Health Care in Small Areas of Three Command

Economies: What Do the Data Tell Us?

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Abstract

Health systems data were collected and maintained by the Communist central governments of East Germany and Czechoslovakia and by the Voivodships in Poland during the command system era. The present project assembles the data for small areas in contiguous regions of these countries in 1988. Analyses of these regions are compared to contemporary data from U.S. regions. Instead of assuming a common goal for each region, the data are studied to ascertain whether they reflect an identifiable, *de facto* goal. The key findings are that 1) coefficients of variation of health care resource availability are somewhat larger in the command systems, 2) coefficients of variation in mortality rates are smaller in two of the command systems, suggesting a *de facto* emphasis on health status equality. The U.S. regions appear to be the more consistent with regional health status maximization. Discussions explain the relationships between the alternative goals and suggest which systems succeed in achieving a particular goal.

Introduction

The fall of Soviet hegemony in East Europe, like all major change, will likely improve lives in many ways and worsen them, at least temporarily, in others. Health systems in these transitional economies pose many critical questions about which elements of which systems to retain or to adopt and develop. This paper provides data as a baseline on the nature of several East Bloc health systems in 1988, the last full year under Communist government; and, it compares these with newly available small area data from the quasi-market, technologically developed regions together representing the United States of the same era.

The performance of a system must be gauged against its own goals, and it is to be expected that the effective, *de facto* goals of Communist and U.S. health systems would be different. We commonly believe that command systems, whatever their benefits and deficits, provide more equal distributions of goods and services, especially the *needed* ones. Research supports the claim that Soviet income distributions attained greater equality than those of the United States and Western Europe (Andorka, Ferge and Toth, 1997; Doyle, 1996; Vercernik, 1995; and, Alexeev and Gaddy, 1993). The degree of inequality, however, surely varies across industries within an economy; the health industry may differ from the labor markets and other sectors. The present study attempts to show that the degree of inequality in health care availability across small areas was lower in the U.S. regions, though in a similar range. The variation in mortality rates across areas was lowest in the Czech and East German regions versus all other regions studied.

This paper presents archival data newly assembled from official government sources on small areas in Poland, East Germany and Czechoslovakia during 1988. These were gathered from government health ministries and statistical offices in these countries in response to my petitions to each central data manager. One or more hospitals were also visited in each region to better understand the nature of the data. These visits were all made early in the project, during May 1992, when the physical plants and most operations methods, such as staffing, usually had not yet changed substantially. The U.S. data for approximately the same period were acquired from the Dartmouth Atlas Project, which studied U.S. small area data beginning in 1991. The Dartmouth project was conceived and conducted by the same researchers who had revived substantial interest in small area health studies during the past three decades, most notably, John Wennberg.

This paper measures the degree of inequality in health care availability and mortality rates in each region using primarily the coefficient of variation. The substantial differences in health care system design and variable definition between the East European U.S. systems are addressed. Questions of inequality are simple on their face but complex in practice. What goals does each system aspire to in fact, that is, implicitly? Tradeoffs exist between equality of health care availability and equality of health status so that perfect equality in both is not logically tenable. In consequence, maximization of regional health status requires the deliberate acceptance of inequality in health care availability, in health status, or both.

Section I describes the data. Section II establishes empirically that variations in health care availability across areas were lower in the U.S. regions than in the East European command systems. Section III describes the relative variations in mortality

rates. Section IV reexamines the regions as if their goals were each to maximize regional

health status. Section V compares the regions under the assumption that each investment

decision is made under a "null" model of pure, narrow self-interest by the decision

maker.

Section VI discusses the overall results of the study, and Section VII provides cautions,

discusses limitations and offers conclusions and suggestions for further research.

I. Data from the Dreil·ndereck and from the United States

       The fall of East European Communism in 1989 (Ash 1993), began with the

dramatic Polish election in June and reached its emotional climax with the fall of the

Berlin Wall and the Czech Velvet Revolution culminating in the demise of the East Bloc

Communist regimes. These events left 1988 as East Europe's last full year under

Communism.

A. *The East European systems studied.*

Map 1 About Here

       The study regions center irregularly around Zittau, East Germany. Map 1 shows

the Dreil·ndereck "three-country-corner," and the shaded portions represent those areas

reporting data. The regions are each split for administrative purposes into hospital

districts of a size similar to the market areas used for small area studies in the West. (The

Czech areas average 390 square miles, the German were 416, while the Polish, though it

is not directly possible to calculate these from the present sources, are visually comparable in size to the Czech areas).

The three command systems directed patients to the health center within the district where they lived, and this practice minimized the patient's use of health care outside his district. Thus, the *border-crossing* problem was virtually eliminated, avoiding a problem that plagues small area studies in the West. Border-crossing issues were also largely resolved for the U.S. data through the analyses applied by the Dartmouth Atlas group.

Visits to the East European hospitals enabled me to see first hand several differences with U.S. hospitals at that time. One prominent difference was that the East European hospitals operated with a greater emphasis on labor, likely a result of the starkly different tradeoffs they faced between man and machine. One administrator, a physician, described his preference for human vs. electronic or other physical capital in terms familiar in economic theory: "Personnel, even the physicians, cost roughly only $400 per month, while computers have to be purchased at world prices." This principle was illustrated by that hospital's intensive care unit. Few electronic devices were found compared to Western hospitals, instead numerous staff cared for relatively few patients. The long lengths of stay could be understood as caused not only by a greater mix of long term patient care but also by a lower intensity of treatment of acute patients.

The hospitals in the European sample were reimbursed by central governments at a fixed per diem. This could encourage administrators to artificially extend patient days; such behavior would be expected in any per diem based system. However, the average *length of stay* was typically less than 15 days, a level common elsewhere in Europe.

B. How the data were acquired and how variables are defined.

The East European data were acquired from the Czech Ministry of Health in Prague; the Statistical Office of the State of Sachsen in Kamenz, Germany; and, from the administrative districts (Voivodships) in western Poland through the aid of the central health ministry in Warsaw. These East European data, though not available in externally published forms, consisted of printouts directly from computer archives or original records provided by these central government offices.

The Czech health ministry in Prague provided the requested data items in printout form; the East German data center for the State of Sachsen provided these data in the same manner. These two data centers maintained substantial archives in apparently meticulous condition. The Polish data, in contrast, were not centrally assembled prior to my request to the health ministry in Warsaw. With help from a generous health ministry executive, the project obtained the requested archival data directly from the intermediate level districts, the Voivodships, within the Silesian region. These arrived, in some cases, as copies of typed tables, in other cases as the original archived documents. Government professionals, health care professionals, as well as U.S. embassy staff in these countries provided briefings on the institutions, patients and providers described in the data.

For these analyses I chose variables that are easy to measure and verify by anyone inspecting the hospitals. The selected variables include beds, physicians, average daily census, occupancy rate, actual mortality rate, length of stay and patient days. These were chosen in part because they were almost always non-missing, with only four or five out of 80+ districts exhibiting a missing data item in a given region. In these few cases, a

regression estimate seemed plausible; for example, a regression of average daily census on beds provided estimates for four instances of missing beds values in the Czech region. Furthermore, the data generally adhere to known identities; for example, *average daily census* ≡ *patient days* / 365.

While the raw data tables collected from the Polish regions contained these same variables in common across areas, there were seldom any others held in common. The Czech and East German datasets contained many more items. These included detailed population distributions, detailed data on physicians, nurses, and other personnel in the hospitals and polyclinics and detailed utilization data for all facilities in the district. These additional items, however, were not commonly found across the East European regions, nor were they available in the U.S. samples.

Four of the 180+ European observations were eliminated as outliers. The decision rule treated excessive standby capacity as evidence of either a data error or of extreme local circumstances. These occurred when the reported gap between the average census and the bed capacity exceeded the general run across observations by a wide (several times) margin. In both the European and the U.S. samples, areas with fewer than 40,000 population were also eliminated. This was done to secure more reliable estimates of mortality rates and to match the U.S. samples better to the European, which rarely had small areas with populations less than 40,000. Cities over one million population were omitted for similar reasons, as were the political divisions of Prague, which divisions were evidently not related to health system patient flow patterns.

Several East European data items differ in definition from those used in the United States. Hospital "beds" are defined throughout as beds physically available to the

general public; they do not include specialty hospitals. However, hospital beds in East

Europe have longer stays, and some beds in nearly all these hospitals are used for long

term care patients; hospital *length of stay* in these samples is typically just under 15 days.

Thus "beds available for general care" does not distinguish between long term and short

term care.

Likewise, there are differences in the definition of physicians; under the East

European style of care, physicians are trained for a lesser period of time than in the

United States. Although the fact does not bear directly on this study, these physicians

were also tremendously less well paid than in the United States.

These differences in data definitions do not preclude cross-country comparisons.

For example, consider the coefficient of variation statistic:

$$(1) \quad CV = \frac{\left[\sum\{(a_i x_i - \sum a_i x_i / n\}^2 / n\right]^{1/2}}{(\sum a_i x_i)/n} = \frac{\left[\sum(a_i x_i)^2 / n - (\sum a_i x_i / n)^2\right]^{1/2}}{(\sum a_i x_i)/n}$$

Here a_i terms have been inserted to represent the fraction of reported beds in hospital i

that are used to treat acute patients. Let x_i be the reported number of beds in hospital i.

Consider first, if $a_i = 1$, Equation (1) then defines the standard *CV*. But, Equation (1)

illustrates another fact: differences in definitions between countries are not distorting if

the patient mix *within* each country is homogeneous. To illustrate let $a_i = k \, \varepsilon \, (0, 1)$,

indicating a region across which each hospital district allocates the same fraction of beds

to acute care; that is, where patient mix varies little *within* country. Equation (2) shows

this result.

$$CV = [\sum (kx_i)^2 / n - (\sum kx_i / n)^2]^{1/2} / (\sum kx_i / n)$$

(2)

$$= k[\sum x_i^2 / n - (\sum x_i / n)^2]^{1/2} / k(\sum x_i / n)$$

We see that the fraction k cancels out, and the calculated CVs have the same meaning in both countries. This paper investigates the issue further in a later section; it finds that the empirical variations in long-term patients have an effect on the reported CV, but the effect is relatively small. This conclusion is supported in the Czech data where *length of stay* is found to vary relatively little across hospitals, the CV for the Czech *length of stay* is 0.133.

C. Comparing the Three East European Regions

The statistics just described were first derived for the three East European regions; and Table 1 presents these data. Note the strong similarity in CVs for both beds and physicians, though there are marked differences regarding mean health care inputs. The mortality rates are practically identical, though Poland's differs in its variability.

Pearson correlations between beds, physicians and mortality present a more complex picture. In the sections which follow, I will argue that a positive correlation between input availability and mortality is desirable, however, we see changes in signs between the beds and physician rows for each country.

These statistics, means, standard deviations, coefficients of variation and correlations provide one basis by which to compare these regions. They also provide a basis of comparison with Western, developed countries; the examples applied here are

health regions within the United States. The data suggest that investment patterns in 1988 could have been more efficiently directed toward the areas with more severe mortality experience.

Table 1 About Here

D. The U.S. Dartmouth Data

The U.S. data were assembled originally by Wennberg's Dartmouth Atlas Project, and they are publicly available online (www.dartmouthatlas.org). These data describe small areas within the United States in 1991 and later years, providing samples of approximately the same time period as with the East European data. The U.S. areas as designed by the Dartmouth group were based on collections of ZIP code areas. American Hospital Association data were applied to measure health care resources.

The Dartmouth U.S. regions were developed in two levels. Large "Hospital Referral Regions (HRRs)", of which there are 306 in the United States, center on major, tertiary hospital care cities. For the HRRs, the average populations are typically larger than 300,000. While they exceed that European areas in size, they provide excellent data on area-specific Medicare populations. To develop HRR supra regions with sufficient numbers of areas, I have grouped the HRRs into four regions: Midwest, Southwest, Southeast, and Northeast.

The Dartmouth study also developed "Health System Areas" (HSAs) of which there are over 3,000 in the United States; these are more comparable to the European areas in population size, though mortality rates are not available directly from the

Dartmouth sources. Mortality rates for the general population living in the central city,

however, were available for these HSAs from other reliable sources; the HSAs are

geographically small enough so that the central city mortality data will largely represent

the HSA itself. Hospital bed per capita data have been adjusted by the Dartmouth group

to neutralize the effect of border-crossing. Inasmuch as each Dartmouth regional level

has some advantages for the present analysis, it seems prudent to compare both U.S.

regional levels with the East European counterparts.

The present study applies Wennberg's techniques of analysis and area definition

for a distinctly different purpose. Wennberg and those following his style of analysis (for

example: Wennberg 1982, 1987; McPherson et al 1982; Green and Becker 1994; Folland

and Stano 1989; Roos and Roos 1982) sought to measure inequalities in health care rates,

especially surgery rates, to identify over and under use of health care by which to assess

the implied welfare loss (Phelps 2000; Phelps and Parente 1990). This market failure is

potentially correctable through improved information, and the effort helped to spawn

U.S. programs for the scientific study of the health status outcomes stemming from health

care treatments.

While the Wennberg methods did not address mortality, it is one of the central

foci here, because reductions in mortality variation trade off against health care

availability variations. The research is not unique in this aspect, small area research

frequently takes forms different from the Wennberg model: See for example instances in

epidemiology, marketing, and economic spatial analysis. Health economic small area

applications involving mortality rates include, for example, Hadley's work (1988, 1982).

E. Comparing Across Vastly Different Governmental Systems and Cultures

When making comparisons from life, we often seek natural experiments, where all aspects of social structure and economy are the same except for the focus variable. The cost of using the advantageous Dartmouth data is primarily that the United States differed in a greater variety of ways from East Europe in 1988 than many other democratic, capitalistic countries. For example, regions in Western Europe would have entailed fewer contrasts of culture and political framework. The data requirements for the study are demanding, however, and they necessitate small area geographical analyses that take account of patient movements. Relatively few such studies are extant. A notable study by McPherson et al (1982), provides this for England, Wales and Norway; but these countries also differed greatly from East Europe, especially in technology and economic prosperity. Perhaps no region would provide a pure natural experiment of the effect of a command system versus a more market-oriented health system, even though each attempt teaches us something more.

With their advantage of providing quality small area data, the U.S. regions also offer a useful extreme test. The English health system, for example, is itself much like a command system making the contrast in the focus variable a weaker one. The United States differs more strongly, it has more often spurned command and control methods. The U.S. health insurance structure, for example, is only about one half governmental financed compared to near fully financed European systems. Its health care capital investment mechanisms have likewise been a mix of government and private (often nonprofit) mechanisms.

Thus the present comparison addresses several questions that have invoked interest: Do these vastly different health systems nevertheless deliver similar results? Do the health care investment patterns direct health care capital to its best possible uses? Are the observed differences between systems proof of system inadequacies in either case?

II. Health Care Availability

A well-established proposition from the small area literature is that health care resource availabilities and use rates vary widely across areas in the United States and other Western industrialized countries. Analysts commonly interpret such data as evidence that medical information spreads slowly or irregularly (Phelps, 2000), and that medical practices are significantly influenced by physician practice style (Wennberg, 1987). Comparing the East European regions with the U.S. regions, however, raises new questions.

Do the systems have the same goals? The public philosophies of both system have emphasized equality, among other goals. Economists who study health and health care often focus on the degree of inequality in the availability of, or access to, health care resources. The small area methods offer a useful way to measure such inequalities. Also, publicly stated goals or official philosophies are not necessarily the same as the effective goals implied by everyday decision making. When we compare the health care availability inequalities and health status inequalities of East European regions with U.S. regions, we get a clearer understanding that there is more than one definition of

"inequality" within a health system and that this has implications for interpreting cross-country comparisons.

Goal setting requires normative reasoning, we cannot determine which system is best by considering data alone. However, the new data provided in the paper can be of assistance to thinkers in making those normative analyses regarding these regions. The statistics used are chosen to be easily replicated independent of one's values; for example, I forgo attempts to measure degrees of *inequity*, because doing so would inject subjective judgments, which may be arbitrary. Efficiency is addressed as well, but in the context of alternative, hypothetical system goals.

The most accepted measure of variation in health economic small area studies is the coefficient of variation (*CV*), which I have described. This regularly shows high levels of variation in data from the United States, Canada, Great Britain and Norway (Folland and Stano, 1990; McPherson et al., 1982). We may argue over the importance of these variations for policy, but no one can study such data without being surprised at the large differences in the rate of hysterectomies, tonsillectomies and other familiar procedures between apparently similar, contiguous, small areas. One question addressed here is: Is the coefficient of variation, which increases with greater inequality, higher or lower in command systems versus comparison regions in the United States? Table 2 describes the data for the three East European regions as indicated by their country, and the U.S. Hospital Referral Regions from the Dartmouth study.

Table 2 About Here

We note that the variations are greater in the East European regions both for beds and physicians. Differences in mean availabilities also occur, the United States tends toward lower mean beds and physicians per capita. These differences will in part reflect the longer training period for U.S. physicians and the greater health capital per bed in the United States; this much is known from previous international reports. The greater variations in East Europe are new findings and need to be examined more fully.

It is also noticeable, for example, that there are larger area populations in these U.S. HRR samples. Do these differences introduce bias into the comparisons, perhaps causing the lower observed U.S. variations?

While population differences can bias such results, they need not do so, and they will not wherever health care availabilities vary little within a country in proportion to population. For example, suppose we conjecture that larger population centers achieve economies in the provision of hospital beds, a plausibility since we know that larger hospitals have higher occupancy rates. But, while U.S. HRRs have larger populations, the centers tend to have multiple hospitals, unlike the East European areas. The pattern does not necessarily introduce a bias. To see this, reexamine Equation (2) momentarily. Let x_i represent beds per capita and let k represent the ratio of average U.S. beds per population to the East European average. It is mathematically trivial but true that the CV will be unaffected provided that the proportion k is constant across areas. This shows that area population differences do not imply a bias; but, we can still ask if there is a bias empirically? Fortunately, the Dartmouth data enable an answer to this question as well. The U.S. HSA areas are smaller and are similar in population size to the East European areas.

Table 3 About Here

Table 3 recapitulates the statistical comparisons in Table 2 but applies them to the U.S. Health Systems Areas. We see some higher numbers for the U.S. HSA regional *CV*s, but the change is not great. Note that this result applies generally across all HSA areas; the U.S. regions exhibit less inequality than do the East European regions.

The data also provide a convenient test of the influence of the greater representation of long term patients in the East European hospitals. The Czech data offer the best benchmark in this context for several reasons: 1) their data (like the German data) are centrally collected and maintained; 2) they contain a similar number of observations (like the Polish data) to most U.S. regions; and 3) they contain an extensive data set (like the German data).

The Czech data include a measure of long term care patients in the hospitals. By first subtracting the reported number of long-term care patients from each hospital's number of beds, the *CV*s were then recalculated. This step reduces the Czech *Bed CV* from 0.330 to 0.265, more clearly within the range of the U.S. *CV*s, though at the high end. The effect, however, is relatively small.

While there is necessarily some overlap in distribution, the Dreil·ndereck regions are noticeably different from the U.S. samples in terms of bed and physician availability. I calculated the five percent confidence intervals about the European coefficient of variation estimates in the manner described by Vangel (1996) and compared these with the American estimated *CV*s. The U.S. values fell outside of and below those intervals

for bed and physician availability with the single exception of physician availability in Germany. In contrast, following the same steps for mortality (addressed in the next section), there was greater overlap generally, and the Czech and East German mean CVs lay below all of the U.S. HSA areas.

III. Variation in Mortality Rates

Must we conclude that the command systems were less capable in achieving equality of health care availability? This would be an incomplete interpretation because the goals of equality of health care availability and equality of health status conflict. An interpretation of health care inequality should include a study of inequalities in health status.

The mortality rate serves as an inverse indicator of health status. This choice was guided by two factors. First, the study regions reported mortality rates as the sole measures of health status held in common across all areas. Mortality rates available in the U.S. HRRs are limited to the Medicare population, those 65 and older. However, general mortality data are available for the U.S. HSAs.

The second advantage of mortality rates is that the commonness of this measure makes the study more accessible to other researchers. The mortality rate, though not ideal in every case, has strong points; for example, unlike morbidity, death is universally identifiable, and its importance to families, among health related incidents, is unquestioned. Mortality rates have been the preferred choice for such exploratory researches as the production of health studies (Auster et al., 1969; Hadley, 1982, 1988 1998)

Let health status be measured as the reciprocal of an area's mortality rate. Let the
health status production function be $HS=f(HC_i, E_i)$ where HC_i indicates area i's health
care per capita, and E_i represents other exogenous input variables such as "cleanness of
the environment", which are productive of health. Further assume that these inputs are
substitutes in the production of health, and let f exhibit diminishing marginal returns to
each input.

Note that as an empirical issue, environment is influential to mortality rates in the
East European region. The heavily polluted central part of this surpra region surrounding
Zittau, East Germany, was known as "the dirty triangle"; in the Czech data, "distance
from Zittau" proved to be negatively correlated with mortality rates, a correlation
especially strong for females.

Figure 1 About Here

Figure 2 About Here

Figure 1 illustrates the health production function and depicts it shifting with
changes in E_i. If equality of health care availability is achieved, for example at HC_G,
then the health status level will vary across areas, perhaps substantially, perhaps driven
by shifts in other factors, such as environment, life style or demographics. Contrast a goal
of equality of health status across areas, the case depicted in Figure 2. Here planners set
the goal to achieve H_G for all regions. Variation in E_i, given the constraint of equal health
status, will induce variation in health care availability.

It is clear that the two goals conflict. A strong emphasis on health status equality leads to variation in health care availability. Is there evidence that the European regions in effect traded off a degree of equality of health care availability to achieve lower variation in health status? Relevant evidence is found by applying our proxy variable for health status, the mortality rate across all the study areas.

The *CV* as calculated from the actual mortality rates, which are available here, will also be close to the *CV* as calculated from the age-adjusted mortality rate. For example, the age adjusted mortality rate and the raw mortality rate by U.S. state in 1990 are highly correlated at 0.80; and the coefficient of variation, which is 0.15 in the unadjusted series, is reduced only to 0.09 by the age-distribution adjustment, both *CV*s are moderate to low. Since the *CV*s are calculated within each country, they are not affected by the larger demographic differences between countries. In examining the regional *CV*s we may ask how low is a "low" *CV*? Phelps (1997) has suggested that a *CV* under 0.10 is "low"; from 0.10 to 0.20 is "moderate" over 0.20 is "high" when applied to small area variations.

Table 4 shows that U.S. mortality variations are low for the HRRs but that variations across the HSAs are in the high range. The East German and Czech variations in mortality are predominately low and clearly lower than the U.S. HSAs.

Which U.S. areas are the most appropriate for this comparison, the HSAs or the HRRs? The HRR mortality data are available only for Medicare populations, those 65 years and older, and they are larger in both population and square mileage than the European areas. These both are limiting features, though their advantage is the precision of the Medicare data. The HSAs are similar to the East European areas in population size

and both datasets apply the general mortality rate. Plausibly, the HSAs are best here. The Czech and East German regions *CV*s are clearly lower than the U.S. HSAs, though the Polish region is similar to them.

Did the Czech and East German planners deliberately choose to limit variation in mortality rates while accepting as a tradeoff a greater inequality in health care availability? The present model describes such a tradeoff as implied by a preference for health status equality, but it does not enable this kind of "look into the minds" of the planners involved. We can say only that the data are consistent with an abstract scenario in which decision makers made choices "as if" this conceptualization were in mind.

Table 4 About Here

Figure 3 About Here

IV. Maximization of Regional Health Status

We have considered two candidate goals, health care equality and health status equality. Let us consider a third: The maximization of regional health status. Let the region consist of *n* areas with populations, p_i. A plausible definition of regional health status is given by Equation (3), which weights area health status by the area's share of regional population.

(3) $Regional\,Health\,Status = \sum_i (\frac{p_i}{P})HS_i(HC_i, E_i)$

Let the total health care available in the region be HC_o. Regional health status maximization requires the optimization of the following LaGrangian over the HC_i.

(4) $L = \sum_i (\frac{p_i}{P}) HS_i - \lambda(HC_o - \sum HC_i)$

The first order conditions of this problem require that

(5) $(\frac{p_1}{P})\frac{\partial HS_1}{\partial HC_1} = (\frac{p_2}{P})\frac{\partial HS_2}{\partial HC_2} = \ldots = (\frac{p_n}{P})\frac{\partial HS_n}{\partial HC_n}$

If populations were equal across areas, then maximization would require equality of the marginal products of health care, a condition that will approximately hold for regions within a narrow band of populations across existing areas.

Figure 3 shows optimal combinations of health status and health care across several areas under the condition of equality of marginal products. Under the earlier assumed condition that the health inputs are substitutes in production, then,

$\frac{\partial HS_i^2}{\partial HC_i, E_i} < 0$ *all i.* Thus, the equilibrium relationship of efficient health status to health care availability will be an inverse one, as shown.

Consider more intuitively that an inverse relationship is what one would expect in health production. To maximize regional health status, one would expect to invest health care resources into areas where they are the most productive. Plausibly health care would deliver the greatest marginal benefit where prior health status was low. Conversely, for example, when heavy air pollution is eliminated from an area, residents will seek doctors less often, the physician is less productive if the population is less ill; the other factors, such as clear air, act as alternative means to the goal of better health.

Do the areas studied fit the described pattern? For this purpose, the raw mortality rate is the appropriate proxy for health status. The raw rate approximates more accurately a local population's actual rate of serious medical cases, ones that would or could benefit from hospital care. By comparison, age-sex standardization would understate the number of serious cases in areas where the elderly are over represented in the population. Since these mortality rates are an inverse proxy for the indicator of health status represented in the figure, the desired correlation between health care and mortality is positive. Are the mortality rates in fact positively correlated with health care availability in the study regions? Tables 5A and 5B report these correlations.

Table 5A presents the Pearson correlation coefficients (and probabiliy values in parentheses) for the East European areas and the Hospital Referral Regions in the United States. Recall that mortality rates for the HRRs are defined only for the Medicare populations. Medicare mortality is correlated with Medicare health care availability to derive the U.S. figures.

The European estimates typically lack the statistical precision of the U.S. comparison estimates, and they are of mixed sign. However, the Czech *Beds* case attains significance easily, is positive and is similar in magnitude to the U.S. estimates. A question of area size remains; the European correlations may be statistically less precise due to smaller sample area populations. Table 5B, where the U.S. HSAs are the regions of comparison, provides a simple test and measure of this effect. The U.S. areas, nevertheless, continue to be predominately positive and the probabiliy values are typically small. We can conclude that the evidence for the regional health maximization

hypothesis is mixed for the East European regions, but generally supportive of the

hypothesis when applied in the U.S. regions.

Table 5A and 5B About Here

V. The Null Model: Narrow Self-Interest

These previous models described decision makers as aimed at a socially

beneficial goal. In this section, I describe and contrast a null model, one which poses

decision makers who base their investment choices on criteria wholly separate from the

health and health care realities of the localities. As with null hypotheses generally, we

ask: Could these data be alternatively explained by the null?

Though it is an extreme assumption about decision maker motives, this null has

counterparts in real existing systems. On one hand, in most systems some decision

makers are uninformed, inexpert, bribed, or base choices on favorites or loyalties. Some

critics of command systems argue that such incentive structures by lacking market

discipline are more vulnerable to these pressures than market-oriented systems. Similarly,

some critics of presumptively market-oriented systems argue that money interests drive

outcomes   irrespective of health needs and also that the markets lack many of the

conditions required for theoretical competition; the result can be health and health care

outcomes that are neither efficient nor equitable. By comparing the null model with the

present data, we can in principle find data by which to rule out the possibility that such

narrowly selfish behaviors dominate in either of the present comparison groups.

Extremely narrow self interest as depicted in the null model would probably appear as a random process when contrasted with behavior pursuant to socially beneficial goals. Across the geographic plane, investment in health facilities and manpower would be a random walk. In such a model, facilities and manpower would tend in time toward a spatial equality of health care resource availability. By the reasoning in previous sections, this equality of health care generates potentially substantial inequality of health status. This pattern is not evident in either the European or American regions. Alternatively, a random pattern in an initial period could establish loyalties that persist. Long run health care inequalities would then also persist, but so would health status inequalities. This pattern fits neither the East European nor the U.S. patterns of the sampled regions.

VI. Discussion

Many people assume that command systems, whether able or unable to attain efficiency, generally deliver greater equality across the board. Were equality of health care availability across small areas at issue, then this assumption is not confirmed by these data. Yet, surely a more sensible equality goal is equality of health status, and that is reflected *de facto* in these East European data. It may be surprising to some that the U.S. areas, both HRRs and HSAs, exhibit low variations in health care availability and low variations in health status among the Medicare population. This might suggest that some market elements could be adopted in the transitional health economies without great sacrifice of equality.

How could the U.S. quasi-market regions, which by reputation lack an ethic of equality as strong the command regions, perform similarly? There are several possible reasons. One, the U.S. Hill-Burton legislation in the 1940s provided substantial federal government money to build hospitals throughout the country, wherever they were perceived to be needed. A second is that over 90% of Americans either has some hospital insurance coverage or is eligible for the government programs of Medicare and Medicaid; this neutralizes to some extent the impact of greater income inequality on hospital care demand. Physician care insurance is less widespread and the relatively low variation in physician care is the more remarkable

As an alternative goal to equality of health care or health status, maximization of regional health status is sometimes considered. A necessary condition to achieve this goal is that the marginal product of health care, weighted by relative populations, must be equal across areas. This in turn requires that mortality rates and health care availability be positively correlated across areas. The correlation data reported in Tables 5A and 5B showed these correlations to be typically positive in the U.S. regions though somewhat mixed in the East European areas.

Regional health maximization requires the sacrifice of equality of health care availability, equality of health status, or both across areas. Instead of resource investments based purely on a concept of need or equity, regional health maximization requires that one invests resources with priority to those areas that gain the most from them. Whether this goal, some defined equality, or some concept of need and equity ought to be chosen by a region (instead of the measures I have considered), is a question for normative analysis and beyond the scope of the present paper. To the extent that this

study's analyses captured a *de facto* policy goal from among those posited in the East European countries, it is the goal of health status equality across areas.

Clearly we can reject the null model, for all regions studied. Were the null model at work we would likely see more substantial variations in health care or health status or both than are seen here.

VII. Conclusions

Any study in economic history and health economics that compares very different cultures and economic systems will surely lack some data needed to achieve the precision of health economic studies focused on a single developed country. For example, personal income, though not available in these data, is an important determinant of health status in developing countries (Pritchett and Summers, 1996).

Nevertheless, it is clear that these three regions in Communist states in 1988 exhibited somewhat a greater inequality of rates of health care availability than similar U.S. regions. It is also found that the command systems exhibited less variation in health status than the U.S. regions, suggesting a *de facto* emphasis on this goal. Finally, maximization of regional health status is not ruled out as a *de facto* goal achieved in the U.S. regions, while the evidence from East Europe in this regard is somewhat mixed.

The results suggest questions for further study. First, what elements of either East European or Western health economies are useful to countries in transition? Second, this study's baseline data, near the end of the Soviet era, might be tested against other regions, and future studies might provide measures of the progress of these health systems. Third, are there market elements that could be productively adopted and culturally suited to the

transitional health economies? Finally, other hypotheses seem fruitful, for example, are greater variations within health systems common in developing countries, and are they temporary? Answers to such questions could benefit the transitional health systems as well as teach us more about developed systems.

Figures

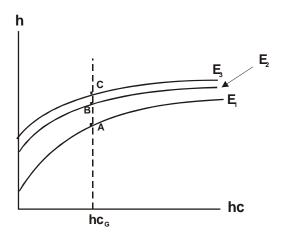Figure1. With equality of health care, variation in exogenous factors across areas may nevertheless cause substantial variations in health.

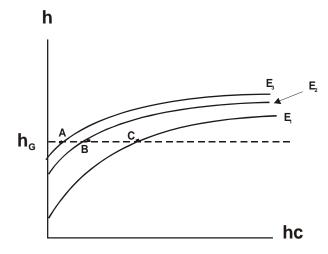Figure 2, With equality of health as the goal, the variation in exogenous factors across areas may require substantial variations in health care.
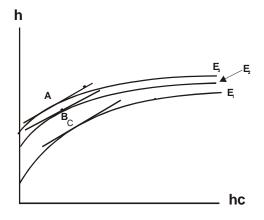
Figure 3. Efficiency in the production
of total health requires that the
marginal product of health care
be equal across areas.

Map 1. The Study Area is Located at the Corner of Three Countries:
        Poland, former East Germany, and the Czech Republic

Table 1. Comparing the Three East European Regions

	Poland Region	Czech Region	E.Germ Region
Population per Small Area	58.8	122.3	81.5
Beds per capita, mean	4.71 (C*,G*)	7.07 (P*,G^N)	6.77 (P*,C^N)
Physicians per capita, mean	70 (C^N,G*)	309 (P^N,G^N)	177 (P*,C^N)
Beds per capita CV	0.467	0.349	0.264
Physicians per capita CV	0.473	0.518	0.180
Mortality rate, actual, mean	13.43 (C*,G^N)	12.22 (P*,G*)	13.45 (P^N,C*)
Mortality rate, actual CV	0.355	0.081	0.129
Correlation, Beds and Mortality (p value in parentheses)	-0.198 (0.123)	0.293 (0.001)	-0.313 (0,123)
Correlation, Physicians and Mortality (p value in parentheses)	0.278 (0.224)	-0.112 (0.194)	0.273 (0.160)
Number of cases	78	68	16

Notes: The letters in parentheses indicate whether the difference in means is significant by the t test when paired with P=Poland, C=Czech region, or G=East Germany; superscripts indicate *=significant at the five percent level, and N=not significant when correlated with the indicated country. The numbers in parentheses are the probabilities in the tail of the distribution of the z transformation; all correlations in this table are calculated applying the general population mortality rate. *Population* is in 1000s. *Beds* are per 1000 population; *Physicians* are per 100,000 population; *CV*, is the ratio of the standard deviation to the mean. These data are for 1988. Only 48 of the Polish districts included physician totals in their reporting data.

Table 2. **Health Care Availability Measures and Their Variability: Comparisons of East European Small Areas with U.S. Hospital Referral Regions ca 1988.**

Inputs	Poland	Czech	E Germ	U.S.	U.S.	U.S.	U.S.
Region	Silesia	Bo-hemia & Moravia	Sachsen	MWest HRRs	SWest HRRs	SEast HRRs	NEast HRRs
Population Mean	58.8	122.3	81.5	372.9	339.2	366.4	455.6
Beds/pop Mean	4.71	7.07	6.77	3.43	2.70	3.68	3.13
Phys/pop Mean	70	309	177	156	188	154	180
Beds/pop CV	0.467	0.349	0.264	0.171	0.236	0.210	0.141
Phys/pop CV	0.473	0.518	0.180	0.152	0.162	0.188	0.140
N of cases	78	68	16	60	38	84	21

Notes: *Population* is in 1000s. *Beds* are per 1000 population; *Physicians* are per 100,000 population; *CV*, is the ratio of the standard deviation to the mean. The U.S. data are from the *Dartmouth Atlas of Health Care*, Dartmouth Medical School, American Hospital Publications, Inc., 1996. European data are for 1988, the U.S. data for 1993. Only 48 of the Polish districts included physician totals in their reporting data.

Table 3. Health Care Availability Measures and Their Variability: Comparisons of East European Small Areas with U.S. Health Service Areas, ca 1988.

Variables	Poland	Czech	E Germ	U.S.	U.S.	U.S.	U.S.
Region	Silesia	Bo-hemia & Moravia	Sachsen	MWest HSAs	SWest HSAs	SEast HSAs	NEast HSAs
Population Mean	58.8	122.3	81.5	145.1	117.0	178.0	152.4
Beds/pop Mean	4.71	7.07	6.77	3.35	2.35	3.38	3.61
Phys/pop Mean	70	309	177	164	193	177	202
Beds/pop CV	0.467	0.349	0.264	0.251	0.235	0.210	0.233
Phys/pop CV	0.473	0.518	0.180	0.237	0.199	0.319	0.299
N of cases	78	68	16	63	84	60	55

Notes: *Population* is in 1000s. *Beds* are per 1000 population; *Physicians* are per 100,000 population; *CV*, is the ratio of the standard deviation to the mean. The U.S. data are from the *Dartmouth Atlas of Health Care*, Dartmouth Medical School, American Hospital Publications, Inc., 1996. European data are for 1988, the U.S. data for 1993. Only 48 of the Polish districts included physician totals in their reporting data.

Table 4. Mortality Rates: Mean, Standard Deviation and Coefficients of Variation ca 1988.

Region	Mean	St. Dev.	CofV	N
Poland, Silesia	13.43	4.77	0.355	34
Czech Republic	12.22	0.99	0.081	68
East Germany, Sachsen	13.45	1.74	0.129	16
US MWest HRRs	50.2	3.35	0.067	60
US SWest HRRs	48.1	2.47	0.051	38
US SEast HRRs	52.3	3.50	0.067	84
US NEast HRRs	51.5	2.11	0.041	21
US MWest HSAs	10.3	2.93	0.285	63
US SWest HSAs	9.2	3.46	0.376	84
US SEast HSAs	12.4	3.99	0.321	60
US NEast HSAs	11.9	2.58	0.217	55
US All 50 States	8.5	1.31	0.154	50

Notes: The mortality rates are per 1000 people. U.S. mortality rates for HRRs are from the Dartmouth Atlas Project, 1996, and they pertain to the Medicare population for the year 1991. U.S. mortality rates for HSAs are from the City and County Data Book, and they pertain to the general population for the year 1988. East European mortality rates are from the sources described in Section I and they pertain to 1988. N of cases in Poland is less than the total sample due to missing values.

Table 5A. Pearson Correlations of Mortality Rates and Input Availability: U.S. Hospital Referral Areas and Dreil·ndereck Small Areas.

Input	Polish Region	Czech Region	East German Region	U.S MWest HRRs	U.S SWest HRRs	U.S. SEast HRRs	U.S. NEast HRRs
Population Mean	58.8	122.3	81.5	372.9	339.2	366.4	455.6
Beds per capita	-0.198 (0.123)	0.293 (0.001)	-0.313 (0.123)	0.402 (0.001)	0.236 (0.078)	0.505 (0.001)	0.106 (0.333)
Phys per capita	0.278 (0.224)*	-0.112 (0.194)	0.273 (0.160)	0.316 (0.001)	0.271 (0.050)	0.469 (0.001)	-0.420 (0.030)
N of cases	34 (10*)	68	16	60	38	76	21

Note: The number in parenthesis is the probability in the tail of the distribution of the z transformation. The U.S. Midwestern sample substitutes Medicare (Age Over 65 Years) mortality and health care availability data for the general case, for which data is not available at the HRR level. Due to the pattern of missing data in the Polish sample, only 10 observations matched for correlations of physician availability and mortality.

Table 5B. Pearson Correlations of Mortality Rates and Input Availability: U.S. Hospital Service Areas and Dreil·ndereck Small Areas.

Input	Poland Region	Czech Region	East Germ. Region	U.S. MWest HSAs	U.S SWest HSAs	U.S. SEast HSAs	U.S. Neast HSAs
Population Mean	58.8	122.3	81.5	145.1	117.0	178.0	152.4
Beds per capita	-0.198 (0.123)	0.293 (0.001)	-0.313 (0.123)	0.496 (0.001)	0.107 (0.174)	0.089 (0.251)	0.131 (0.171)
Phys per capita	0.278 (0.224)*	-0.112 (0.194)	0.273 (0.160)	-0.074 (0.271)	0.201 (0.037)	0.433 (0.001)	-0.144 (0.147)
N of cases	34 (10*)	68	16	63	84	60	55

Note: The number in parenthesis is the probability in the tail of the distribution of the z transformation. All correlations in this table are calculated applying the general population mortality rate.

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