

# Productivity Spillovers in Health Care

By *Amitabh Chandra*, Kennedy School of Government, and *Douglas O. Staiger*, Dartmouth College

Since 1938 when Sir Allison Glover first documented significant variation in tonsillectomy rates across areas in the United Kingdom, an enormous body of literature in economics and medicine has documented variations in the use of surgically or technologically intensive treatments – for example, cesarean delivery, angioplasty, bypass surgery and spinal fusion surgery – across comparable geographic locales. These variations have been shown to be uncorrelated with patient preference and characteristics. Surprisingly, though, the use of more intensive procedures is *not* associated with improved satisfaction, outcomes, or survival but *is* associated with significantly higher costs.

Consider, for example, the case of cardiovascular disease, the number one cause of death in the United States. One treatment for cardiovascular disease is percutaneous coronary intervention (PCI), formerly referred to as angioplasty, which is a surgery performed by threading a slender balloon-tipped tube – a catheter – from an artery in the groin to a trouble spot in an artery of the heart. The balloon is then inflated, compressing the plaque and widening the narrowed coronary artery so that blood can flow more easily. Often, this procedure is followed by inserting an expandable metal stent, a wire mesh

tube, into the artery in order to keep it open after it had been cleared by the PCI procedure.

In Massachusetts, Worcester has a PCI rate that is more than double that of Springfield (Figure 1). Each PCI costs the Medicare program over \$12,000. Yet, outcomes are no better in Worcester than in Springfield. Traditional explanations such as sampling variation, differences in income and insurance, patient preferences, and underlying health status do not explain these variations.

These facts, however, stand in sharp contrast to the results of Randomized Clinical Trials (RCT) that consistently find gains from the surgical management of acute conditions that are routinely interpreted as evidence in support of more intensive management of patients.

These apparently conflicting findings can potentially be explained by a model of diminishing returns. RCTs, on the one hand, are performed on a pool of patients who are considered very likely to benefit from the intervention. By contrast, the medical and economic studies take data from a full range of patients who receive these treatments in clinical practice. The lack of a cross-sectional relationship between intensity and outcomes is thus explained by a “flat

## Amitabh Chandra and Douglas O. Staiger

*Amitabh Chandra is an Assistant Professor of Public Policy at the John F. Kennedy School of Government, Harvard University. Douglas O. Staiger is Professor of Economics at Dartmouth College. Each is affiliated with the National Bureau of Economic Research.*

*This policy brief is based on Amitabh Chandra and Douglas O. Staiger, “Productivity Spillovers In Healthcare: Evidence From The Treatment Of Heart Attacks,” Journal of Political Economy, 2007, vol. 115, no. 1. That article provides a more extended discussion of their argument and presents supporting empirical data. The authors received support for this research from a National Institute of Aging grant P01 AG19783-02. The opinions in this policy brief are those of the authors and should not be attributed to the National Institute of Aging or the National Bureau of Economic Research.*

## A. Alfred Taubman Center for State and Local Government

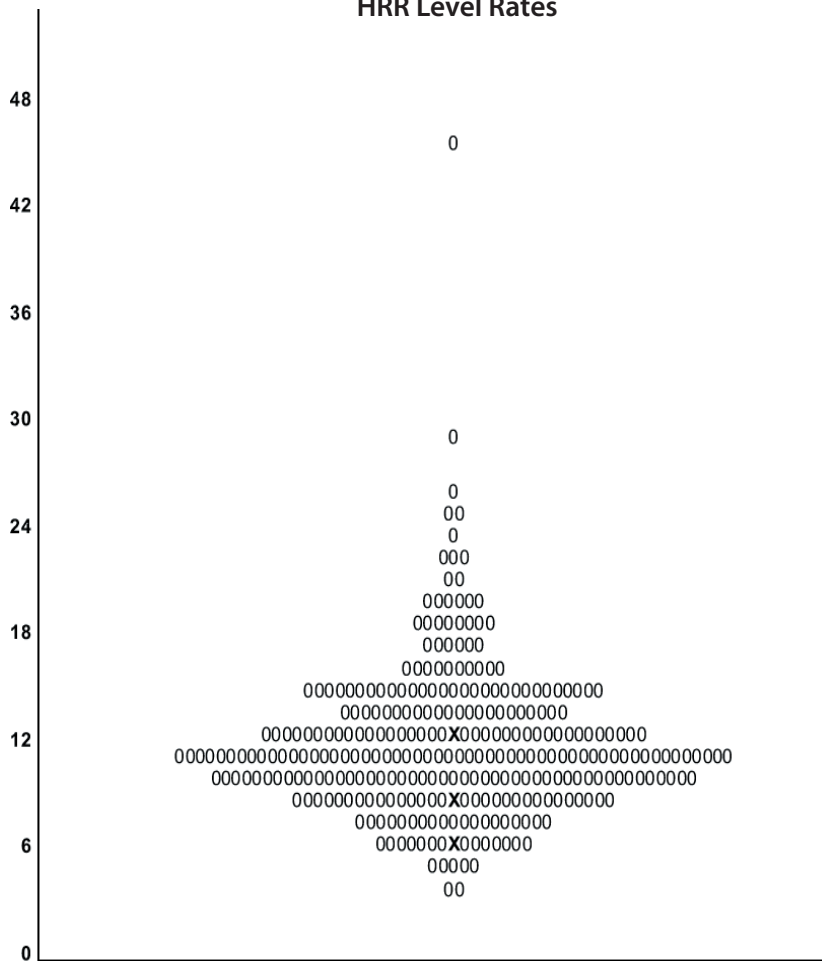
*The Taubman Center and its affiliated institutes and programs are the Kennedy School of Government’s focal point for activities that address urban policy, state and local governance and intergovernmental relations.*

*Taubman Center Policy Briefs are short overviews of new and notable research on these issues by scholars affiliated with the Center.*

*© 2007 by the President and Fellows of Harvard College. The contents reflect the views of the authors (who are responsible for the facts and accuracy of the material herein) and do not represent the official views or policies of the Taubman Center for State and Local Government.*

*A. Alfred Taubman Center for State and Local Government  
John F. Kennedy School of Government,  
79 JFK St., Cambridge, MA 02138*

**Figure 1: Percutaneous Coronary Interventions per 1,000 Medicare Enrollees  
HRR Level Rates**



Notes: This figure shows the geographic variation of the PCI procedure across various places in the United States. The dark “X”s are, in order moving down from the top of the graph, Worcester, Springfield, and Boston.

of the curve” argument, where physicians perform the intervention until the marginal return is zero. This explanation emphasizes inefficiency of medical spending, suggesting that welfare improvements may be realized by reducing spending in high-use regions. Indeed, several commentators apply this logic to argue that a 30 percent reduction in Medicare spending, such that spending in high-use regions is reduced to that of low intensity areas, would not have any deleterious effects on patient outcomes or satisfaction. In the example of the PCI procedure in Worcester and Springfield, where it is clear that more care is

not associated with improved outcomes, one must ask “are we doing too much?”

While the diminishing returns model is intuitively appealing, it has a number of problems. First, there is no reason to expect wide variation in the use of treatments across areas that are similar, without making additional assumptions such as area norms (e.g., that physicians in one area apply different decision rules in deciding which patients should be treated by which method) or supplier-induced demand (e.g., that hospitals or physicians in some areas take actions that encourage patients more frequently to select

certain treatment methods). Second, such models still predict a positive relationship between medical spending in a region and patient outcomes unless all areas are in the range of zero or negative marginal benefits. This has never been empirically documented, however. A more fundamental problem with the diminishing returns model is that it predicts that the marginal benefit from more intensive patient treatment is *lower* in areas that are

**In our model, patients are treated medically or intensively depending upon their clinical appropriateness for these treatments, but we allow productivity spillovers to also affect the therapeutic benefit from each treatment.**

more aggressive. But US-Canada comparisons suggest the opposite: the marginal benefit from more technologically intensive treatment in heart attack patients is larger in the US, where management of heart attacks is much more aggressive. These are facts that the flat of the curve model cannot reconcile. If it is the incorrect model, then embracing its policy implications of cutting spending could result in deleterious outcomes for many patients.

As an alternative, we have developed a simple model of specialization in healthcare that makes two assumptions. In our model, patients are treated medically or intensively depending on their clinical appropriateness for these treatments. This assumption allows, for example, patients who are young to benefit more from invasive medicine than those who are relatively older. Second, we also allow *productivity spillovers* to also affect the therapeutic benefit from each treatment. The second assumption allows areas or hospitals that perform a greater proportion of invasive

procedures to realize a larger benefit from each of these procedures. These productivity spillovers may arise from *knowledge spillovers*, where physicians build experience by learning from each other; but they may also arise from other sources, such as the selective migration of the best intensive physicians to certain areas, and the corresponding migration of physicians who specialize in less intensive treatments to other areas. In this frame, as the proportion of patients in an area that are treated intensively increases, productivity spillovers increase the return to intensive treatment, while simultaneously reducing the return to the competing medical treatment. Thus, on the one hand, this model naturally generates higher returns to receiving intensive treatment in intensive areas; yet, on the other hand, because of the negative externality on patients receiving the competing treatment, it does not necessarily generate any relationship between specialization and overall health outcomes.

Our model has generated a rich set of predictions that we have tested using detailed data on a sample of Medicare beneficiaries who had a heart attack (clinically referred to as an Acute Myocardial Infarction (AMI)). Some of these predictions are consistent with other models, but others are unique to the particular modeling approach we have taken. We find strong empirical support for our

**Our findings suggest that productivity spillovers play an important role in explaining geographic specialization in production.**

model, and we reject alternative explanations such as “diminishing returns/flat of the curve medicine” or “supplier induced demand” that are commonly proposed to explain geographic variation in medical care.

Our findings suggest that productivity spillovers play an important role in explaining geographic specialization in production. A large medical literature has documented the important role of social networks in physician adoption of new technologies, suggesting that knowledge externalities are the source of the productivity spillovers. While knowledge spillovers are the most natural interpretation of our model and empirical results, alternative mechanisms, such as the migration of specialized inputs (e.g., physician specialists) into regions that favor one type of production, could generate the productivity spillovers we observe. These alternative mechanisms, share the key feature that specialization in one sector *improves* productivity in that sector while *reducing* productivity elsewhere, thereby reinforcing the tendency to specialize.

The presence of productivity spillovers may justify a policy intervention to ameliorate the negative effects of the externality. However, evaluating the welfare implications of any proposed intervention is not a trivial exercise.

### **Our results also raise important questions about what can be learned from randomized controlled trials in medicine.**

With multiple equilibria, different areas are stuck in sub-optimal equilibrium and one-time interventions that “shock” the system to a different equilibrium would be called for. An example would be to force areas to practice medicine in a radically different manner. Retraining physicians and imposing limits on an area’s capacity to perform intensive medicine would be potential tools to achieve this goal. In contrast, if the pattern of variation in practice style reflects single equilibria, further specialization may be justified. In this scenario, the pattern of specialization that we observe reflects patient characteristics, and

encouraging further specialization in either intensive or non-intensive medicine will benefit more people than it harms.

While other commentators have emphasized the welfare cost of excess geographic variation in practice style, our work (in the context of single equilibrium) suggests that there is too little variation from a welfare perspective. If aggressive areas became even more aggressive, *average* patient welfare would increase. Naturally, this improvement in average outcomes would be accompanied by a worsening of outcomes for those patients least appropriate for intensive medicine. Thus, understanding the optimal policy response hinges importantly on whether the variations observed in the data are the consequence of single or multiple equilibria.

Our results also raise important questions about what can be learned from randomized controlled trials in medicine. While randomized trials are considered the gold standard for determining the effectiveness of a given medical treatment, they are designed to provide a partial-equilibrium estimate of the treatment effect in a well-defined population. But with productivity spillovers, the general equilibrium effect of adopting a new treatment could be smaller or larger than the partial equilibrium estimate of treatment effectiveness because of the *negative* externality imposed on patients who are more appropriate for an alternative treatment and the *positive* externality on patients who are more appropriate for the new treatment. This general-equilibrium effect is not identified in a typical randomized trial, but could potentially be estimated in a trial that randomized across areas rather than individuals. In addition, the effectiveness of the treatment depends on where the trial is conducted. Surgical interventions may perform poorly in an area that specializes in medical management of its patients and perform well in a more surgically intensive area. As such,

the external validity of a randomized trial is compromised.

The implications of our findings extend beyond the treatment of heart attacks. To the extent that productivity spillovers are a common feature of many sectors, our results provide compelling evidence that such spillovers are an important feature of geographic specialization. Moreover, our results provide some of the first direct evidence of the negative externalities imposed on a subset of the population because of equilibrium pressures towards specialization. Such negative externalities are a central component of arguments for government intervention.

Finally, our model has interesting empirical implications when applied to the more general question of human capital externalities. For example, our model would suggest that people living in areas with higher ability populations would be more likely (holding ability constant) to go to college. The return to going to college in these areas would be higher, but wages of low ability people in these areas would be lower. In principle, these are all testable implications.

## RELATED PUBLICATIONS

**“Productivity Spillovers In Healthcare: Evidence From The Treatment Of Heart Attacks,”**

By Amitabh Chandra and Douglas O. Staiger, *Journal of Political Economy*, 2007, vol. 115, no. 1.

**“The Incidence of Tonsillectomy in School Children,”** By Allison F. Glover, *Proceedings of the Royal Society of Medicine* 31, 1938: 1219-1236.

**“Medicare Spending, The Physician Workforce, and The Quality Of Health Care Received By Medicare Beneficiaries.”** By Katherine Baicker and Amitabh Chandra, *Health Affairs*, April 2004a: 184-97.

**The Quality of Medical Care in the United States: A Report on the Medicare Program**

By John Wennberg and M.M. Cooper, Eds., *The Dartmouth Atlas of Health Care 1999* (Chicago: American Health Association, 1999).

## TAUBMAN CENTER POLICY BRIEFS

**PB-2007-4 “Productivity Spillovers in Health Care,”**

by Amitabh Chandra (Kennedy School of Government) and Douglas O. Staiger (Dartmouth College)

**PB-2007-3 “High Performance in Emergency Preparedness and Response: Disaster Type Differences”**

by Herman B. “Dutch” Leonard and Arnold M. Howitt (Kennedy School of Government)

**PB-2007-2 “Racial Statistics and Race-Conscious Public Policy,”**

by Kim M. Williams (Kennedy School of Government)

**PB-2007-1 “Transparency Policies: Two Possible Futures”**

by Archon Fung, Mary Graham, David Weil, and Elena Fagotto (Transparency Policy Project)

**PB-2006-2 “Beyond Katrina: Improving Disaster Response Capabilities”**

by Arnold M. Howitt and Herman “Dutch” Leonard (Kennedy School of Government)

**PB-2006-1 “Why are Smart Cities Getting Smarter?”**

by Edward L. Glaeser (Harvard University) and Christopher Berry (University of Chicago)

**PB-2005-4 “The ‘Third Way’ of Education Reform?”**

by Brian Jacob (Kennedy School of Government)

**PB-2005-3 “From Food to Finance: What Makes Disclosure Policies Work?”**

by Archon Fung, Mary Graham, David Weil, and Elena Fagotto (Kennedy School of Government)

**PB-2005-2 The Fiscal Crisis of the States: Recession, Structural Spending Gap, or Political “Disconnect”?**

by Robert Behn and Elizabeth Keating (Kennedy School of Government)

**PB-2005-1 “Smart Growth: Education, Skilled Workers and the Future of Cold-Weather Cities,”**

by Edward L. Glaeser (Harvard University)