatment of OHP patients.

# Areas for further research:

- Impact on health/resource use.
- Our technical innovations can be useful in detecting inequity in treatment elsewhere.
  - Women, minorities, lower income.
- Better identification of capacity constraints using more detailed data and observation.
- Our technical advances can have applications in demand forecasting.