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Why has medicine expanded? The role of consumers

Hui Zheng

Department of Sociology, The Ohio State University, Columbus, OH 43210, United States

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ABSTRACT

In the past 50 years, the field of medicine has expanded dramatically in many Western societies. Despite substantial improvements in objective health measures, there has not been a commensurate increase in assessments of subjective health. We hypothesize that medical expansion may lower people's subjective health perceptions, leading to an increase in health care utilization, and, in turn, fueling further medical expansion. We use OECD (Organization for Economic Co-operation and Development) Health Data, World Development Indicators, the World Values Survey, and the European Values Study to fit a difference-in-differences model that removes unobserved cross-national heterogeneity and any period trend that is shared across nations. We find that three dimensions of medical expansion at the societal level (medical investment, medical professionalization/specialization, and an expanded pharmaceutical industry) negatively affect individual subjective health. These findings are robust to different model specifications. We conclude by discussing possible explanations for the adverse effect of medical expansion on subjective health, and how this effect may be related to other mechanisms through which medicine expands.

1. Introduction

In the past 50 years, the Western world has observed skyrocketing health care costs, explosive growth in the number of hospitals and health care centers, a burgeoning medical workforce that has become increasingly specialized, the expansion of the pharmaceutical industry, and the extension of medical treatments to nonmedical problems. Some examples of this medical expansion come from the United States, where total health expenditures as a percentage of GDP increased from 5.1 percent in 1960 to 17.4 percent in 2009; Australia, where medical workforce employment has increased from 12.5 per 1000 persons in 1960 to 36.7 per 1000 persons in 2006; the United Kingdom, where the number of doctors has increased from 0.8 per 1000 persons in 1960 to 2.7 per 1000 persons in 2009; and Switzerland, where the number of medical specialists increased from 0.5 per 1000 persons in 1960 to 2.7 per 1000 persons in 2006.

What mechanisms and agents are responsible for this increase? In the first 75 years of the 20th century, known as the "Golden Age of Doctoring," (McKinlay and Marceau, 2002) physicians were the main agents of medical expansion. They exercised their power to define and control what constituted health and illness in order to extend their professional dominance and attain cultural authority (Freidson, 1970a,b; Starr, 1982). In the past two decades, physicians' autonomy and independence has been challenged by other actors (Light and Levine, 1988) due to the introduction of managed care, the bureaucratization (or corporatization) of doctoring, and the introduction of medical markets. Consequently, pharmaceutical companies, insurers, and consumers have become increasingly involved in directing medical care (Conrad, 2005).

E-mail address: zheng.64@osu.edu

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In this study, we focus on the role of consumers in driving medical expansion. Current literature suggests that, in the course of medical expansion, consumers' health knowledge and literacy have been substantially enriched. This trend has led to a lower tolerance for disease and discomfort (Conrad, 2005; Barsky and Borus, 1995). In turn, this drives consumer demand for medical solutions and contributes to the growth of the medical industry. This mechanism focuses on the impact of medical expansion on consumers' knowledge and intolerance of diseases. We focus on a complementary mechanism that describes how consumer demand drives medical expansion: medical expansion may lower people's subjective health perceptions, leading to increased health care utilization. Despite five decades of medical expansion and contemporaneous improvements in life expectancy and physical health (Olshansky and Ault, 1986), there has not been a commensurate increase in subjective health assessments. We have analyzed the trend of mean self-rated health over the last two decades in 28 developed countries, and found that it did not significantly improve over time. The contrast between improvement in objective health and stagnation in subjective health may indicate that, although medical expansion improves objective health, it might not improve subjective health. Illich's (1975) influential work on medical nemesis stated that modern medicine has removed personal responsibility for suffering, pain and impairment, and created dependence on health care. Thus, when people feel badly about their health, they become dependent on medicine, whereby medicine reproduces and expands. We will examine this possible mechanism with multilevel cross-national comparisons using OECD (Organization for Economic Co-operation and Development) Health Data, World Development Indicators, the World Values Survey, and the European Values Study.

2. Agents of medical expansion

Since the first part of the 20th century, a "burst of new knowledge flowing from the dramatic rise and productivity of biomedical research" (Barondess, 2000:1300) has spurred growth in the number and specialization of physicians. Physicians became a quasi-monopoly interest group (Starr, 1982) that parlayed a "claim of valuable and complex knowledge into cultural and legal authority and thence into institutional authority" (Light and Levine, 1988:12). Physicians established dominance in the field of medicine (Freidson, 1968, 1970a,b) by exercising autonomy in their work and control over others' work. By invoking the cultural belief that doctors are healers and assuming institutional power, physicians convinced the public to rely on them in matters of health and even personal problems (Zola, 1972).

In the latter part of the 20th century, however, physicians ceased to be the main agents of medical expansion. Their autonomy was challenged by the bureaucratization (corporatization) of doctoring and the application of market principles to the medical field. Consequently, the status of physicians changed from that of independent practitioners (Starr, 1982) to employees "relying on complex organizations and financial arrangements to carry out their sophisticated work" (Light and Levine, 1988:19). Biotechnology and pharmaceutical companies, insurers, and consumers have become increasingly involved in medical markets and the advancement of medical expansion. Although physicians remain gatekeepers of the health care system and legally supervise the medical work of others (Freidson, 1994; Mechanic, 1991), their role in directing the course of the medical field has become a subordinate one as medical expansion has become primarily driven by market interests (Conrad, 2005). On the supply side, biotechnology and pharmaceutical companies have increased their influence through direct-to-consumer and direct-to-physician advertising. On the demand side, consumers have increasingly demanded new and improved medical solutions to address their lower tolerance for diseases, benign symptoms and mild problems (Conrad, 2005; Barsky and Borus, 1995).

3. The consumer as an agent of medical expansion

In this study, we focus on the role of consumers in furthering medical expansion. Consumers have become a leading force demanding the expansion of medical treatments for diseases, newly-identified conditions, and even mild symptoms. This is believed to reflect their intolerance of disease, illness and bodily discomfort, which is itself a result of medical expansion. Part of this medical expansion has increased consumers' health knowledge (Broom and Woodward, 1996). For example, Bearman and colleagues show that the increase in autism prevalence can be traced in large measure to increasing awareness of this condition and its symptoms. Knowledge was passed from more affluent communities to less affluent ones (King and Bearman, 2011) and from individuals to individuals (Liu et al., 2010). Parents then sought out the latest treatments, increasing the demand for them.

The dissemination of health knowledge is not the only mechanism driving consumer demand for medical expansion. Another mechanism, complementary rather than contradictory to the first, is the decline in consumers' subjective health perceptions in response to medical expansion. Over the past 50 years, medical explanations have become increasingly dominant in discourses on health, illness and other human problems and behavior. The medical model of health and illness tends to marginalize social origins of disease (Waitzkin and Britt, 1989) and "define[s] health problems as the result of individual failures of biology, hygiene, and behavior, with the implicit or explicit belief that the primary strategy for addressing these problems is through biomedical treatments delivered to individuals by physicians and other providers" (Lantz et al., 2007: 1254). As this perspective won legitimacy, it fueled the growth of three major components of the health care system: investment in medical infrastructure; the size and specialization of the medical workforce; and the pharmaceutical industry. Despite its obvious benefits to public health (e.g., Szreter, 1988, 1994), this expansion of medicine has made less certain contributions to subjective health. Fisher et al. (2003a,b) investigated the implications of Medicare spending and found that regions with higher Medicare spending and a specialist-oriented pattern of practice did not provide better quality of care, and did not show higher patient satisfaction with care. This may be partially attributed to the lack of significant improvements in individual subjective health with higher Medicare spending. Furthermore, we have analyzed trends in mean self-rated health across 28 countries participating in the World Values Survey or the European Values Study since 1981, and also did not find significant improvements in self-rated health over this period, despite contemporaneous medical expansion in each country (Appendix A).

There are at least four explanations why medical expansion has not been accompanied by substantial improvement in subjective health assessments. First, more diseases are discovered or "created" during periods of medical expansion (Brown, 1995), which increases people's risk of being labeled or diagnosed with some disease, and increases their own perception of being vulnerable to various diseases. For example, King and Bearman (2009) found about one quarter of the increase in autism prevalence in California between 1992 and 2005 was due to a change in the way autism was diagnosed. Grinker (2007) called the effect of this change on the increasing prevalence of autism an "epidemic of discovery." To a certain degree, some new diseases may be socially constructed (Conrad and Barker, 2010) via the "medicalization" of an array of symptoms or behaviors, meaning the "process by which nonmedical problems become defined and treated as medical problems" (Conrad, 1992: 209). For example, the extension of attention deficit hyperactivity disorder (ADHD) diagnosis to adults (Conrad, 2007) may have negatively affected the subjective health of adults diagnosed with this disorder.

Second, as the medical field expands, people are exposed to more aggressive screening and diagnostic tests, which increase their likelihood of being diagnosed with one or more diseases (Thorpe et al., 2007). For example, the higher cancer incidence rate in the United States, as compared to other developed countries, is partially due to a higher rate of screening (Crimmins et al., 2010; Preston and Ho, 2010). Overdiagnosis can potentially render harm to perfectly healthy people (Welch et al., 2012). Third, medical expansion may increase people's expectations for health, and people may believe they suffer from health issues when their expectations are not met. Martin et al., 2009 found that Baby Boomers were more likely to report poor or fair health status than the earlier cohort of War Babies, despite having a lower mortality rate. This may be due to higher (and unmet) expectations of health in the later cohort. Fourth, medical expansion causes people experiencing health or even non-health problems to subordinate their lives to medical institutions and treatments. Once in the medical system, patients are subject to "sick role expectations" (Parson, 1951) and stigma (Link et al., 1989, 1997) that contribute to social withdrawal, reduction of activities, increased dependency, and the loss of self-esteem, self-efficacy, and sense of control. These adverse effects of assuming the patient role or being exposed to stigma may result in decreased subjective health.

In these four ways, medical expansion can have a negative impact on subjective health that will lead to further health care utilization and, more broadly, further expansion of the medical system. Illich's (1975) early work demonstrated that modern medicine has invaded every aspect of our personal lives, removing individuals' responsibility to deal with pain and disability and fostering dependence on care and drugs provided by the medical system. Although Illich's work may have over-simplified the complex functions of modern medicine and ignored its positive contributions to objective health, it astutely points out that the expansion of modern medicine has undermined individuals' assessment of their own health and encouraged their dependence on medicine. Current literature confirms that individual perceptions of poor health strongly predict health care utilization, including outpatient visits to psychiatrists, generalists, specialists and other health care providers; home-based health care; ambulatory care visits; and hospitalization (e.g., Andersen and Newman, 1973; DeSalvo et al., 2005; Trump, 2006; Bierman et al., 1999; Miilunpalo et al., 1997; Mutran and Ferraro, 1988). These social processes function together to reproduce and expand the medical field.

4. Methods

We have theorized that medical expansion lowers individuals' perception of health, leading to increased health care utilization and further medical expansion. The contribution of low self-rated health to increased health care utilization is well established in prior literature, so we focus our study on the hypothesis that medical expansion adversely affects individual self-rated health. We characterize the extent of medical expansion by measuring three major components of the health care system at the national level: investment in medical infrastructure, the size and specialization of the medical workforce, and the size of the pharmaceutical industry. We then test how the expansion of these three components affects individual subjective health with cross-national data collected at several time points. We use a difference-in-differences (DD) model to mitigate the endogeneity problem resulting from unobserved cross-national differences and period influences that are shared across countries. We confirm the robustness of our findings to alternative modeling strategies by fitting a cross-classified random-effects model (CCREM), results from which are presented in Appendix B.

4.1. Data and variables

We examine how medical expansion at the national level is related to individuals' subjective health assessments in survey data collected from 1981 through 2007 in 28 countries belonging to the Organization for Economic Co-operation and Development (OECD), an international organization of countries that accept the principles of representative democracy and free-market economy. We link OECD Health Data, World Development Indicators (WDI), the World Values Survey

(WVS), and the European Values Study (EVS) to construct a multilevel data set in which medical expansion and other national characteristics are assessed at the macro level, and individual subjective health and sociodemographic characteristics are assessed at the micro level.

OECD Health Data have been released annually since 1960 and include more than 1200 indicators of the health care systems of the 30 member countries. WDI provide information on more than 700 development (e.g., social, economic, and environmental) measures, with time series for more than 200 countries, and have also been released annually since 1960. For this study, we integrated data from these sources from 1981 onwards, or beginning in the first year in which the WVS and the EVS were administered. These integrated data include indicators of national characteristics and medical expansion.

The WVS is a worldwide survey of more than 80 countries, with nationally representative samples of at least 1000 respondents collected in each country. A total of four waves (1990, 1995, 2000, and 2005) have been fielded, allowing reliable cross-national comparisons and analyses of social change. The EVS is a comprehensive survey conducted in 32 European countries, and has fielded three waves in 1981, 1990, and 1999. Recently, the WVS and EVS were integrated for international comparisons. The integrated data provide information about individual-level characteristics: demographic characteristics (e.g., age and gender), socioeconomic status (e.g., income, education, and employment status), and subjective health. For this study, we focus on 28 OECD countries that have participated in either the WVS or the EVS. Table 1 provides detailed information about available data for these 28 OECD countries from the World Values Survey and the European Values Study. The "subjective health" question was included in all waves of the WVS and the EVS except for the 1999 EVS. Not all countries participated in all waves. The data used in this study include 89 country-periods.

The dependent variable (subjective health) and individual-level control variables (socioeconomic and demographic characteristics) are from the integrated WVS and EVS data displayed in Table 1. They were merged with medical expansion variables and macro-level control variables (socioeconomic, demographic, and environmental indicators) from the integrated OECD Health Data and WDI. Missing values on macro-level covariates were filled in using multiple imputation, discussed in detail below. The final sample includes 71,643 respondents.

Table 2 describes the outcome, explanatory, and control variables, as well as their data sources. The outcome variable is subjective health, measured using five categories ranging from "very poor" to "very good." The key explanatory variables are three major dimensions of medical expansion, measured by growth in the three major components of the health care system (medical investment, medical professionalization/specialization, and an expanded pharmaceutical industry). Indicators of medical investment include health care spending per capita, proportion of GDP spent on health care, the density of health employment, and health employment as a percentage of total employment. Indicators of medical professionalization/specialization include the density of physicians, the density of specialists, and the ratio of specialists to generalists. Indicators

Table 1
Waves of data collected in 28 OECD countries by the World Values Survey and the European Values Study, 1981–2007.

Period country	1981–1984	1989–1991	1994–1998	1999–2001	2005–2007	Number of waves
Australia	1981		1995		2005	3
Austria		1990				1
Belgium	1981	1990				2
Canada	1982	1990		2000	2005	4
Czech Republic		1991	1998			2
Denmark	1981	1990				2
Finland	1981	1990	1996		2005	4
France	1981	1990			2006	3
W. Germany	1981	1990	1997	1999	2006	5
Hungary	1982	1991	1998			3
Iceland	1984	1990				2
Ireland	1981	1990				2
Italy	1981	1990			2005	3
Japan	1981	1990	1995	2000	2005	5
S. Korea	1982		1996	2001	2005	4
Mexico	1981	1990	1996	2000	2005	5
Netherlands	1981	1990			2006	3
New Zealand			1998		2004	2
Norway	1982	1990	1996		2005	4
Poland		1990	1997		2005	3
Portugal		1990				1
Slovakia		1991	1998			2
Spain	1981	1990	1995	2000	2007	5
Sweden	1982	1990	1996		2006	4
Switzerland		1989	1996		2007	3
Turkey		1990	1996	2001	2007	4
UK	1981	1990			2006	3
US	1982	1990	1995	1999	2006	5
Number of countries	20	25	17	8	19	89

Note: Subjective health was not assessed in the 1999 EVS.
Blank cells indicate data are not available.

Table 2
Variables and data sources.

Variables	Data
Outcome variable	
Subjective health: 5 = very good, 4 = good, 3 = fair, 2 = poor, 1 = very poor	WVS and EVS
Medical expansion	
Medical investment	
• Health care spending per capita	OECD health data
• Proportion of GDP on health care	OECD health data
• Total health employment: density per 1000 population (head counts)	OECD health data
• Total health employment: % of total employment (head counts)	OECD health data
Medical professionalization/specialization	
• Ratio of specialists to generalists	OECD health data
• Practicing physicians density per 1000	OECD health data
• Practicing specialists density per 1000	OECD health data
Expanded pharmaceutical industry	
• Pharmaceutical production per capita	OECD health data
• Pharmaceutical sales per capita	OECD health data
• Pharmaceutical value added	OECD health data
• Expenditure on pharmaceutical industry R&D	OECD health data
Control variables: national characteristics	
GDP per capita/1000	WDI
Government consumption expenditure as percentage of GDP	OECD health data
The proportion of total population in urban areas	WDI
Population size/1,000,000	OECD health data
Life expectancy at birth (lagged one year)	OECD health data
Control variables: individual covariates	
Age	WVS and EVS
Age2: age squared	WVS and EVS
Male: 1 = man, 0 = woman	WVS and EVS
Married: 1 = married, 0 = unmarried	WVS and EVS
Education: years of education	WVS and EVS
Employed: 1 = employed, 0 = not employed	WVS and EVS
Chief wage: 1 = respondent is primary wage earner in the house, 0 = Not	WVS and EVS
Income: income decile	WVS and EVS

*WVS: World Values Survey; EVS: European Values Study; WDI: World Development Index.

of the pharmaceutical industry include pharmaceutical production per capita, pharmaceutical sales per capita, pharmaceutical value added, and expenditures on the pharmaceutical industry's research and development (R&D).

We also control for both national and individual characteristics. GDP per capita is a general measure of the level of socioeconomic development and is strongly related to health outcomes (Firebaugh and Beck, 1994; Pritchett and Summers, 1996). Government consumption expenditure as a percentage of GDP is an indicator of the government's involvement in providing goods and services to meet the needs of its people. The proportion of total population in urban areas is an indicator of urbanization. Total population size may affect the extent of medical expansion and individual health. Life expectancy at birth is a synthetic measure of population health, which is correlated with the three components of medical expansion and with individual subjective health. In order to better adjust for the temporal relationship between life expectancy and subjective health, life expectancy lagged by one year is used in the main analysis. We have also considered replacing this indicator with life expectancy at birth; the all-cause mortality rate; or the all-cause mortality rate lagged by one year, none of which changed the overall findings. Individual covariates include age, age squared, sex (1 = man, 0 = woman), marital status (1 = married, 0 = unmarried), years of education, employment status (1 = employed, 0 = not employed), chief wage earner status (1 = the primary wage earner in the house, 0 = not the primary wage earner), and household income. To facilitate international comparison, household income was measured as an ordinal variable indicating the income decile in which the household fell.

4.2. Multiple imputation and identifying the latent variables

In OECD Health Data and WDI, most macro-level indicators have missing data for approximately 20% of observations. Therefore, we applied multiple imputation to these integrated macro-level data spanning the years 1981–2007 to create five complete data sets. This approach avoids the biases and inefficiencies caused by listwise deletion, single imputation, or best-guess imputation. Multiple imputation was applied not only to the data that were merged with WVS and EVS micro-level data, but to all the macro-level data collected over the period 1981–2007. This means the imputation algorithm made use of all data available over this period to attain credible and efficient imputation. For example, even though Austria only participated in one wave of the EVS in 1990, its missing values on macro-level measures as of 1990 were imputed using all OECD and WDI data on this country assessed from 1981 to 2007.

To perform multiple imputation, we used the bootstrapped-based expectation maximization (EM) algorithm for multiple imputation developed by Honaker and King (2010). This algorithm was used instead of more common multiple imputation methods, such as the regression method, the propensity score method or the Markov Chain Monte Carlo (MCMC) method. These other methods often produce implausible imputations of missing values in time-series cross-sectional data such as the OECD Health Data used in this paper. Particularly, imputed values attained using common imputation methods often deviate far from the preceding and subsequent observations, which is highly improbable in reality. In contrast, the bootstrapped-based EM algorithm "recognize[s] the tendency of variables to move smoothly over time, to jump sharply between some cross-sectional units like countries, to jump less or be similar between some countries in close proximity, and for time series patterns to differ across many countries" (Honaker and King, 2010: 566). The EM algorithm includes time functions (e.g., polynomials, LOESS) to smooth time trends and interactions of the time function with the cross-sectional unit to differentiate trends among units. We use Amelia II, embedded in the R statistical software package, to apply multiple imputation using this method to missing data in our analysis.

In addition to the 11 indicators of medical expansion in Table 2, multiple imputation was applied to the following variables: the size of the urban population, the urban population as a percentage of the total population, GDP per capita, life expectancy at birth, male life expectancy at age 65, female life expectancy at age 65, the all-cause gross mortality rate, household consumption expenditure per capita, household consumption expenditure as a percentage of GDP, government consumption expenditure per capita, government consumption expenditure as a percentage of GDP, gross fixed-capital formation, gross fixed-capital formation per capita, foreign direct investment net inflows as a percentage of GDP, compensation to employees as a percentage of GDP, services value added, industry value added, alcohol consumption per capita, tobacco consumption per capita, and the percentage of women in the labor force. These variables are included because they have modest-to-strong correlations with medical expansion indicators, and they have relatively smaller proportions of missing values. Comparisons of imputed values from the bootstrapped-based EM method with time setting and the interaction of the time function with the cross-sectional unit and imputed values achieved using the MCMC method without time setting showed that the MCMC method produced implausible results, with imputed values deviating from the general smooth trend. Conversely, the bootstrapped-based EM method produced more plausible imputations of missing values consistent with the smooth trend in each country (figures available upon request).

After producing the five datasets, we applied both explanatory and confirmatory factor analysis to the eleven indicators of medical expansion in each dataset. We then calculated five sets of factor scores (i.e., one in each dataset) for each domain, and obtained the average factor score for each domain. Table 3 shows results from exploratory factor analysis (EFA) without specifying the number of factors. As can be seen from the rotated factor loadings, EFA suggests that the three-factor solution is best. In addition, each indicator loads primarily on one factor. Overall, these results provide empirical support for our conceptualization of the three domains of medical expansion. We also applied confirmatory factor analysis (CFA) in Mplus to these indicators, but the results were not as clear as those from EFA. There were many fluctuations in each trend; indeed, some of the trends make no sense (figures available upon request). These findings suggest that EFA is more meaningful and appropriate in this dataset. From a methodological perspective, EFA is also more appropriate than CFA because no previous research has examined the latent structure underlying these eleven indicators of medical expansion.

4.3. Methods

We analyze a multilevel data set with the outcome variable of subjective health and independent variables assessed at the individual level and at the population level (the latter including three components of medical expansion). We use a model known as *Difference-in-Differences* in econometrics (Imbens and Wooldridge, 2007) or as the fixed effect model in sociology. In this model, we treat country and year effects as fixed rather than random. This allows us to remove unobserved between-group heterogeneity and any period trend that is shared across groups. In the context of this study, this model allows us to mitigate the endogeneity problem resulting from unobserved cross-national differences and universal period influences on self-rated health. Instead of writing the model as a difference equation, which is conventional in analyses of two groups and two time points, we write the model in a level equation with controls for country dummies and period

Table 3
Rotated factor loadings (pattern matrix) and unique variances for 11 indicators of medical expansion.

Variable	Factor1	Factor2	Factor3	Uniqueness
Health employment density	0.109	0.938	0.050	0.106
Health employment as % of total employment	0.067	0.918	0.050	0.150
Health care spending per capita	0.612	0.668	0.142	0.159
Proportion of GDP on health care	0.380	0.768	0.224	0.216
Practicing physicians density per 1000	0.287	0.359	0.724	0.265
Practicing specialists density per 1000	0.153	0.190	0.906	0.120
Ratio of specialists to generalists	−0.210	−0.227	0.743	0.352
Pharmaceutical production per capita	0.931	0.180	0.038	0.099
Pharmaceutical sales per capita	0.628	0.541	0.252	0.250
Pharmaceutical value added	0.926	0.105	−0.003	0.131
Expenditure on pharmaceutical industry R&D	0.787	0.133	0.204	0.321

dummies. This notation is suitable to analyzing multiple groups across multiple time points (Imbens and Wooldridge, 2007) and is more common in sociology. The equation can be written as follows:

$$\begin{aligned}Y_{igt} = {} & u_g + v_t + \beta_{1gt}(\text{age}) + \beta_{2gt}(\text{age}^2) + \beta_{3gt}(\text{sex}) + \beta_{4gt}(\text{marital}) + \beta_{5gt}(\text{education}) + \beta_{6gt}(\text{work}) + \beta_{7gt}(\text{chief wage}) \\ & + \beta_{8gt}(\text{income}) + \gamma_1(\text{medical investment}) + \gamma_2(\text{expanded pharmaceutical industry}) \\ & + \gamma_3(\text{medical professionalization/specialization}) + \gamma_4(\text{GDP per capita}) \\ & + \gamma_5(\text{government consumption expenditure}) + \gamma_6(\text{urbanization}) + \gamma_7(\text{population size}) \\ & + \gamma_8(\text{lagged life expectancy}) + w_{gt},\end{aligned}$$

where i indexes each individual, g indexes each group (country in this study), t indexes time (year in this study), Y_{igt} stands for the ordinal response outcome of health of the ith respondent from the gth country surveyed in the tth year. For the outcome variable, "very poor health" is the reference group. But, interpretation of this model is the same regardless of which category of the outcome is compared to which reference group (Long, 1997). In every case, the model can be interpreted by describing how the odds of reporting better health (i.e., being in the next higher category of health) are changed by a one-unit increase in an explanatory variable.

This model includes a full set of group (country) effects u_g, a full set of time (year) effects v_t, individual-level covariates (i.e., the variables from age to income), macro-level covariates (i.e., the variables from medical investment to life expectancy), and unobserved group/time effects w_{gt}. By including u_g and v_t, this model controls for universal period effects that may affect the health outcome in the same way across nations; and also controls for unobserved heterogeneity among nations, such as the health implications of each nation's specific culture or traditions. Therefore, this model mitigates the endogeneity problem.

Because the independent variables are located at two levels (individual level and population level), we also repeat the analysis using Hierarchical Generalized Linear Models (HGLM) to test whether our findings may be sensitive to model specification. HGLM offers a coherent modeling framework for multilevel data, and in the case of an ordinal outcome such as self-rated health, can accommodate nonlinear structural models and non-normally distributed errors (Raudenbush and Bryk, 2002). Variables from the WVS and EVS are measured at the individual level, and those from OECD Health Data and WDI are measured at the population level. The HGLM specification of the model is represented by the following equations:

Level-1 model:

$$\begin{aligned}Y_{igt} = {} & \beta_{0gt} + \beta_{1gt}(\text{age}) + \beta_{2gt}(\text{age}^2) + \beta_{3gt}(\text{sex}) + \beta_{4gt}(\text{marital}) + \beta_{5gt}(\text{education}) + \beta_{6gt}(\text{work}) + \beta_{7gt}(\text{chief wage}) \\ & + \beta_{8gt}(\text{income}),\end{aligned}$$

Level-2 model:

$$\begin{aligned}\beta_{0gt} = {} & \gamma_{00} + \gamma_{01}(\text{medical investment}) + \gamma_{02}(\text{expanded pharmaceutical industry}) \\ & + \gamma_{03}(\text{medical professionalization/specialization}) + \gamma_{04}(\text{GDP per capita}) \\ & + \gamma_{05}(\text{government consumption expenditure}) + \gamma_{06}(\text{urbanization}) + \gamma_{07}(\text{population size}) \\ & + \gamma_{08}(\text{lagged life expectancy}) + u_{0g} + v_{0t},\end{aligned}$$

$$\begin{aligned}& \beta_{1gt} = \gamma_{10} + u_{1g} + v_{1t}, \\ & \ldots\ldots\ldots \\ & \beta_{8gt} = \gamma_{80} + u_{8g} + v_{8t}.\end{aligned}$$

The Level-1 model is an ordered logit model regressing the five-category measure of subjective health on several individual-level covariates. The Level-2 models are a set of linear regression models that treat the intercept and coefficients in the Level-1 model as functions of country and year, which have random effects. For example, the first equation among Level-2 models (i.e., the random intercept equation) regresses the intercept β_{0gt} in the Level-1 model on group/time covariates (country/year covariates in this study, including three dimensions of medical expansion and other national development indicators), random effects of country u_{0g} (allowing the intercept to vary randomly from country to country), and random effects of year v_{0t} (allowing the intercept to vary randomly from year to year). This specification of HGLM is commonly referred to as a *Cross-Classified Random-Effects Model*. Results from this model are presented in Appendix B.

4.4. Results

Fig. 1 portrays country trends in mean self-rated health in 28 OECD countries surveyed between 1981 and 2007. For most countries, except for South Korea, Poland, and Spain, there is no significant trend of improvement in self-rated health during this period. Table 4 shows unstandardized odds ratios from difference-in-differences models of individual subjective health regressed on medical expansion, national development indicators, and individual covariates. Model 1 is an unconditional means model that does not include any explanatory or control variables. The intercept, 0.609, suggests people are less likely to report very good health as compared to reporting other levels of health. Model 2 adds individual-level covariates. The odds

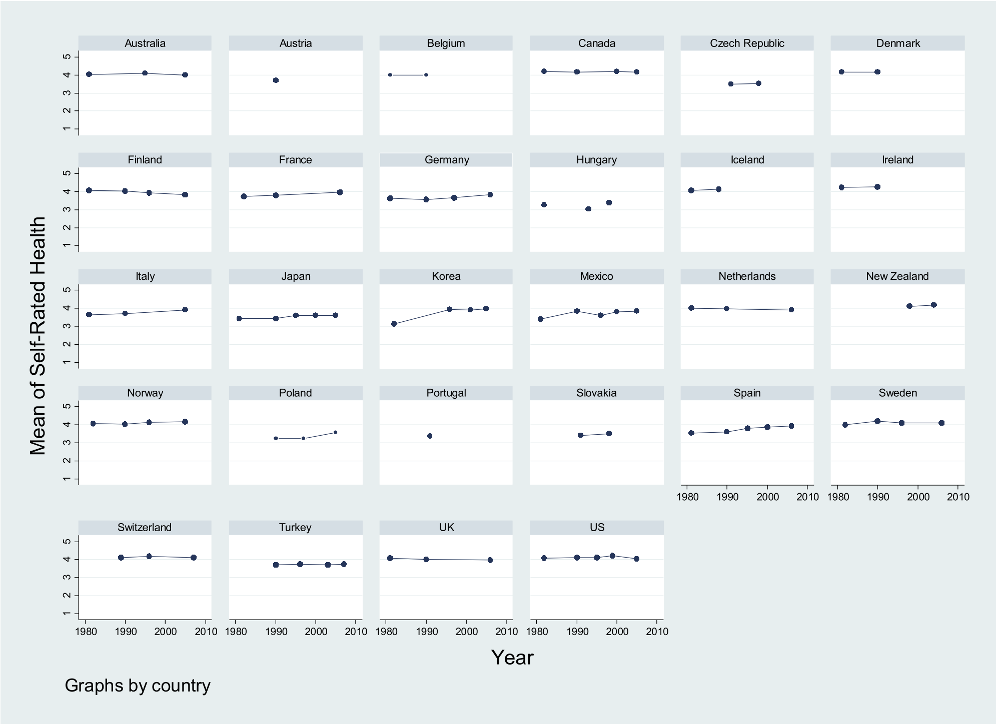


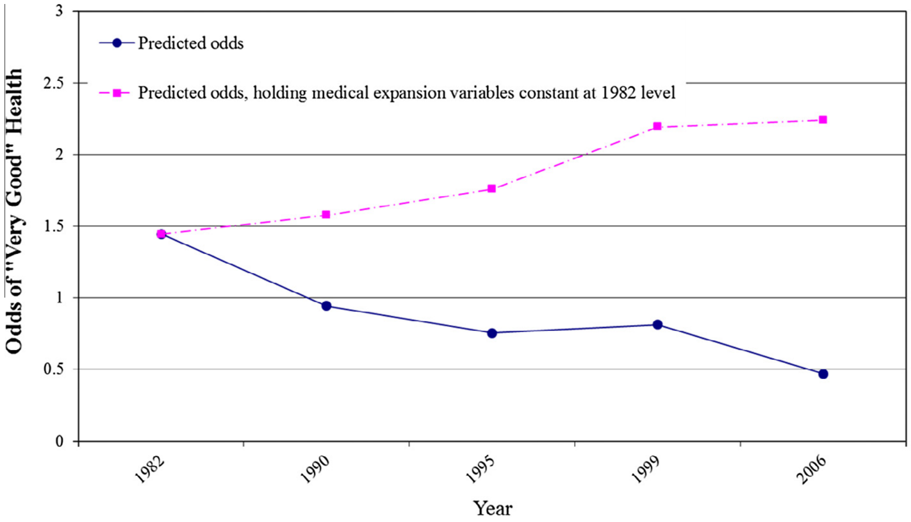
Fig. 1. Trends of mean self-rated health among 28 countries from the World Values Survey and the European Values Study, 1981–2007.

Table 4
Unstandardized odds ratios from difference-in-differences models regressing individual subjective health on medical expansion, national characteristics, and individual-level covariates.

	Model 1	Model 2	Model 3	Model 4	Model 5
Fixed effects					
Intercept[a]	0.609***	1.276**	2.434***	183.5***	24.267
Age		0.948***	0.949***	0.950***	0.950***
Age2		1.001***	1.001***	1.001***	1.001***
Male		1.068***	1.065***	1.062***	1.062***
Married		1.161***	1.153***	1.151***	1.151***
Education		1.047***	1.048***	1.050***	1.050***
Employed		1.354***	1.350***	1.340***	1.340***
Chief wage		1.049**	1.049**	1.055**	1.055**
Income		1.092***	1.093***	1.094***	1.094***
Medical investment			1.054	0.766**	0.769**
Expanded pharmaceutical industry			0.769***	0.832***	0.820***
Medical professionalization/specialization			0.903*	0.809***	0.798***
GDP per capita				1.065***	1.068***
General government consumption expenditure (% of GDP)				1.076***	1.079***
Percent of total population in urban areas				0.883***	0.886***
Population size				1.008***	1.009***
Lagged life expectancy at birth					1.019
Model fit					
BIC	309048.3	173263.1	168075.5	168016.3	168018.4

* $p < .05$.
** $p < .01$.
*** $p < .001$.
[a] Intercept of rating own health as very good (5) versus other responses (1–4). Intercepts for other comparisons are omitted.

of reporting better health decrease by 5 percent with every year of age. But the effects of age are curvilinear, such that the odds of reporting better health increase in late life. Men have 7 percent greater odds of reporting better health than women. Being married is associated with a 16 percent increase in the odds of reporting better health. Each year of education increases the odds of reporting better health by 5 percent. Employment is associated with a 35% increase in the odds of reporting better health. Being the primary wage earner in the household and being in the next higher income decile are associated with 5% and 9% increases in the odds of reporting better health, respectively.



Note: We used a simple standardization technique by inputting means of each control variable for each year in Model 5 of Table 4 to produce the odds for each year. Standardized to 1982 medical expansion level means keeping medical investment, expanded pharmaceutical industry, and medical professionalization / specialization at the 1982 level while other variables change.

Fig. 2. Predicted odds of "Very Good" self-rated health in the U.S., 1982–2006.

The three dimensions of medical expansion are added in Model 3. An expanded pharmaceutical industry and medical professionalization/specialization both significantly reduce the odds of reporting better health by 23% and 10%, respectively. Medical investment, however, is not significantly related to the odds of reporting better health. Yet, medical investment becomes significantly and negatively associated with reporting better health after other national development indicators are added in Model 4, and after life expectancy at birth (lagged by one year) is added in Model 5. This is because most of the national development indicators are positively correlated with both medical investment and individual subjective health, and omitting these variables (as in Model 3) upwardly biases the coefficient of medical investment. For example, GDP per capita, general government consumption expenditures, and total population size are associated with higher odds of reporting better health. The lagged measure of life expectancy at birth is included as a covariate to account for the possibility that increasing life expectancy contributes to increasing health care expenditure, drug consumption and demand for physicians. The effect of life expectancy at birth is not statistically significant, however, and BIC statistics suggest Model 4 (without the life expectancy variable) is the best fitting model.

Fig. 2 shows the odds of "very good" health from 1982 to 2006 in the U.S., predicted from the coefficients estimated in the difference-in-differences model. One set of predictions is derived from the observed changes in medical expansion since 1982, whereas another set of predictions represents a counterfactual scenario in which medical expansion is frozen at 1982 levels. The former predicted time series suggests the odds of "very good" health decreased from 1982 to 2006 (as shown by the solid line with circles). If medical expansion (i.e., medical investment, expanded pharmaceutical industry and medical professionalization/specialization) had remained at the same level from 1982 to 2006, the odds of "very good" health would have increased instead (as shown by the dashed line with squares). This figure illustrates how increasing medical expansion has suppressed a potential increase in individuals' subjective health from 1982 to 2006 in the U.S. Similar predictions from this model can also be obtained for other countries.

4.4.1. Sensitivity analysis

Appendix B shows unstandardized odds ratios from Cross-Classified Random-Effects Models regressing individual subjective health on medical expansion, national development indicators, and the individual-level covariates. The overall findings are consistent with those in Table 4, indicating that medical investment, an expanded pharmaceutical industry and medical professionalization/specialization negatively affect subjective health. When the three dimensions of medical expansion are added in Model 3 of Appendix B, the variance in the intercept associated with year becomes non-significant. This suggests medical expansion explains the period-to-period variation in mean subjective health. The variance in intercept associated with country is reduced from .443 to .329, indicating that medical expansion explains 26 percent ((0.443–0.329) ∗ 100/0.443) of the country-to-country variation in mean subjective health. Pseudo-BIC statistics suggest Model 3 is the best-fitting model.[1]

[1] We used SAS PROC GLIMMIX to estimate these models. The default estimator of GLIMMIX is RSPL, which maximizes the residual log pseudo-likelihood and provides unbiased predictors of the random effects. The pseudo-maximum likelihood estimator uses a consistent and asymptotically normal estimator rather than a maximum likelihood estimator for the variance parameters in the solution of the score equation $\partial l / \partial \beta = 0$, where l denotes the log-likelihood and β denotes the vector of parameters to be estimated. In models for a normally distributed outcome variable with an identity link, RSPL is equivalent to REML (Littell et al., 2006), but RSPL is consistent and asymptotically normally distributed for non-normal data as well. The smaller the BIC, the better the model fit.

5. Discussion and conclusion

In the past 50 years, we have witnessed a dramatic expansion in the field of medicine in the United States and many other developed countries. Due to the introduction of managed care and medical markets, this expansion has been driven increasingly by agents other than physicians, including biotechnology and pharmaceutical companies, insurers, and consumers. In this study, we focus on the role of consumers in driving medical expansion. Prior literature implies that medical expansion may promote people's health knowledge, increase their awareness of diseases, and decrease their tolerance for illnesses, which, in turn, leads them to seek more frequent and intensive medical attention. This study provides evidence for another mechanism by which consumer demand can reproduce medical expansion. We hypothesize that medical expansion may lower individuals' perception of health, leading to increased health care utilization, and, therefore, continued and increasing medical expansion. This mechanism is counterintuitive because research has generally found the expansion of medicine benefits objectively measured health characteristics in the general population. For example, epidemiologic transition theory has attributed mortality declines in developed countries since the early 20th century to medical advances and the expansion of health care (Omran, 1971). It stands to reason that medical expansion should likewise promote better subjective health. Yet, the opposite may be true, as mean or median of self-rated health has not substantially improved in the countries studied in this project (Appendix A and Fig. 1). Given this incongruence between self-rated health trends and mortality trends in developed countries, we carefully examine the relationship between medical expansion and self-rated health using multilevel cross-national comparisons.

Using OECD Health Data, World Development Indicators, the World Values Survey, and the European Values Study, we fit difference-in-differences models to mitigate the omitted variable bias. This bias may arise from unobserved cross-national differences or an unobserved universal trend in the perception of health. Our results show that three dimensions of medical expansion at the societal level (medical investment, medical professionalization/specialization and an expanded pharmaceutical industry) significantly and negatively affect individual subjective health after controlling for national socioeconomic characteristics and individual socio-demographic characteristics. We confirm this finding with an alternative set of results obtained from fitting cross-classified random-effects models.

Few studies have examined self-rated health outcomes of medical expansion, yet our findings are consistent with the prior research in this area. For example, Fisher et al. (2003a,b) found higher medical spending and a specialist-oriented pattern of practice were not associated with higher satisfaction with care or greater subjective health across regions of the United States. Until now, no studies have investigated how the expansion of the entire national medical system (including infrastructure, medical professionalization, and the pharmaceutical industry) affects individual subjective health. This study overcomes the limitations of prior research, and proposes a testable and falsifiable hypothesis describing how consumer demand reproduces and accelerates medical expansion.

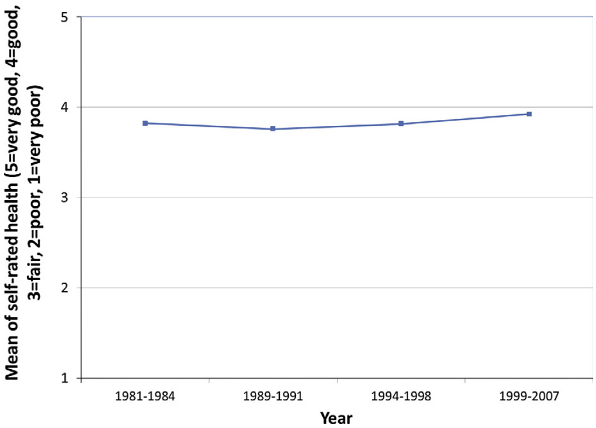
Individual subjective health is affected by multiple macro-level social trends. Socioeconomic development and improvements in living standards improve subjective health. At the same time, however, these improvements in subjective health are suppressed by medical expansion. The counterbalancing effects of socioeconomic development and medical expansion result in a stagnant trend of individual subjective health even while other indicators of population health, such as the mortality rate, show ongoing improvement. The multivariate regression methods used in this study are able to tease out the net effect of medical expansion on subjective health after controlling for socioeconomic development. This point is particularly demonstrated by the switch in the direction of the medical investment effect from Model 3 to Model 4 in Table 4 and Appendix B.

Several possible pathways may explain the negative impact of medical expansion on individuals' subjective health. First, more diseases are discovered and "created" during periods of medical expansion, which increases the risk of being diagnosed with "new" diseases. Second, medical expansion encourages aggressive screening, which increases the risk of being diagnosed with both "old" and "new" diseases. Third, medical expansion may increase people's expectations for health, perhaps to an unrealistic degree. Fourth, medical expansion increases individuals' reliance on medicine, leading more people to participate in the medical system as patients, and experience "sick role expectations" (Parson, 1951) and stigma (e.g., Link et al., 1989, 1997). The sick role and stigma may lead patients to experience negative consequences, such as reduction in activities and loss of control. These four pathways describe adverse effects of medical expansion on individual subjective health. Pharmaceutical companies and medical professionals are the main actors in these four mechanisms because they are involved in the process of creating new diseases, labeling patients, aggressively screening for diseases, escalating people's health expectations, and advertising, selling or prescribing drugs. At the same time, patients may experience psychological harm from taking medication or interacting with physicians. Due to data limitations, we are unable to directly test these four mechanisms, which should be examined in further research on this topic.

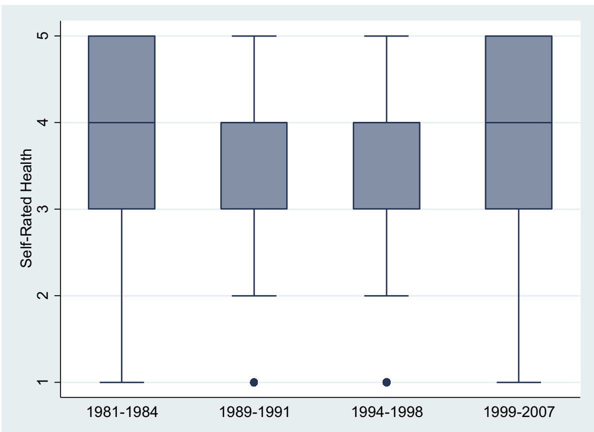
Subjective health is a good indicator of objective health and subclinical illness, and has been found in some studies to be a better predictor of mortality among the elderly than physician assessment (Schoenfeld et al., 1994; Hays et al., 1996; Idler and Benyamini, 1997). The present study also finds a strong positive correlation between life expectancy at birth and individual subjective health (Appendix B), which suggests self-rated subjective health reflects objective health status. We also find that medical expansion harms individual subjective health, although this finding does not indicate that medical expansion adversely affects indicators of objective health. Instead, medical expansion generally improves populations' physical health (e.g., Omran, 1971). Thus, whereas individual subjective health is a good indicator of objective health at the individual level, it is still affected by macro-level societal changes, including medical expansion, meaning that differences in the extent of medical expansion may explain cross-national differences and period changes in self-rated health.

This study has some limitations, and the findings should be understood in this context. First, we used a multiple imputation method to handle the missing data problem in OECD Health Data and World Development Indicators. Although Honaker and King's (2010) bootstrapped-based expectation maximization method is useful in dealing with missing values in time-series cross-sectional data, it would have been better to have a more complete dataset. To our knowledge, a more complete dataset containing the macro-level indicators used in this study does not exist. Second, due to data limitations, we are not able to empirically test the four proposed mechanisms linking medical expansion to worse self-rated health. Further research needs to test whether individuals' subjective health is adversely affected by higher dependence on medicine for dealing with personal health problems, more frequent interactions with doctors, or higher dependence on pharmaceuticals. In future studies testing these hypotheses, the analysis must adjust for individual objective health status because objective health is positively correlated with both subjective health and medical treatment. Omitting measures of objective health would upwardly bias the estimated effect of dependence on medicine, and may even yield a spurious positive estimate of this effect. Third, our data series starts in 1981, so we do not know the relationship between medical expansion and self-rated health prior to 1981, or whether the inverse relationship found in this study characterizes only this recent period. When suitable data become available, future research should investigate whether the findings can be generalized to other periods and countries. Fourth, even though difference-in-differences model can mitigate the endogeneity problem, it cannot completely resolve the causality issue as this model assumes the unobserved unit-level time-varying factors are uncorrelated with the explanatory variables.

This study uses empirical data and statistical models to examine the role of consumers in the process of medical expansion. It finds medical expansion can lower individuals' perceptions of their own health, which, according to prior studies, should increase their utilization of health care (e.g., DeSalvo et al., 2005; Trump, 2006; Bierman et al., 1999). This, in turn,



(a)



(b)

Fig. A1. Note: Years are collapsed into four periods representing the five waves of integrated World Values Survey and European Values Study data. The last two waves of the World Values Survey are collapsed into one period to reduce variation caused by the small number of countries in those waves. Detailed information about countries and time periods included in the World Values Survey and the European Values Study is presented in the Data section and Table 1.

promotes further medical expansion. This mechanism can complement a previously described pattern whereby medical expansion increases individuals' health knowledge and decreases their tolerance for illness. These two mechanisms may work simultaneously for the same person, such that medical expansion simultaneously increases this person's health knowledge and lowers their perception of their own health. Yet, the strength of each mechanism may vary across people. Moreover, there may be some interaction between these two mechanisms, and this interaction effect may be heterogeneous across individuals. Finally, research suggests other agents are also involved in medical expansion, including pharmaceutical companies, insurers, and physicians. Additional research is needed to investigate consumers' interaction with these agents and how these interactions may further contribute to expansion of the medical field.

Acknowledgments

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Appendix A

Mean and interquartile range of self-rated health from pooled data representing 28 countries in the World Values Survey and the European Values Study, 1981–2007 (see Fig. A1).

Appendix B

Unstandardized odds ratios for cross-classified random-effects models regressing individual subjective health on medical expansion, national characteristics, and individual covariates.

	Model 1	Model 2	Model 3	Model 4	Model 5
Fixed effects					
Intercept[a]	0.332***	0.555**	0.523**	24.366*	0.000***
Age		0.946***	0.947***	0.948***	0.948***
Age2		1.001***	1.001***	1.001***	1.001***
Male		1.087*	1.081*	1.081*	1.081*
Married		1.133**	1.131**	1.131**	1.130**
Education		1.060***	1.060***	1.061***	1.061***
Employed		1.368***	1.366***	1.359***	1.359***
Chief wage		1.055**	1.059**	1.061**	1.061**
Income		1.091***	1.091***	1.092***	1.092***
Medical investment			1.168*	0.782*	0.840*
Expanded pharmaceutical industry			0.754***	0.821***	0.820***
Medical professionalization/specialization			0.864**	0.769***	0.698***
GDP per capita				1.071***	1.075***
General government consumption expenditure (% of GDP)				1.080***	1.082***
Percent of total population in urban areas				0.907***	0.946***
Population size				1.007**	1.005**
Lagged life expectancy at birth					1.170***
Random effects–variance components[b]					
Intercept/country	.390***	.443**	.329**	2.181*	0.900*
Male/country		.030**	.028**	.029**	.029**
Married/country		.031**	.030**	.029**	.029**
Education/country		.001**	.001**	.001**	.001**
Employed/country		.031**	.034**	.034**	.034**
Income/country		.001**	.001**	.001**	.001*
Intercept/year	.043**	.075*	.288	.190	.022
Model fit					
−2 Res log pseudo-likelihood	2,039,732	1,276,179	1,237,788	1,240,234	1,236,368
Pseudo-BIC	2,039,802	1,276,392	1,238,034	1,240,525	1,239,670

* $p < .05$.
** $p < .01$.
*** $p < .001$.
[a] Intercept of very good health (5) versus other categories (1–4). The intercepts for other comparisons are omitted.
[b] Insignificant variance components of other Level-1 covariates subject to country and year are not reported here in the interest of space.

References

Andersen, R.M., Newman, J.F., 1973. Societal and individual determinants of medical care utilization in the United States. Milbank Memorial Fund Q. 51, 95–121.
Barondess, J.A., 2000. Specialization and the physician workforce. Drivers and determinants. J. Am. Med. Assoc. 284 (10), 1299–1301.
Barsky, A.J., Borus, J.F., 1995. Somatization and medicalization in the era of managed care. J. Am. Med. Assoc. 274, 1931–1934.
Bierman, A.S., Bubolz, T.A., Fisher, E., Wasson, J., 1999. How well does a single question about health predict the financial health of medicare managed care plans? Effective Clin. Practice 2 (2), 56–62.
Broom, D.H., Woodward, R.V., 1996. Medicalization reconsidered: toward a collaborative approach to care. Sociol. Health Illness 18, 357–378.
Brown, P., 1995. Naming and framing: the social construction of diagnosis and illness. J. Health Soc. Behav. 35, 34–52.
Conrad, P., 1992. Medicalization and social control. Annu. Rev. Sociol. 18, 209–232.
Conrad, P., 2005. The shifting engines of medicalization. J. Health Soc. Behav. 46, 3–14.
Conrad, P., 2007. The Medicalization of Society. Johns Hopkins University Press, Baltimore, MD.
Conrad, P., Barker, K.K., 2010. The social construction of illness: key insights and policy implications. J. Health Soc. Behav. 51 (s), S67–S79.
Crimmins, E.M., Garcia, K., Kim, J.K., 2010. Are international differences in health similar to international difference in life-expectancy? In: Crimmins, E.M., Preston, S.H., Cohen, B. (Eds.), Washington International Differences in Mortality at Older Ages: Dimensions and Sources. The National Academies Press, DC, pp. 69–101.
DeSalvo, K.B., Fan, V.S., McDonell, M.B., Fihn, S.D., 2005. Predicting mortality and healthcare utilization with a single question. Health Serv. Res. 40 (4), 1234–1246.
Firebaugh, G., Beck, F.D., 1994. Does economic growth benefit the masses? Growth, dependence, and welfare in the third world. Am. Sociol. Rev. 59, 631–653.
Fisher, E., Wennberg, D.E., Stukel, T.A., Gottlieb, D.J., Lucas, F.L., Pinder, E.L., 2003a. The implications of regional variations in medicare spending. Part 1: the content, quality, and accessibility of care. Ann. Intern. Med. 138, 273–287.
Fisher, E., Wennberg, D.E., Stukel, T.A., Gottlieb, D.J., Lucas, F.L., Pinder, E.L., 2003b. The implications of regional variations in medicare spending. Part 2: health outcomes and satisfaction with care. Ann. Intern. Med. 138, 288–298.
Freidson, E., 1968. The impurity of professional authority. In: Becker, H.S., Geer, B., Riesman, D., Weiss, R.S. (Eds.). Institutions and the Person, Aldine, pp. 25–34.
Freidson, E., 1970a. Profession of Medicine. Dodd, Mead, New York.
Freidson, E., 1970b. Professional Dominance. The Social Structure of Medicine. Atherton, New York.
Freidson, E., 1994. Professionalism Reborn: Theory, Prophecy, and Policy. University of Chicago Press.
Grinker, R.R., 2007. Unstrange Minds: Remapping the World of Autism. Basic Books, Cambridge, MA.
Hays, J.C., Schoenfeld, D., Blazer, D.G., Gold, D.T., 1996. Global self-ratings of health and mortality: hazard in the North Carolina piedmont. J. Clin. Epidemiol. 49, 969–979.
Honaker, J., King, G., 2010. What to do about missing values in time series cross-section data. Am. J. Political Sci. 54 (2), 561–581.
Idler, E.L., Benyamini, Y., 1997. Self-rated health and mortality: a review of twenty-seven community studies. J. Health Soc. Behav. 38, 21–37.
Illich, I., 1975. Medical Nemesis: The Expropriation of Health. Calder & Boyars, London.
Imbens, G.W., Wooldridge, J.M., 2007. Recent Developments in the Econometrics of Program Evaluation. mimeo, Harvard university Department of Economics.
King, M., Bearman, P., 2009. Diagnostic change and increased prevalence of autism. Int. J. Epidemiol. 38 (5), 1224–1234.
King, M., Bearman, P., 2011. Socioeconomic status and the increased prevalence of autism in California. Am. Sociol. Rev. 76 (2), 320–346.
Lantz, P.M., Lichtenstein, R.L., Pollack, H.A., 2007. Health policy approaches to population health: the limits of medicalization. Health Aff. 26 (5), 1253–1257.
Light, D., Levine, S., 1988. The changing character of the physicians: a theoretical overview. Milbank Q. 66, 10–32.
Link, B.G., Gullen, F.T., Struening, E., Shrout, P., Dohrenwend, B.P., 1989. A modified labeling theory approach in the area of the mental disorders: an empirical assessment. Am. Sociol. Rev. 54, 400–423.
Link, B.G., Struening, E., Rahav, M., Phelan, J.C., Nuttbrock, L., 1997. On stigma and its consequences: evidence from a longitudinal study of men with dual diagnoses of mental illness and substance abuse. J. Health Soc. Behav. 38, 177–190.
Littell, R.C., Milliken, G.A., Stroup, W.W., Wolfinger, R.D., Schabenberger, O., 2006. SAS for Mixed Models, second ed. SAS Institute, Cary, NC.
Liu, K., King, M., Bearman, P., 2010. Social influence and the autism epidemic. Am. J. Sociol. 115 (5), 1387–1434.
Long, J.S., 1997. Regression Models for Categorical and Limited Dependent Variables. Sage, Thousand Oaks, CA.
Martin, L.G., Freedman, V.A., Schoeni, R.F., Andreski, P.M., 2009. Health and functioning among baby boomers approaching 60. J. Gerontol.: Soc. Sci. 64B (3), 369–377.
McKinlay, J.B., Marceau, L.D., 2002. The end of the golden age of doctoring. Int. J. Health Serv. 32 (2), 379–416.
Mechanic, D., 1991. Sources of countervailing power in medicine. J. Health Polit. Policy Law 16, 485–498.
Miilunpalo, S., Vuori, I., Oja, P., Pasanen, M., Urponen, H., 1997. Self-rated health status as a health measure: the predictive value of self-reported health status on the use of physician services and on mortality in the working-age population. J. Clin. Epidemiol. 50 (5), 517–528.
Mutran, E., Ferraro, K.F., 1988. Medical need and use of services among older men and women. J. Gerontol.: Soc. Sci. 43, S162–S171.
Olshansky, S.J., Ault, A.B., 1986. The fourth stage of the epidemiologic transition: the age of delayed degenerative diseases. Milbank Q. 64, 355–391.
Omran, A.R., 1971. The epidemiologic transition: a theory of the epidemiology of population change. Milbank Memorial Fund Q. 49 (4), 509–538.
Parson, T., 1951. The Social System. Free Press, Glencoe, Ill.
Preston, S., Ho, J., 2010. Low life expectancy in the United States: is the health care system at fault? In: Crimmins, E.M., Preston, S.H., Cohen, B. (Eds.), International Differences in Mortality at Older Ages: Dimensions and Sources. The National Academies Press, Washington, DC, pp. 259–298.
Pritchett, L., Summers, L.H., 1996. Wealthier is healthier. J. Human Resour. 31, 841–868.
Raudenbush, S.W., Bryk, A.S., 2002. Hierarchical Linear Models: Applications and Data Analysis Methods. Sage Publications.
Schoenfeld, D.E., Malmrose, L.C., Blazer, D.G., Gold, D.T., Seeman, T.E., 1994. Self-rated health and mortality in the high-functioning elderly-a closer look at healthy individuals: Macarthur field study of successful aging. J. Gerontol.: Med. Sci. 49, M109–M115.
Starr, P., 1982. The Social Transformation of American Medicine. Basic Books.
Szreter, S., 1988. The importance of social intervention in Britain's mortality decline c. 1850–1914: a re-interpretation of the role of public health. Soc. History Med. 1, 1–38.
Szreter, S., 1994. Mortality in England in the eighteenth and nineteenth centuries: a reply to Guha. Soc. History Med. 7 (2), 369–382.
Thorpe, K.E., Howard, D.H., Galactionova, K., 2007. Differences in disease prevalence as a source of the U.S.-European health care spending gap. Health Aff. 26 (6), w678–w686.
Trump, D.H., 2006. Self-rated health and health care utilization after military deployments. Mil. Med. 171 (7), 662–668.
Waitzkin, H., Britt, T., 1989. A critical theory of medical discourse: how patients and health professionals deal with social problems. Int. J. Health Serv. 19 (4), 577–597.
Welch, H.G., Schwartz, L., Woloshin, S., 2012. Overdiagnosed: Making People Sick in the Pursuit of Health. Beacon Press, Boston, MA.
Zola, I.K., 1972. Medicine as an institution of social control. Sociol. Rev. 20, 487–504.