CYBER SEMINAR:

Econometric Issues in Analyzing Health Care Cost and Utilization Outcomes

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September 26, 2007

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ROADMAP

1. The importance of quantitative analysis in health care
2. Cost and utilization data
3. "What is the question?"
4. Where we've been ...
5. Where we are ...
6. Where we might be heading ...

You should know...

... ceteris paribus, I have a preference for simple and user-friendly econometric approaches over complicated ones (Occam's Razor? Cognitive constraints?)

... I now do ~100% of my empirical work using Stata (v. 9/10), especially now since Stata has developed a user-friendly matrix programming language (Mata)

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1. THE IMPORTANCE OF QUANTITATIVE ANALYSIS IN HEALTH CARE ... SOME EXAMPLES

MMAHelp

- Overview
- Medicare Advantage and Prescription Drug Plans Communications User Guide
- MA/PDP Operational User Group Materials
- System Letters
- Enrollment and Payment Systems Training Materials
- Beneficiary Eligibility and Enrollment
- **Prescription Drug Event and Risk Adjustment Data**
- IACS
- Frequently Asked Questions

Prescription Drug Event and Risk Adjustment Data

Prescription Drug Event

The Prescription Drug Event Front End System (PDFS) performs the initial file processing of the Prescription Drug Event data submitted by the Part D Plans. Upon completion of the intial file processing, the Prescription Drug Event data is then sent to the Drug Data Processing System for validation and authentication of the Medicare payment of covered drugs made by the Part D plans for their enrolled Medicare beneficiaries. Next, an analytic component, the Drug Benefit Calculator (DBC), loads the data into the National Medicare Drug Benefit Database and aggregates the data into data marts, when appropriate, to support drug, beneficiary, and plan analysis of incurred payments and payment reconciliation.

Risk Adjustment

The Front End Risk Adjustment System (FERAS) performs the initial file processing for risk adjustment data submitted by MA and MA-PD plans. Upon completion of the initial file processing, the risk adjustment data is sent to the Risk Adjustment Processing System (RAPS) at CMS for use in the calculation of Part C and Part D risk scores. These beneficiary level risk scores are passed to the Medicare Advantage Rx (MARx) system for use in Part C and Part D payment calculations.

The NEW ENGLAND JOURNAL of MEDICINE

SPECIAL ARTICLE

Level and Volume of Neonatal Intensive Care and Mortality in Very-Low-Birth-Weight Infants

Ciaran S. Phibbs, Ph.D., Laurence C. Baker, Ph.D., Aaron B. Caughey, M.D., Ph.D., Beate Danielsen, Ph.D., Susan K. Schmitt, Ph.D., and Roderic H. Phibbs, M.D.

Independent.ie

Revealed: the 11 breast cancer units to be closed

HSE to shut services within weeks due to lack of hospital procedures

The new guidelines say that consultant surgeons should treat at least 50 new patients for breast cancer each year to keep their skills up to date. However, the Health Services Executive (HSE) disclosed last week that 11 hospitals had performed less than 20 procedures in 2005 and promised to shut down their breast cancer services in weeks.

The HSE did not name the hospitals. But the Sunday Independent has identified them as the Mercy in Cork city, which performed two procedures in 2005, Mallow General, which performed four, Monaghan General performed 10, Louth County Hospital, which performed 15, Nenagh General, which performed six, Tullamore General in Offaly, which performed one, Ennis General, which performed seven and Portiuncula hospital in Ballinasloe, which performed 17.

Three Dublin hospitals are also expected to be asked to drop breast cancer services. They are Loughlinstown and St Michael's in Dun Laoghaire, which performed two procedures each in 2005. James Connolly Memorial hospital, which performed 20 procedures that year, may also be asked to cut its services.

Health Technology Assessment

The Health Technology Assessment Program (HTA) provides high-quality information about the clinical effectiveness, cost-effectiveness, and broader impact of drugs, medical technologies, and health systems. Our impartial, rigorous, and comprehensive assessments examine four questions:

- How will this health technology affect the health of Canadians?
- How does it compare with alternatives?
- Does it provide value for the investment?
- Are there other health service implications to consider?

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CONGRESS OF THE UNITED STATES
CONGRESSIONAL BUDGET OFFICE

A
CBO
PAPER

MAY 2005

High-Cost Medicare Beneficiaries

Physician Profiling, Guiding Principles

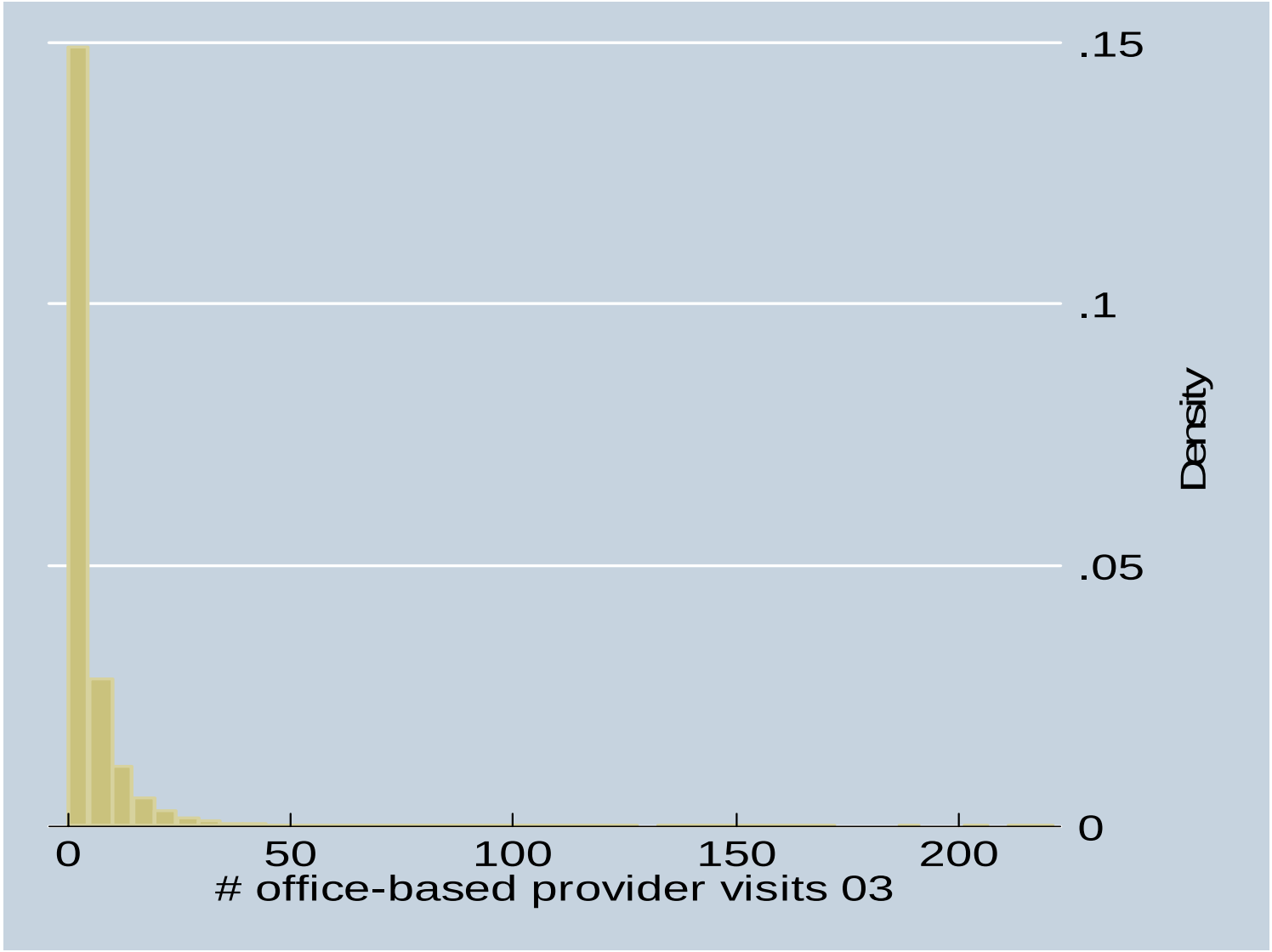
See also:
Performance Measures Criteria
Pay-for-Performance

Preamble

The AAFP believes physician profiling is an analytic tool that uses epidemiological methods to compare physician practice patterns across various quality of care dimensions (process and clinical outcomes). Cost, service and resource utilization data are dimensions of measuring quality, but should not be used as independent measures of defining quality care. The ultimate goal is to improve clinical outcomes.

It is important to recognize that physician profiling is not intended to be used to address issues of physician competency, including the dimensions of medical knowledge, skills competence and physician performance. It is our belief that these issues should be addressed by the appropriate public and private credentialing bodies that exist for these purposes.

2. COST AND UTILIZATION DATA ... SOME EXAMPLES OF "TYPICAL" CHARACTERISTICS



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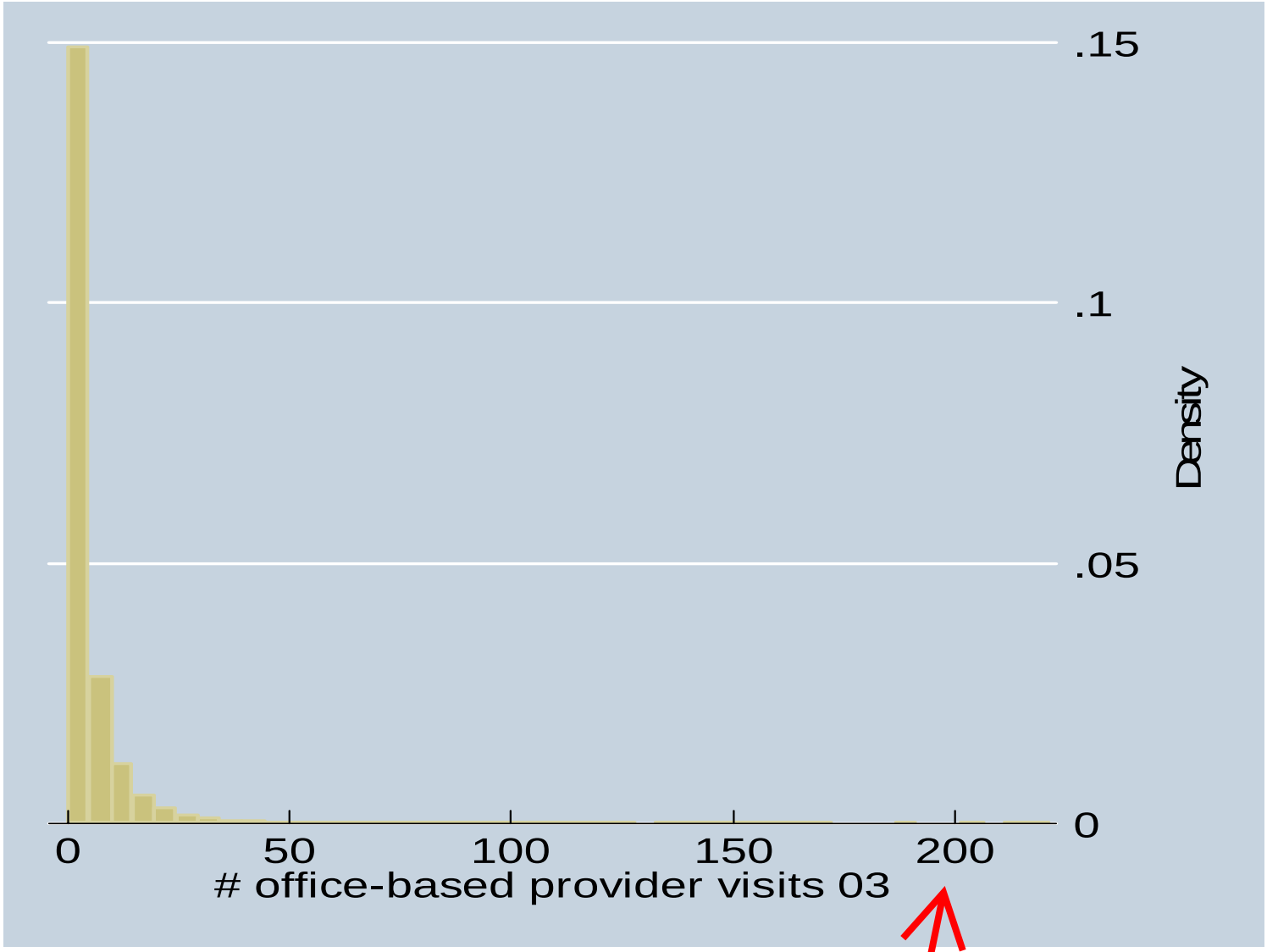

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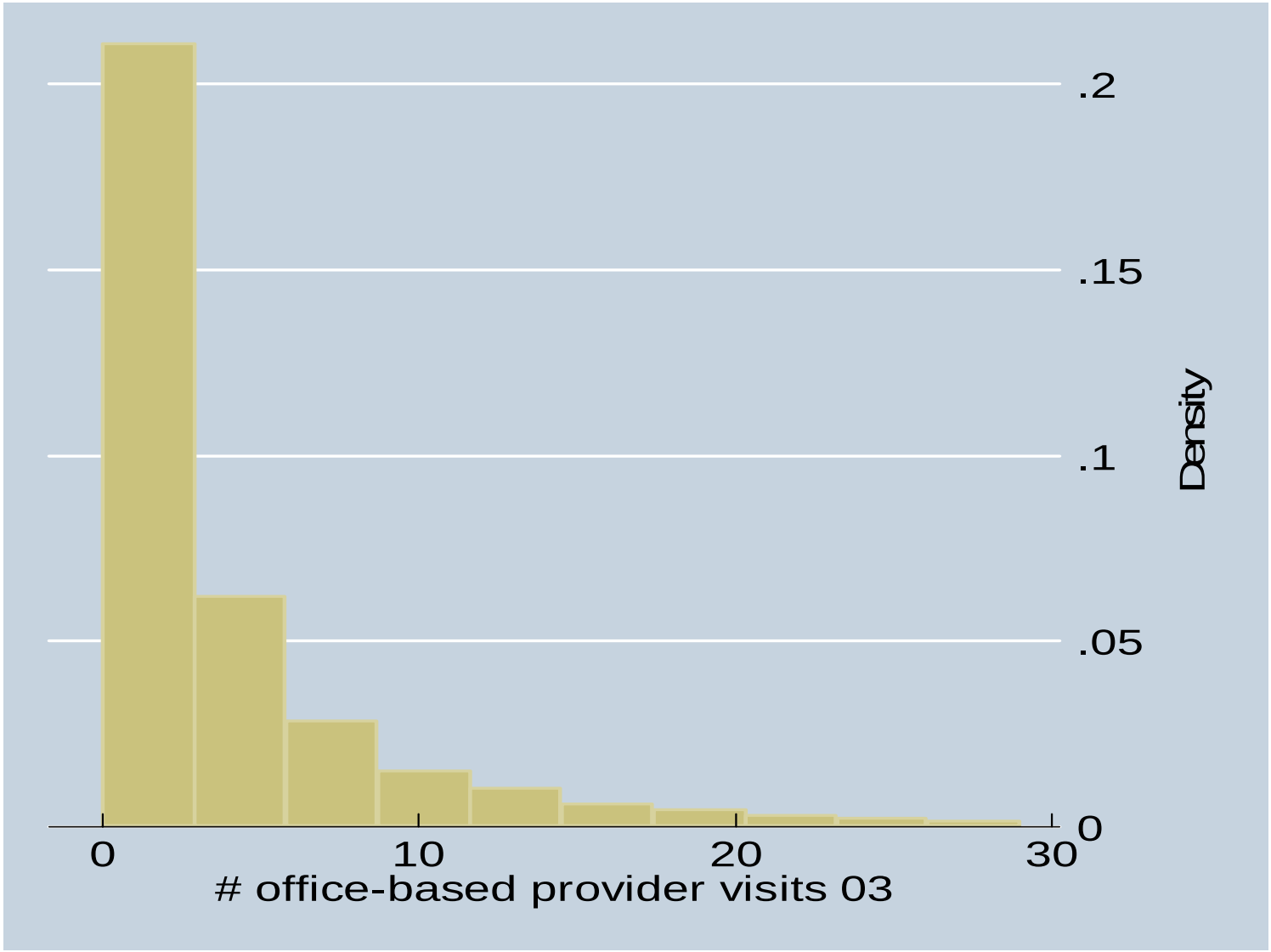

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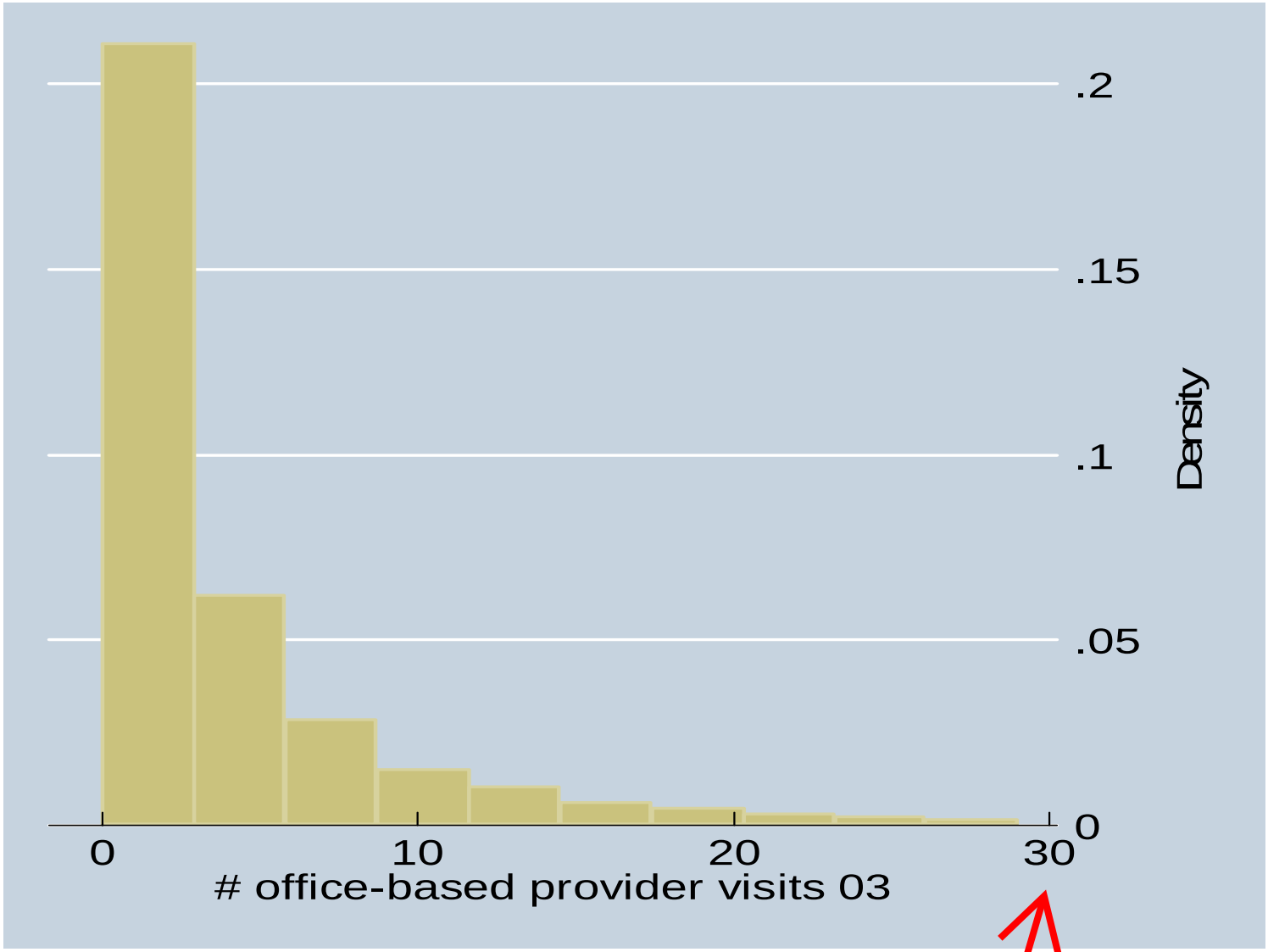

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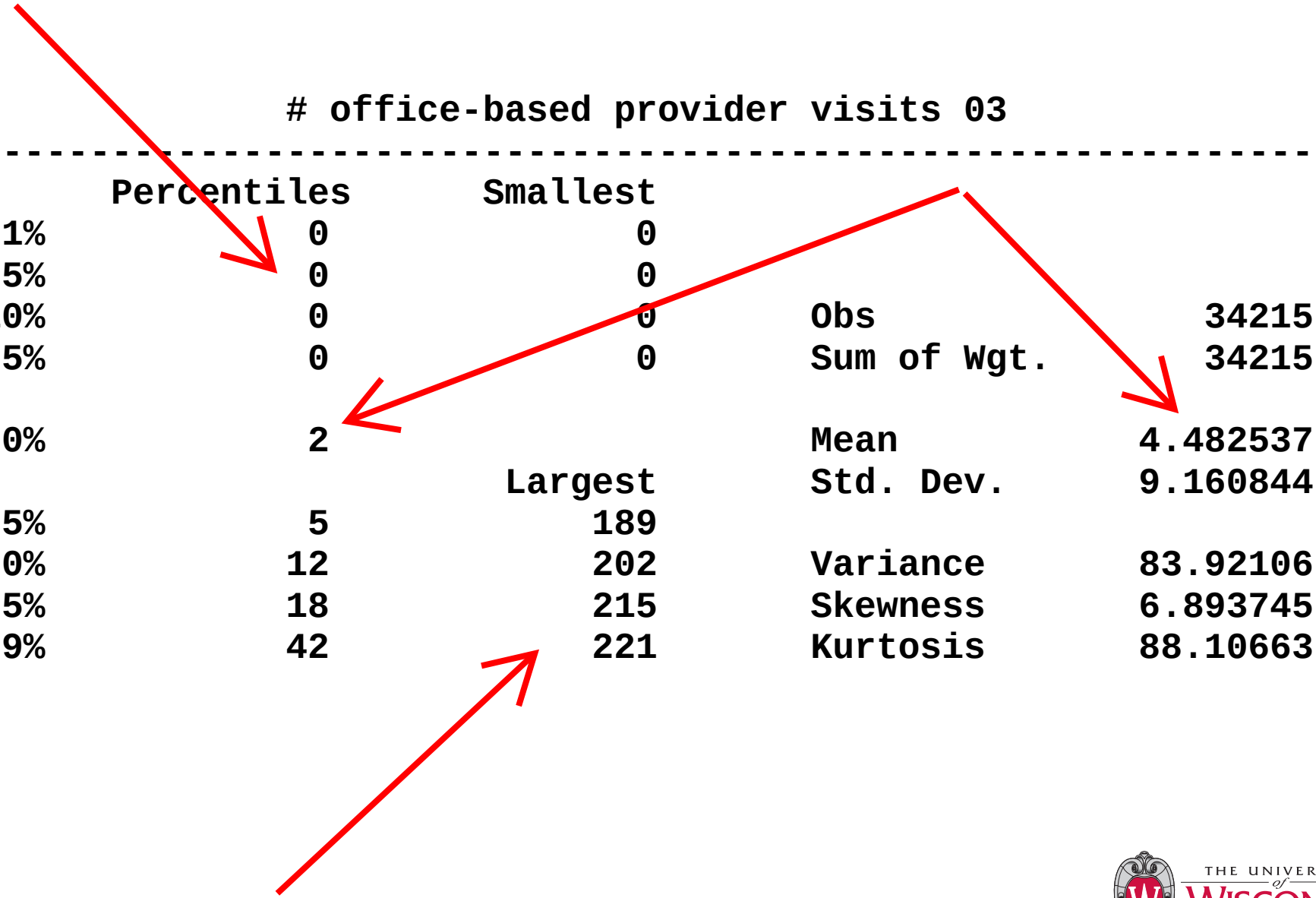
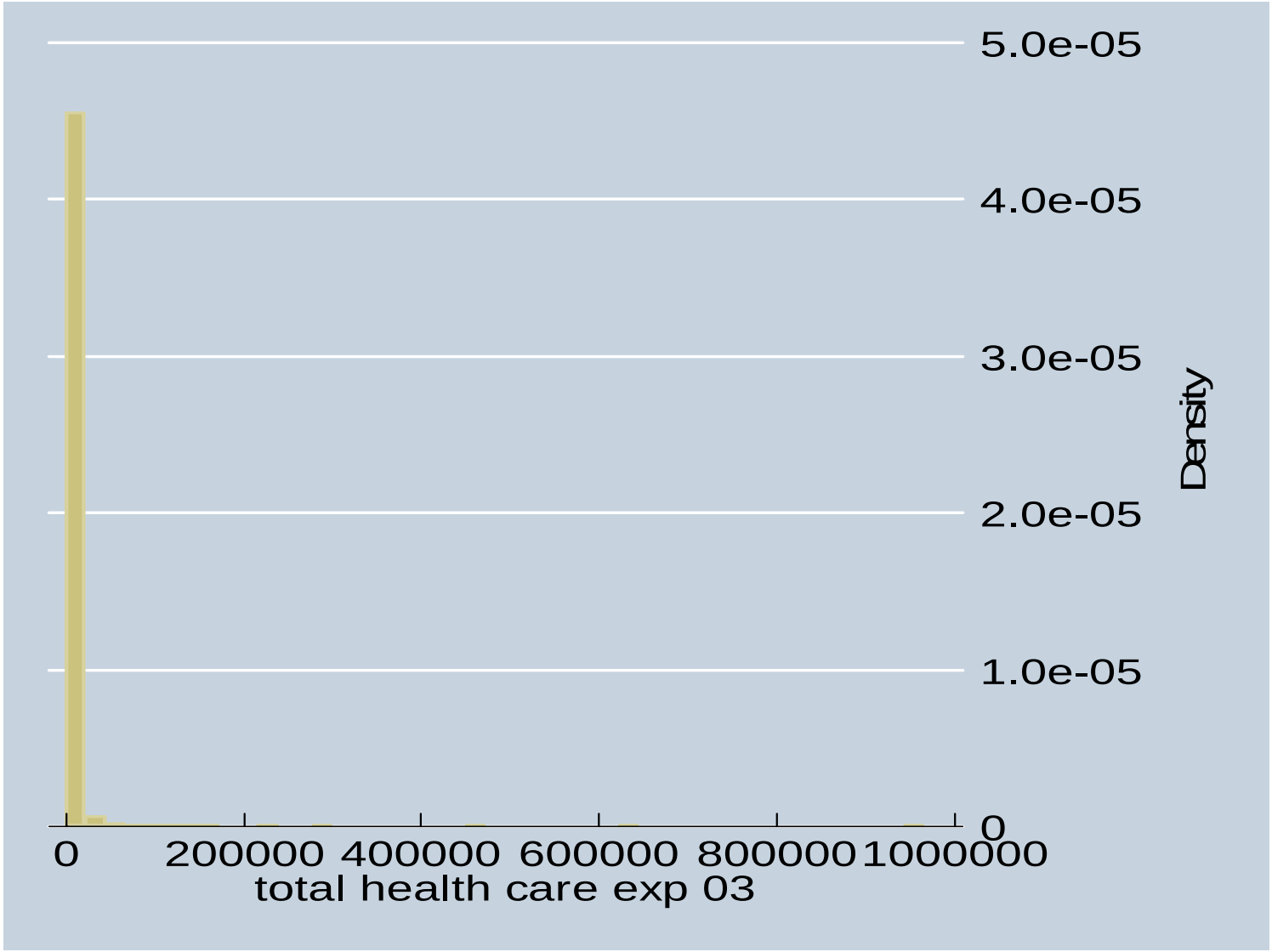


office-based provider visits 03

Percentiles		Smallest		
1%	0	0		
5%	0	0		
10%	0	0	Obs	34215
25%	0	0	Sum of Wgt.	34215
50%	2		Mean	4.482537
		Largest	Std. Dev.	9.160844
75%	5	189		
90%	12	202	Variance	83.92106
95%	18	215	Skewness	6.893745
99%	42	221	Kurtosis	88.10663



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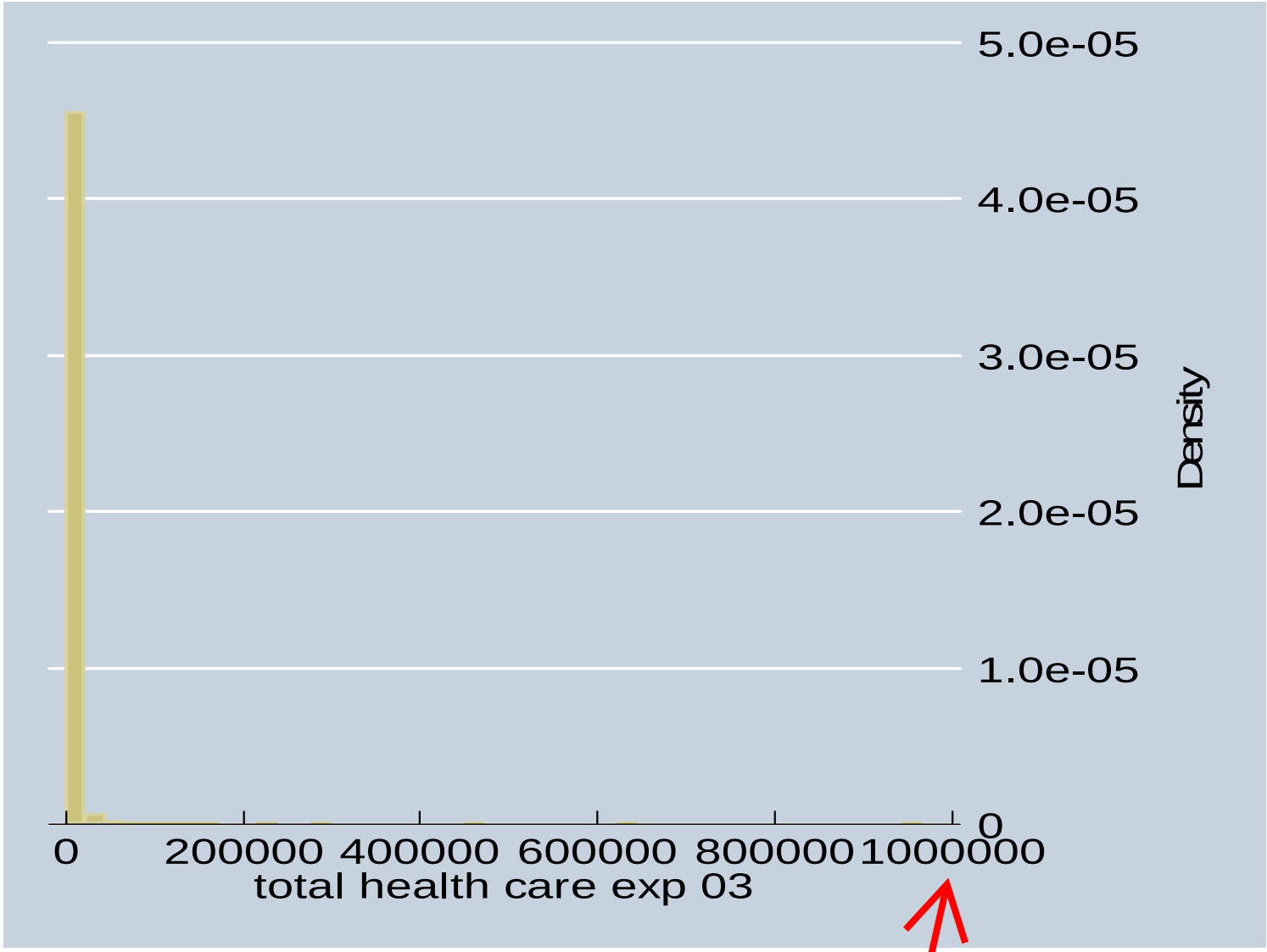

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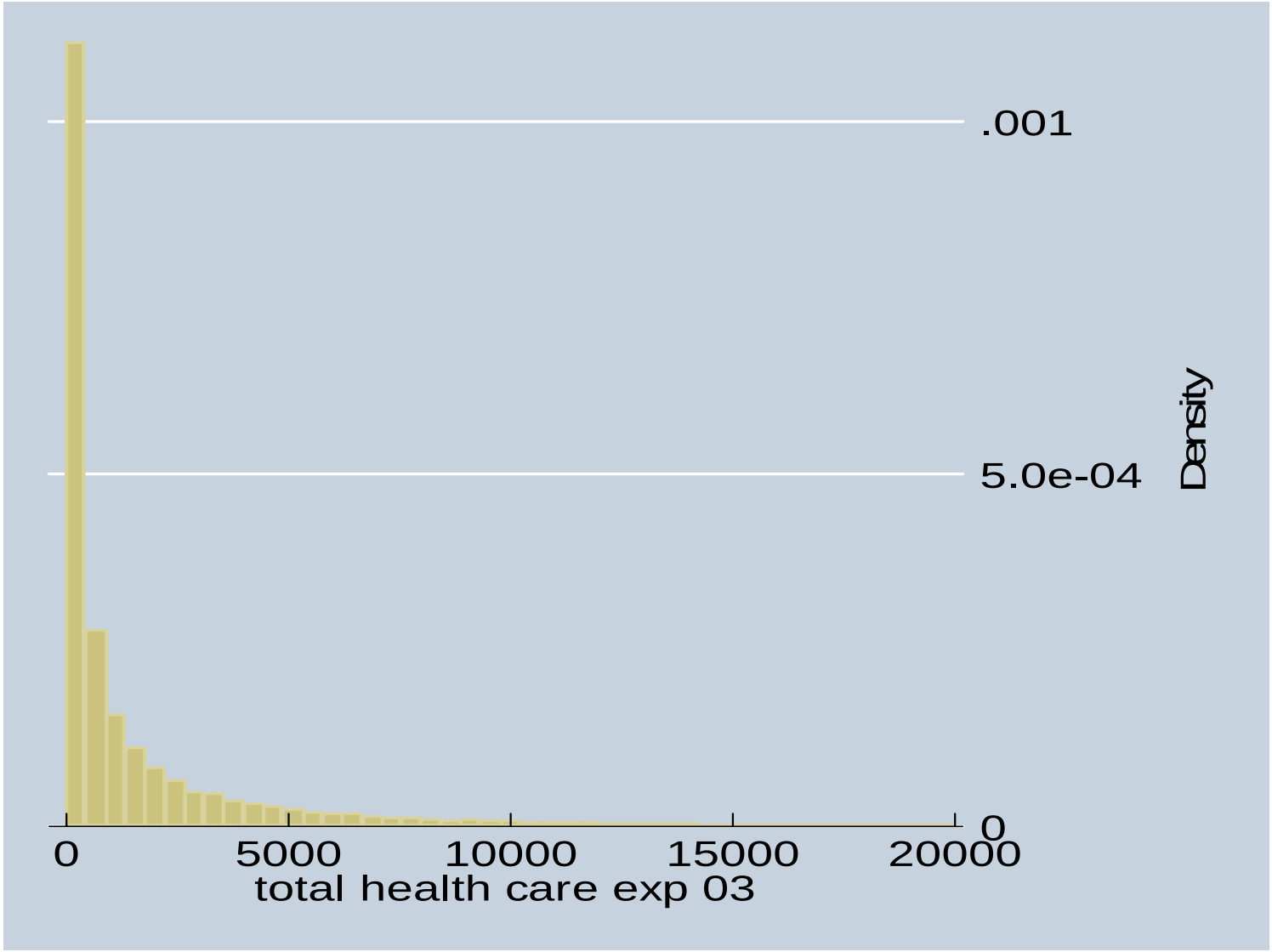

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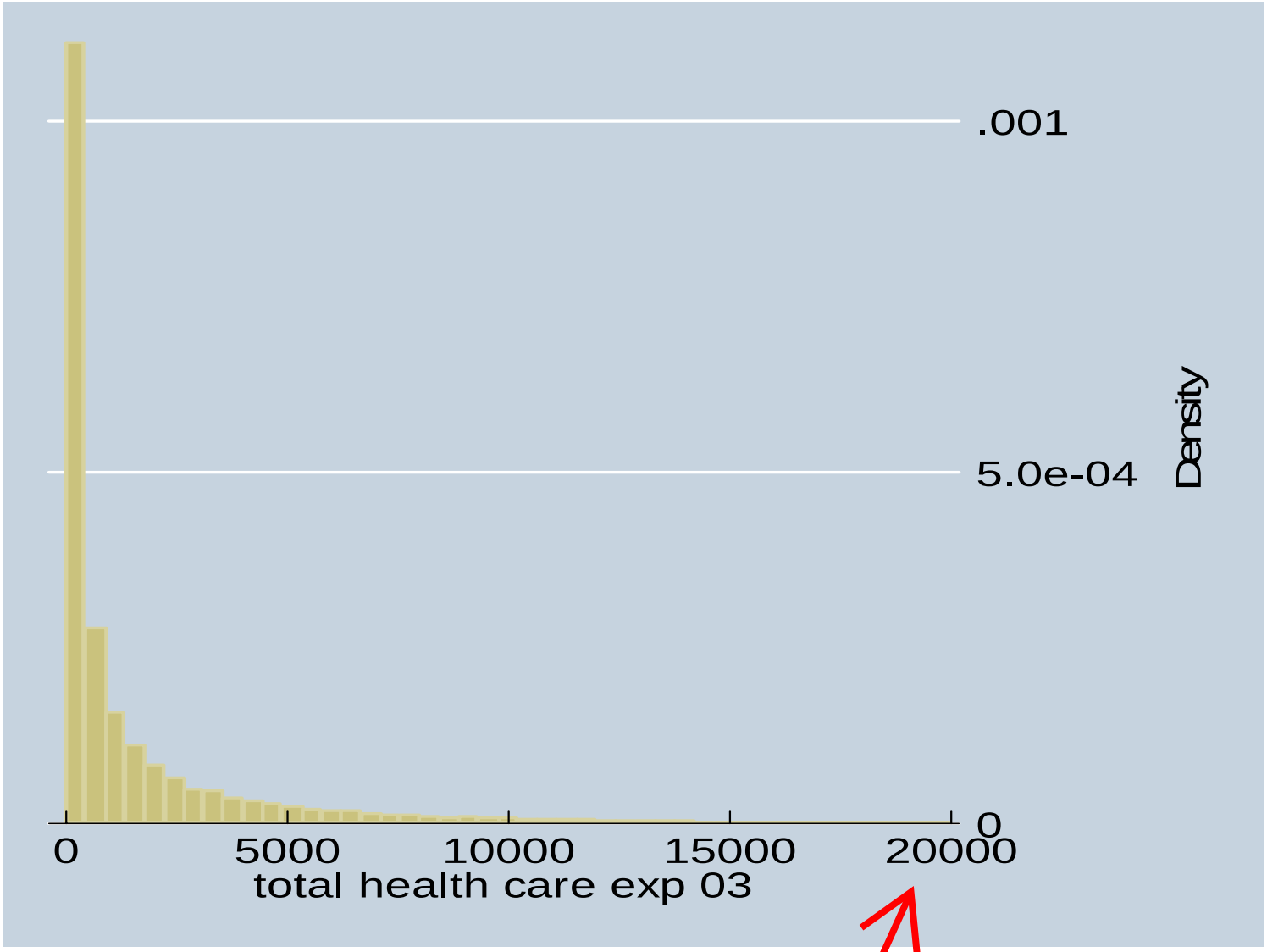

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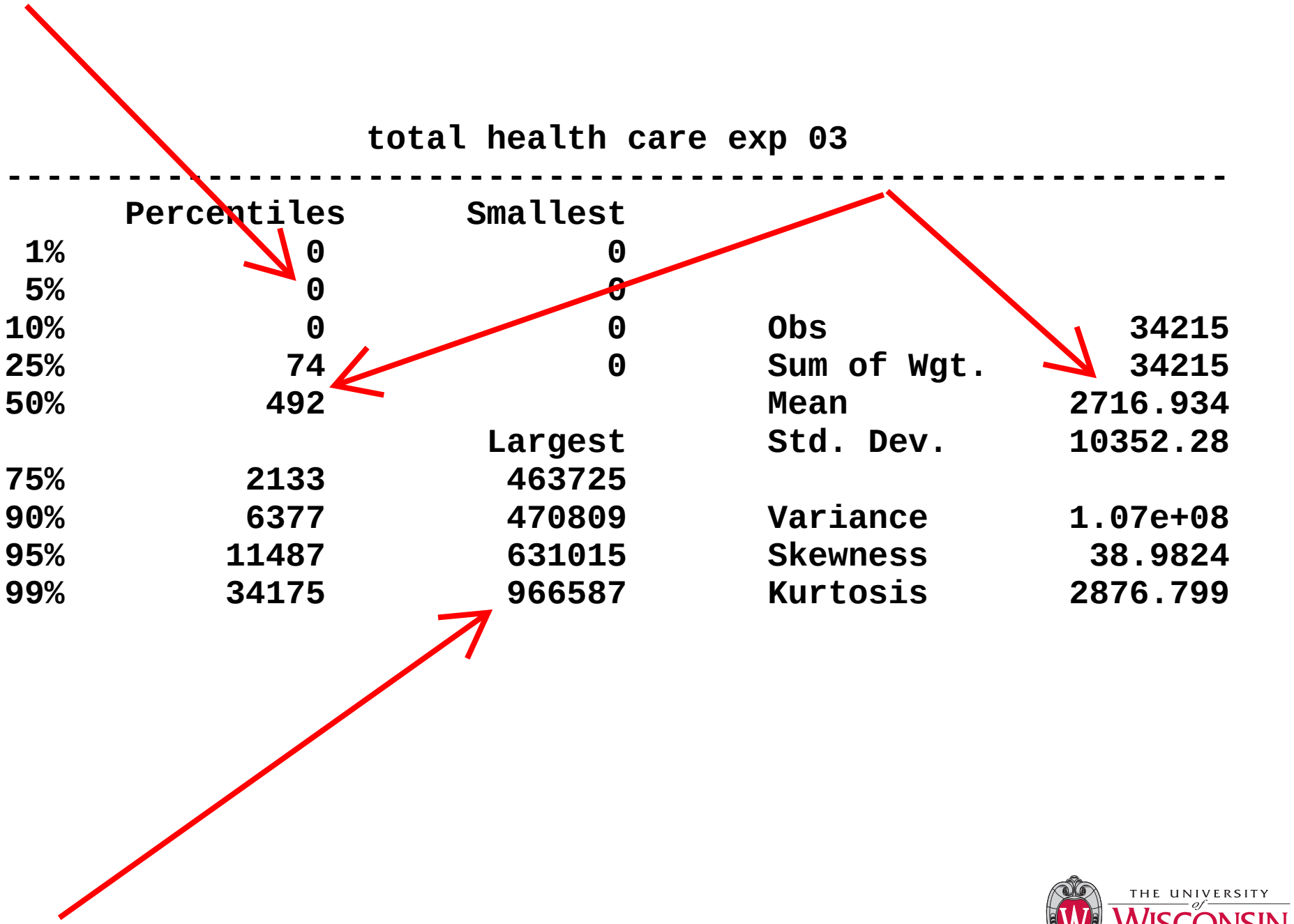

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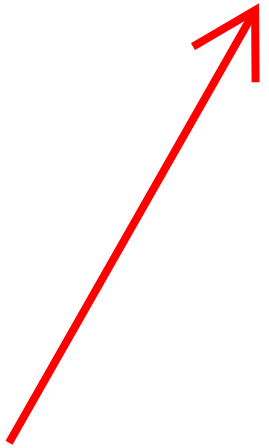
total health care charges 03, excl rx

Percentiles		Smallest		
1%	0	0		
5%	0	0		
10%	0	0	Obs	34215
25%	70	0	Sum of Wgt.	34215
50%	462		Mean	4420.367
		Largest	Std. Dev.	21353.04
75%	2071	792440		
90%	8847	825832	Variance	4.56e+08
95%	18692	1401198	Skewness	31.88939
99%	70408	1696354	Kurtosis	1908.468



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3. WHAT IS THE QUESTION? ... *WHY* AM I ANALYZING DATA ON COSTS AND/OR UTILIZATION?

a. this is nothing more than a brief reminder that good scientific practice is as important here as anywhere

* if relevant questions involve means, e.g., they can't be answered (in general) by analyzing medians or quantiles

* if relevant questions entail hypothesis testing, then the "right" standard errors may be important

* if the data represent one "perspective" in an analysis, but the scientific/ policy question comes from another, then be explicit about compromises, etc.

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4. WHERE WE'VE BEEN ... TRADITIONAL ECONOMETRIC METHODOLOGIES IN HEALTH CARE STUDIES (SOME OF WHICH MAY STILL BE OF GREAT VALUE)

a. linear regression, with or without transformation

* when the focus of the analysis is a conditional mean (e.g. as in a risk adjustment exercise), empirical strategies where y (perhaps including zero values) is regressed on x can be and continue to be of use, particularly in large datasets

* alternatives have used transformations of y:

  - log(y) with y>0 or with y'=y+d
  - sqrt(y) with y>=0

* transformation methods have necessitated *retransformation* methods in order to recover consistent estimates of E[y|x]

  - retransformation is not, of course, guaranteed to recover E[y|x] if incorrect distributional assumptions are made (e.g. normal-theory retransformation) or with heteroskedasticity in x (e.g. standard "smearing" estimator)

5. WHERE WE ARE ... ECONOMETRIC METHODOLOGIES IN USE TODAY

a. nonlinear models

* in light of issues like transformation/ retransformation problem, recent literature suggests compelling motivations for using nonlinear models to *directly* model cost/utilization conditional mean structures

* the leading example in the literature is the GLM suite of estimators, most often specified with a log-link for non-negative outcomes like healthcare costs/utilization:

$$\log(E[y|x]) = x*b$$

* notes:

  - this specification can be deployed for always-positive data on y *or* in cases where y is only restricted to be non-negative; importantly, this encompasses the case of count data models

  - the specification

    log(E[y|x]) = x*b

    does *not* imply the specification

    E[log(y)|x] = x*b

b. two-part model structures

* empirical "fit" characteristics of two-part (or multi-part) models have been appreciated since early RAND HIE work, e.g.

  $$E[y|x] = \underbrace{Prob(y>0|x)}_{\text{(part 1)}} * \underbrace{E[y|y>0,x]}_{\text{(part 2)}}$$

* some concerns about interpretation and identification of part 2 advanced in the literature

* in light of GLM-type models, one needn't resort to 2PM/MPM models *unless* one is particularly interested in sub-components

* caveats:

  - circumstances under which transform/ retransform *may* outperform nonlinear models (e.g. heavy upper tails

  - circumstances may call for more general approaches that don't fall neatly into the GLM suite of canned programs (e.g. generalized gamma models)

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Journal of Health Economics 24 (2005) 465–488
JOURNAL OF HEALTH ECONOMICS
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Generalized modeling approaches to risk adjustment of skewed outcomes data

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c. Accommodating endogeneity in models of costs or utilization

* ***conceptual*** **issues regarding appropriateness of including endogenous risk adjusters in empirical R.A. models**

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Journal of Health Economics 23 (2004) 1237–1259

JOURNAL OF HEALTH ECONOMICS

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Risk selection and the specification of the conventional risk adjustment formula

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Available online 19 June 2004

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* ***garden-variety*** **econometric issues with endogenous RHS variables even in *linear* models (bias/inconsistency; extrapolation bias; etc.)**

* **exacerbation of problems in nonlinear (e.g. log-link) formulations**

* **potential applicability of nonlinear instrumental variable methods**

JOURNAL OF APPLIED ECONOMETRICS, VOL. 12, 281–294 (1997)

ENDOGENEITY IN COUNT DATA MODELS: AN APPLICATION TO DEMAND FOR HEALTH CARE

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SUMMARY

The generalized method of moments (GMM) estimation technique is discussed for count data models with endogenous regressors. Count data models can be specified with additive or multiplicative errors. It is shown that, in general, a set of instruments is not orthogonal to both error types. Simultaneous equations with a dependent count variable often do not have a reduced form which is a simple function of the instruments. However, a simultaneous model with a count and a binary variable can only be logically consistent when the system is triangular. The GMM estimator is used in the estimation of a model explaining the number of visits to doctors, with as a possible endogenous regressor a self-reported binary health index. Further, a model is estimated, in stages, that includes latent health instead of the binary health index. © 1997 by John Wiley & Sons, Ltd.

J. Appl. Econ., **12**, 281–294 (1997)

INSTRUMENTAL-VARIABLE ESTIMATION OF COUNT DATA MODELS: APPLICATIONS TO MODELS OF CIGARETTE SMOKING BEHAVIOR

John Mullahy*

Abstract—As with most analyses involving microdata, applications of count data models must somehow account for unobserved heterogeneity. The count model literature has generally assumed that unobservables and observed covariates are statistically independent. Yet for many applications this independence assumption is clearly tenuous. When the unobservables are omitted variables correlated with included regressors, standard estimation methods will generally be inconsistent. Though alternative consistent estimators may exist in special circumstances, it is suggested here that a nonlinear instrumental-variable strategy offers a reasonably general solution to such estimation problems. This approach is applied in two examples that focus on cigarette smoking behavior.

estimating equations defining the standard estimators, say, $q(x_i)[y_i - \exp(x_i\alpha)]$, does not have zero expectation at the true model so that the estimating equations defining such estimators, $\Sigma_{i=1}^{N} q(x_i)[y_i - \exp(x_i\alpha)] = 0$, will have biased and inconsistent solutions.

Consider the following illustrative example, suggested by the work of Cameron and Trivedi (1986). Suppose the demand for some form of medical care y is measured as a count—such as the number of physician visits or consulta-

d. treatment effects beyond mean treatment effects

* clinical trial literature has long used versions of quantile treatment effects as main focus in assessing efficacy/effectiveness/outcome (e.g. ED50, LD50, etc. are essentially median treatment effects)

* econometric advances in quantile analysis have brought such methods into a greater domain of inquiry that encompasses observational data with covariates and, more recently, endogenous covariates

* (Yet: What is the question?)

6. WHERE WE MIGHT BE HEADING ... INNOVATIONS IN METHODOLOGY TO IMPROVE QUANTITATIVE ANALYSIS IN HEALTH CARE

a. Assessing co-movement of two or more jointly-distributed variables (e.g. {IP,OP,Rx}; vol-qual.; etc.)

* substitute/complement issues

* lessons from financial portfolio analysis (comonotonicity; copulas; quadrant dependence; etc.)

* "richer" characterizations of co-movement (quantile treatment effects; etc.)

* examining interaction among RHS variables comprehensively (e.g. co-morbidities in R.A.) (quantile interaction; nonlinear D-I-D; etc.)

Operative Mortality and Procedure Volume as Predictors of Subsequent Hospital Performance

John D. Birkmeyer, MD, Justin B. Dimick, MD, MPH,*† and Douglas O. Staiger, PhD‡*

Context: Despite growing interest in evidence-based hospital referral for selected surgical procedures, there remains considerable debate about which measures should be used to identify high-quality providers.

Objectives: To assess the usefulness of historical mortality rates and procedure volume as predictors of subsequent hospital performance with different procedures.

future. The optimal measure for selecting high-quality providers depends on the procedure.

(*Ann Surg* 2006;243: 411–417)

Econometrica, Vol. 74, No. 2 (March, 2006), 431–497

IDENTIFICATION AND INFERENCE IN NONLINEAR DIFFERENCE-IN-DIFFERENCES MODELS

BY SUSAN ATHEY AND GUIDO W. IMBENS[1]

This paper develops a generalization of the widely used difference-in-differences method for evaluating the effects of policy changes. We propose a model that allows the control and treatment groups to have different average benefits from the treatment. The assumptions of the proposed model are invariant to the scaling of the outcome. We provide conditions under which the model is nonparametrically identified and propose an estimator that can be applied using either repeated cross section or panel data. Our approach provides an estimate of the entire counterfactual distribution of outcomes that would have been experienced by the treatment group in the absence of the treatment and likewise for the untreated group in the presence of the treatment. Thus, it enables the evaluation of policy interventions according to criteria such as a mean–variance trade-off. We also propose methods for inference, showing that our estimator for the average treatment effect is root-N consistent and asymptotically normal. We consider extensions to allow for covariates, discrete dependent variables, and multiple groups and time periods.

b. Focusing analysis on "high-end" or "upper-tail" costs/utilization

* policy-relevance of disease management strategies

* what is the "goodness of fit" of distributional models (e.g. gamma, lognormal, etc.) in tails of distributions (not just means)?

c. Episodes of care

* merging policy focus on episodic treatment/cost with typically non-episodic data on utilization/cost

Journal of Health Economics 7 (1988) 369–392. North-Holland

THE DEMAND FOR EPISODES OF MENTAL HEALTH SERVICES*

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JOURNAL OF Econometrics

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Two-part multiple spell models for health care demand

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d. "Costs-of-Illness" or "Costs-of-Behaviors"

* "arms race" in cost-of-disease studies

* need for better grounding in economic theory, definition of relevant counterfactuals, etc.

* reasonable conjecture is that resultant econometric formulations will be complicated (dynamics; endogeneities), with consequent issues of identification

* potential (???) for piggy-backing on RCT studies

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State of Diabetes Complications in America

MEDIA INQUIRIES WWW.PRNEWSWIRE.COM/MNR/AACE/2007 ★ PATIENT EDUCATION WWW.STATEOFDIABETES.COM

American Heart Association. Learn and Live.

First-of-its-Kind National Report Reveals Estimated High Prevalence and Heavy Cost of Type 2 Diabetes Complications in America

In Response, Health Organizations Unite to Help Educate on Good Diabetes Management and How to Reduce the Risk of Other Serious Health Problems

Seattle, WA, April 10, 2007 – A first-of-its-kind report looking at the prevalence and cost of type 2 diabetes complications shows that an estimated three out of five people (57.9 percent) with type 2 diabetes have at least one of the other serious health problems commonly associated with the disease, and that these health problems are taking a heavy financial toll on the United States. In 2006, the nation spent an estimated $22.9 billion on direct medical costs related to diabetes complications.*

Cardiovascular Disease Cost

The cost of cardiovascular diseases and stroke in 2006 is estimated to be **$403.1 billion**, according to the American Heart Association and the National Heart, Lung, and Blood Institute (NHLBI). This figure includes both direct and indirect costs. Direct costs include the cost of physicians and other professionals, hospital and nursing home services, the cost of medications, home health care and other medical durables. Indirect costs include lost productivity that results from illness and death.

This is only the economic cost. The true cost in human terms of suffering and lost lives is incalculable.

American Cancer Society

Treatment Topics & Resources

print
close

Costs of Cancer

The financial costs of cancer are great both for the individual and for society as a whole. In the year 2006, the National Institutes of Health estimated overall annual costs for cancer as follows:

Total Cost: $263.3 billion

Direct Medical Costs: $ 78.2 billion (total of all health expenditures)

Indirect Morbidity Costs: $17.9 billion (cost of lost productivity due to illness)

Indirect Mortality Costs: $110.2 billion (cost of lost productivity due to premature death)

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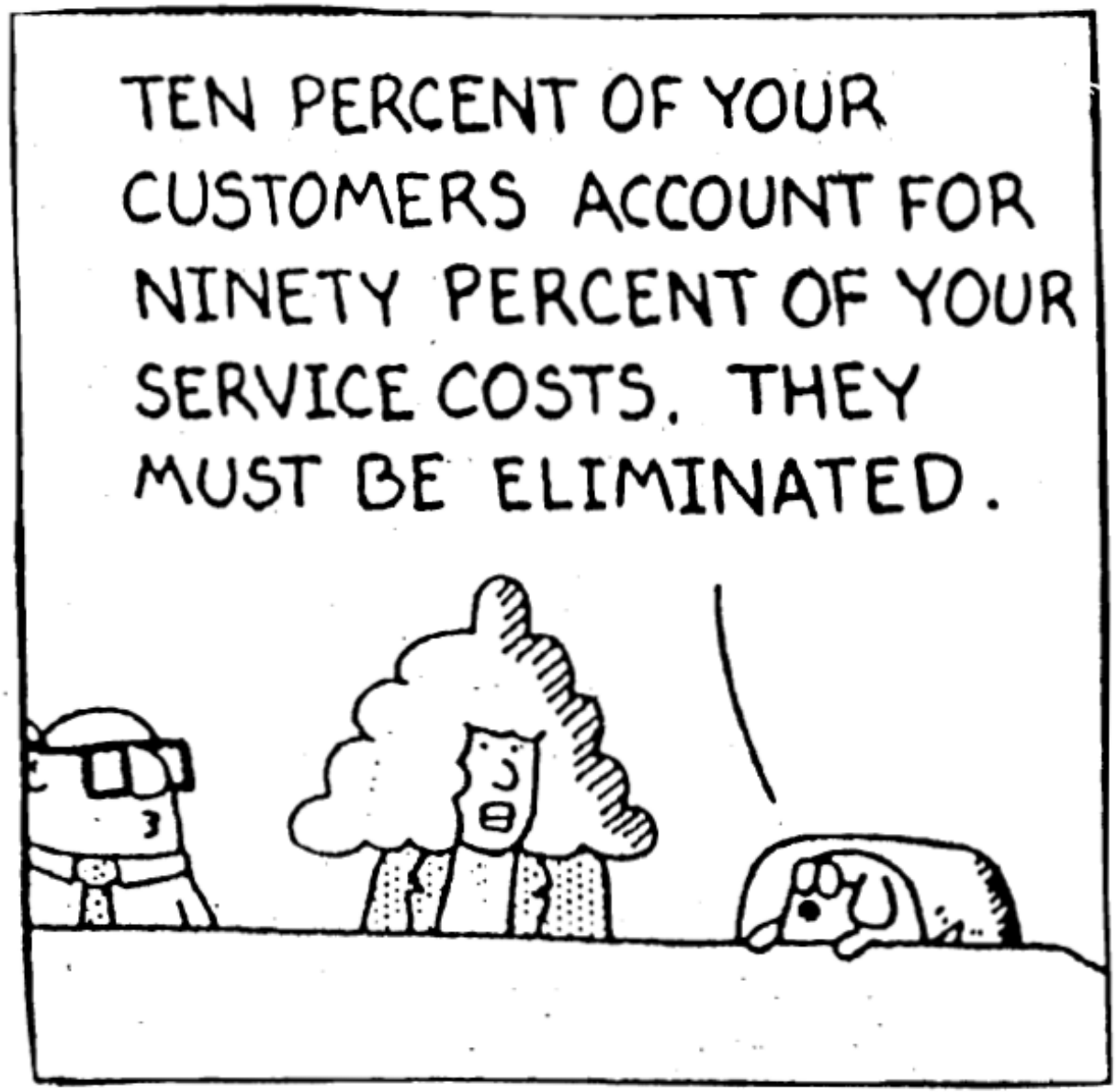
e. accommodating time-censoring of data on cost/utilization

* accounting or followup period definitions *may* (but do not always) present obstacles for analyzing cost/utilization questions of primary interest

* important methodological advances made and underway in better understanding the "time structure" of cost distributions



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