THE IMPACT OF THE ECONOMY AND RECESSIONS ON THE MARKETPLACE DEMAND FOR OPHTHALMOLOGISTS (AN AMERICAN OPHTHALMOLOGICAL SOCIETY THESIS)

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ABSTRACT

Purpose: To develop a help-wanted index (HWI) to measure trends in marketplace demand for ophthalmologists, to identify the economic drivers of demand, and to determine the impact of economic recessions on the ophthalmology job market.

Methods: Review of physician recruitment advertisements appearing in the journals *Ophthalmology*, *American Journal of Ophthalmology*, and *Archives of Ophthalmology* from January 1980 through June 2006.

Results: Over the 26-year study period a consistent increase in the demand for subspecialists (31% of HWI in 1980 to 80% in 2005) was noted. There was also an increase in the demand for academic ophthalmologists. The need for academic ophthalmologists seems to be correlated with national research expenditure and stock market gains (P = .00191), whereas demand for private practice ophthalmologists seems to be correlated with the national economic well-being, as measured by gross domestic product (GDP) (P < .001). Residency applicants (P = .0128) and fellowship applicants (P = .0198) respond to marketplace demand. During the recessions, the demand for ophthalmologists fell 2 to 3 years after the economic downturn.

Conclusions: Over a 26-year period, HWI data suggest an increased need for subspecialists and academic ophthalmologists. The ophthalmic community has been quick to respond to marketplace demand. National research expenditure, stock market gains, GDP, and discretionary health care expenditure have been associated with the ophthalmology job market. These factors tend to decline with economic recessions. Historically, the demand for ophthalmologists has declined 2 to 3 years following a recession, which may mean lower demand in the near future, given the recent recession.

Trans Am Ophthalmol Soc 2011:109:49-65

INTRODUCTION

According to the Business Cycle Dating Committee of the National Bureau of Economic Research, the US economy was in recession between December 2007 and June 2009.[1] This recession, dubbed the Great Recession, was the longest and the worst recession that the United States has experienced since World War II.[1,2] The Business Cycle Dating Committee also noted that unemployment increased every month from December 2007 to December 2008.[3] The rate of unemployment increased from 5.0% in December 2007 to 9.5% in June 2009.[4]

The impact of recessions, regulations, and economic policies on the job market has been the subject of extensive research. In October 2010, the Nobel Prize in Economic Sciences was awarded to three economists who have formulated a theoretical framework for job markets. The Royal Swedish Academy of Sciences, in a press release, stated that Peter Diamond, Dale Mortensen, and Christopher Pissarides have analyzed the foundations of search markets, expanded the theory, and applied it to the labor market. The 2010 Nobel Laureates' models help us understand the ways in which unemployment, job vacancies, and wages are affected by regulations, economic policies, and recessions.[5]

The Great Recession's impact on health care has been apparent since the beginning of the recession. Within the first 6 months of the recession, patients started cutting back on both their visits to physicians and the number of prescriptions that they filled.[6,7] A survey by the National Association of Insurance Commissioners (state insurance regulators) revealed that 22% of patients had cut back their visits to physicians because of economic concerns, and 11% had cut back on either the number or the doses of the prescription drugs that they take, in order to save money.[8] By the end of the Great Recession, 5.8 million adults had lost their employment-based health insurance, 2.7 million had gone on Medicaid, and 5.6 million had joined the ranks of the uninsured.[9] The American Hospital Association reported that during the recession 70% of hospitals experienced reduced patient volumes, 65% reported an increase in patients on Medicaid and the Children's Health Insurance Program (CHIP), and 90% reported increases in uncompensated care. This economic reality caused 76% of hospitals to cut administrative costs, 53% to reduce staff levels, and 25% to reduce the number of services offered.[10] In spite of the fact that the recession has ended, hospitals are still experiencing its adverse effects: 98% of hospitals have not restored cut programs or services and 89% have maintained reduced staff levels.[10]

The potential impact of the current economic recession on the ophthalmology job market is not well characterized. In 2008 McDonnell[11] reported that decreased ophthalmology patient volume was a result of patients' economic situations. He also suggested that medicine is not recession-proof. In the current thesis, we attempt to quantify the demand for ophthalmologists and to determine how this demand has changed relative to various macroeconomic variables.

Previous studies that have attempted to quantify the demand for ophthalmologists include the five-part Ophthalmology Manpower Studies,[12-16] the Graduate Medical Education National Advisory Committee (GMENAC) Report on Ophthalmology[17] during the 1980s,

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and the American Academy of Ophthalmology–commissioned Eye Care Workforce Study[18-20] during the 1990s. The initial impetus for the ophthalmology manpower studies was the US government's concerns about the overproduction of ophthalmologists (among other specialists). The Eye Care Workforce Study was carried out to update knowledge about supply and demand for ophthalmic services, given the technological, regulatory, practice pattern, and health care delivery changes that occurred during the 1990s. In spite of these studies, there is still uncertainty about the adequacy of the supply of both ophthalmologists and other physicians. In 2005, the US Department of Health and Human Services' Council on Graduate Medical Education announced that a physician shortage was likely by 2020 and recommended a 15% increase in the number of medical students (relative to 2002 levels) and an increase in the number of residency positions.[21] In a 2006 position statement, the Association of American Medical Colleges stated that a physician shortage was likely to materialize and recommended a 30% increase in the number of medical students (relative to 2002 levels) by 2015 with concurrent expansion of residency programs.[22]

Given the current climate, the ophthalmology profession may soon be faced with the decision of whether or not to expand by increasing the number of ophthalmology training positions. Furthermore, if a decision is made to expand, there is a question as to what extent the number of ophthalmologists should be expanded. These are critical decisions because too few ophthalmologists could mean that patients do not receive adequate care and that physicians are overworked. On the other hand, too many ophthalmologists may result in high unemployment, demoralization of trainees and recent graduates, avoidance of the specialty by medical students, and issues of perception of the quality of the field's graduate medical education, as was experienced by the anesthesiology community during the mid-1990s.[23,24] Clearly, to optimize decision making about the size of the field, the current ophthalmology workforce needs to be rigorously examined.

Studies like the Ophthalmology Manpower Studies and its updated version, the Eye Care Workforce Study, have been very useful in evaluating the state of supply and demand for ophthalmologists at the time that they were done; however, they have been less successful at capturing trends in supply and demand. The shortcomings of these studies are partially a result of the fact that they are theoretical estimates of demand generated by enumerating the types of diseases treated by the physician, estimating total disease burden, and then estimating the number of physicians needed to handle the estimated disease burden. At best, studies of this sort provide a theoretical estimate of the maximum number of physicians needed. For example, if patients cut back on their physician visits for economic reasons, then the real demand that physicians experience will be less than estimated. Furthermore, the reliance of these studies on multiple estimates makes them prone to error as reflected by the discrepancy in the results of the essentially concurrent Ophthalmology Manpower Studies and the GMENAC report.[25] These studies are further limited by their inability to capture the dynamics of the variable that they use. For example, Penne and Lemke, who examined the oculoplastic surgery results of the Eye Care Workforce Study , noted that the scope of disease, the disease burden, and the treatment's manpower requirements all change with time.[26,27] Thus the errors of the initial estimates are likely to get compounded the further away one gets from the initiation of the study. With implicit recognition of the previous point, Penne and Lemke[26] suggest that more continuous monitoring of manpower needs is required, but note that studies like the Eye Care Workforce Study cannot be continuously updated because of the high expense involved in their execution.

A help-wanted index (HWI) can potentially address the problems inherent to studies like the Eye Care Workforce Study. Help-wanted indices are a compilation of the volume of advertisements for workers assessed over a specific time period.[28] Historically, HWIs have been compilations of either the number of advertised positions or the amount of space dedicated to advertisements, (eg, the inches of advertisement columns). Economists have used HWI data as a measure for workforce demand as early as 1893.[29] A HWI initiated in 1927 by economist William A. Berridge, but currently published by the Conference Board, a nonprofit business research organization, is recognized as the best source of US labor demand data.[28,30-32] The HWI published by the Conference Board has been extensively studied and validated by many economists. Robert M. Solow, the 1987 Economics Nobel Prize laureate, correlated changes in the HWI of the Conference Board to changes in unemployment, hiring, and the labor cycle.[28,33-36]

Interestingly, HWIs were first introduced to the medical literature as a new method of labor demand quantification in an appendix of the Ophthalmology Workforce Study.[12] Subsequently HWIs have been used to evaluate marketplace demand for internists, family practitioners, pediatricians, anesthesiologists, pulmonologists, orthopedic surgeons,[37] infectious disease specialists,[38,39] and radiologists.[40-45]

Help-wanted indices are dynamic tools that directly measure workforce demand and thus eliminate the errors and biases inherent to theoretic workforce demand estimates and projections. Help-wanted indices are also relatively inexpensive to generate, which facilitates the continuous collection of labor demand data. Furthermore, historical demand data can be obtained, and these data can be analyzed to test hypotheses about which factors labor demand is correlated with, which in turn will enable more robust prediction models. Therefore, HWIs can provide a useful supplement to, and a reality check for, ophthalmology workforce demand estimates. As an initial step toward this goal, we compiled a HWI for ophthalmology from January 1980 through June 2006. The HWI was then used to elucidate the economic factors that affect demand for both academic and private practice ophthalmologists. Finally, the HWI was used to assess the impact of marketplace demand on training programs, ophthalmology residents, medical students, and compensation of ophthalmologists. The HWI was also used to assess the historical impact of recessions on the demand for ophthalmologists.

METHODS

All job advertisements in the journals *Ophthalmology*, *American Journal of Ophthalmology,* and *Archives of Ophthalmology* during the 318-month period from January 1980 through June 2006 were reviewed. Each job advertisement was disaggregated into the

number of individual positions advertised, and each position was coded. Coding was done along three axes: practice type, geography, and subspecialty.

Advertisements were coded into one of three practice types: academic, private, and government. For an advertisement to be coded as an academic position, the originating institution had to be an academic center or an academic center affiliate, or the position had to be advertised as either an academic appointment or a professorship. Positions at Veterans Affairs hospitals were also coded as academic positions, because advertisements for ophthalmologists from Veterans Affairs hospitals invariably mentioned academic affiliations. Positions were coded as government jobs if they involved working for governmental agencies other than the Department of Veterans Affairs. All other positions were designated as private practice positions.

Geographical coding within the United States was done according to a scheme derived from Forman and associates[41] that is summarized in Table 1. Positions outside the United States were coded as either Canadian or International.

TABLE 1. GEOGRAPHIC CODING SCHEME FOR HELP WANTED INDEX

SOUTHEAST	MIDWEST	NORTHEAST	SOUTHWEST	NORTHWEST	CALIFORNIA
Alabama	Colorado	Connecticut	Arizona	Alaska	California
Arkansas	Illinois	Delaware	Hawaii	Idaho	
Florida	Indiana	Maine	Nevada	Montana	
Georgia	Iowa	Massachusetts	New Mexico	Oregon	
Gulf Coast	Kansas	New Hampshire	Oklahoma	Washington	
Kentucky	Michigan	New Jersey	Texas	Wyoming	
Louisiana	Minnesota	New York	Utah		
Maryland	Missouri	Pennsylvania			
Mississippi	Nebraska	Rhode Island			
North Carolina	North Dakota	Vermont			
South Carolina	Ohio				
Tennessee	South Dakota				
Virginia	Wisconsin				
Washington, DC					
West Virginia					

Adapted from Forman et al.41

Advertisements were divided among 15 groups: comprehensive ophthalmology, retina, cornea (and/or anterior segment), glaucoma, uveitis, pediatrics, oculoplastics, neuro-ophthalmology, research, pathology, cataracts, low vision, oncology, education, and leadership. Jobs that did not fit into any of the preceding categories were coded as "other." Comprehensive ophthalmology was used to code advertisements for comprehensive ophthalmologists, positions without subspecialty designations, and positions mentioning more than two specialties. In cases where two subspecialties were mentioned for a single position, the position was coded as 0.5 of each of the mentioned specialty positions. Advertisements for directors of residency programs were categorized as education positions. Advertisements for leaders of ophthalmology departments or leaders of ophthalmology departments in satellite locations were coded as leadership positions. Positions that involved research for more than 50% of the time were coded as research positions.

The HWI generated in this study includes all job advertisements for ophthalmologists printed in three academic journals, namely, *Ophthalmology*, *American Journal of Ophthalmology*, and *Archives of Ophthalmology*. This represents a subset of all ophthalmology job advertisements and does not capture other sources of job information, such as the Internet (notably the American Academy of Ophthalmology's Academy Jobs Web site), nonacademic ophthalmology journals, and headhunter firms. Therefore, when appropriate, sensitivity analyses are carried out to further assess the conclusions drawn from the study.

Coded positions were aggregated on a monthly basis to generate the HWI. To determine the economic factors that drive demand for ophthalmologists, multiple regression analysis was used to discern relationships between subgroups of the annualized HWI and various economic variables. Only real (inflation-adjusted) variables were used for the analysis. If only nominal (non-inflation-adjusted) data were available from the various sources, the nominal data were adjusted by dividing the variable by the ratio of the consumer price index (CPI) deflator values for the year in question and the year preceding it. Symbolically, real X_n = nominal $X_n*(CPI_n/CPI_{n-1})$, for variable X in year n. CPI data was obtained from the US Department of Labor's Bureau of Labor Statistics.[46]

To assess the historical impacts of recession on the marketplace, demand for ophthalmologists during and after the recessions from July 1990 to March 1991 and March 2001 to November 2001 were compared. Similar analysis was done with published data on the marketplace demand for radiologists.[40-45] Multiple regression analysis was also used to establish a relationship between the marketplace demand for radiologists and economic drivers. Statistical analysis mostly consisted of a comparison of proportions or means, and statistical significance was determined by means of Student's *t* test. For multivariate correlations an analysis of variance

test was done and statistical significance was determined using the *F* test. Resultant *P* values were deemed significant if less than .050

The variables and HWI subcomponents that are used in this thesis are described below:

Research funding refers to an aggregate of private, federal, state, and local government funding dedicated to research. These numbers were obtained from the Centers for Medicare and Medicaid Services of the US Department of Health and Human Services.[47]

S&P is the annual percentage appreciation or depreciation of the Standard and Poor's 500 stock market index. S&P was calculated by dividing the adjusted closing price of the S&P 500 on the last trading day of a particular year with the price on the first trading day of that year. Symbolically $S\&P_n = (\text{price}_{\text{last trading day}}/\text{price}_{\text{first trading day}})$. Data for the S&P 500 was obtained from Yahoo! Finance using the ticker symbol: ^GSPC.[48]

GDP refers to the gross domestic product, which is the sum of all goods and services produced in a country in a year. The GDP data used for this analysis was obtained from the Bureau of Economic Analysis of the US Department of Commerce.[49]

CMS refers to the annual expenditures of the Centers for Medicare and Medicaid Services.

Durable equipment refers to the annual sums spent on durable medical equipment. These numbers were obtained from the Centers for Medicare and Medicaid Services of the US Department of Health and Human Services.[47]

Discretionary expense refers to out-of-pocket expenditures on "services provided in establishments operated by health practitioners other than physicians and dentists. These professional services include those provided by private-duty nurses, chiropractors, podiatrists, optometrists, and physical, occupational, and speech therapists, among others."[47]

Offered fellowships is the annual number of ophthalmology fellowship positions offered by training institutions. This information is published in the Fellowship Match Report of the Association of University Professors of Ophthalmology.[50]

Fellowship applicants is the annual number of applicants to ophthalmology fellowship programs. This number is the sum of applicants to the various ophthalmology fellowship programs. These numbers are published in the Fellowship Match Report of the Association of University Professors of Ophthalmology.[50]

Residency applicants is the number of applicants who register for the San Francisco Matching Program. This information was obtained from the Ophthalmology Match Report of the Association of University Professors of Ophthalmology.[51]

Physician compensation variables refer to the physician compensation data from the Physician Compensation and Production Survey series of the Medical Group Management Association.[52] The specific compensation categories used in this thesis are listed below:

- ***Median academic compensation*** is the median total compensation of academic ophthalmologists.
- ***Mean academic base compensation*** is the mean base salary of academic ophthalmologists.
- ***Mean retina compensation*** is the mean total compensation of retina specialists.
- ***Median academic retina compensation*** is the median compensation of academic retina specialists.

Academic HWI is the annualized sum of all advertisements for academic ophthalmologists. *Academic HWI* is a proxy for the marketplace demand for academic ophthalmologists.

Private practice HWI is the annualized sum of all advertisements for private practice ophthalmologists. *Private practice HWI* is a proxy for the marketplace demand for private practice ophthalmologists.

Private subspecialist HWI is the annualized sum of all advertisements for nongeneralist, private practice ophthalmologists. This series was obtained by subtracting general practice positions from the private HWI. *Private subspecialist HWI* is a proxy for the marketplace demand for private practice subspecialists.

Academic retina HWI is the annualized sum of all advertisements for academic retinal specialists. *Academic retina HWI* is a proxy for the marketplace demand for academic retinal specialists.

Radiology HWI is the annualized sum of all advertisements for radiologists. *Radiology HWI* is a proxy for the market demand for radiologists.

RESULTS

HELP WANTED INDEX 1980-2006

General Trends

Between January 1980 and June 2007, 15,283 positions were advertised in *Ophthalmology*, *Archives of Ophthalmology*, and *American Journal of Ophthalmology*. Overall the HWI was biphasic between 1980 and 2006 (Figure 1). The annual number of advertised positions started at 264 ads in 1980 and peaked at 944 in 1990; it subsequently fell to a nadir of 291 in 1996, then increased to 734 in 2001; it then fell to 450 in 2004, but rose to 663 in 2005. Analysis of the monthly number of ads (Figure 2) revealed local maxima in June 1990 and January 2002 and local minima in October 1996 and February 2005. Interestingly, the major declines of the HWI from its relative maxima began during periods of economic recession (July 1990-March 1991 and March 2001-November 2001).

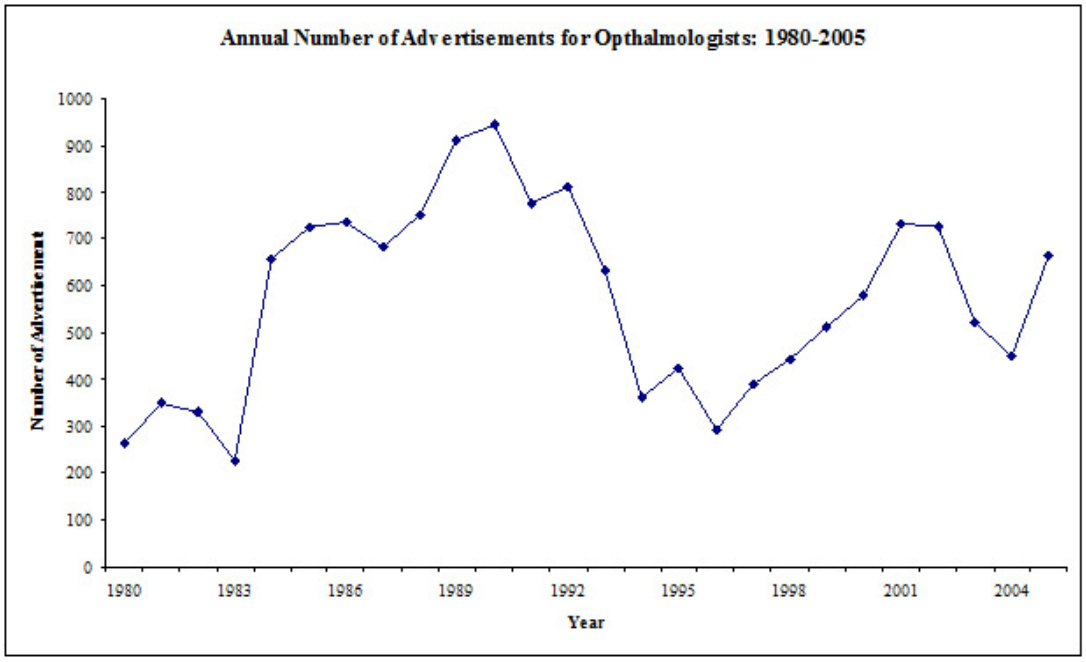

FIGURE 1

Annual number of advertisements for ophthalmologists from 1980 through 2005

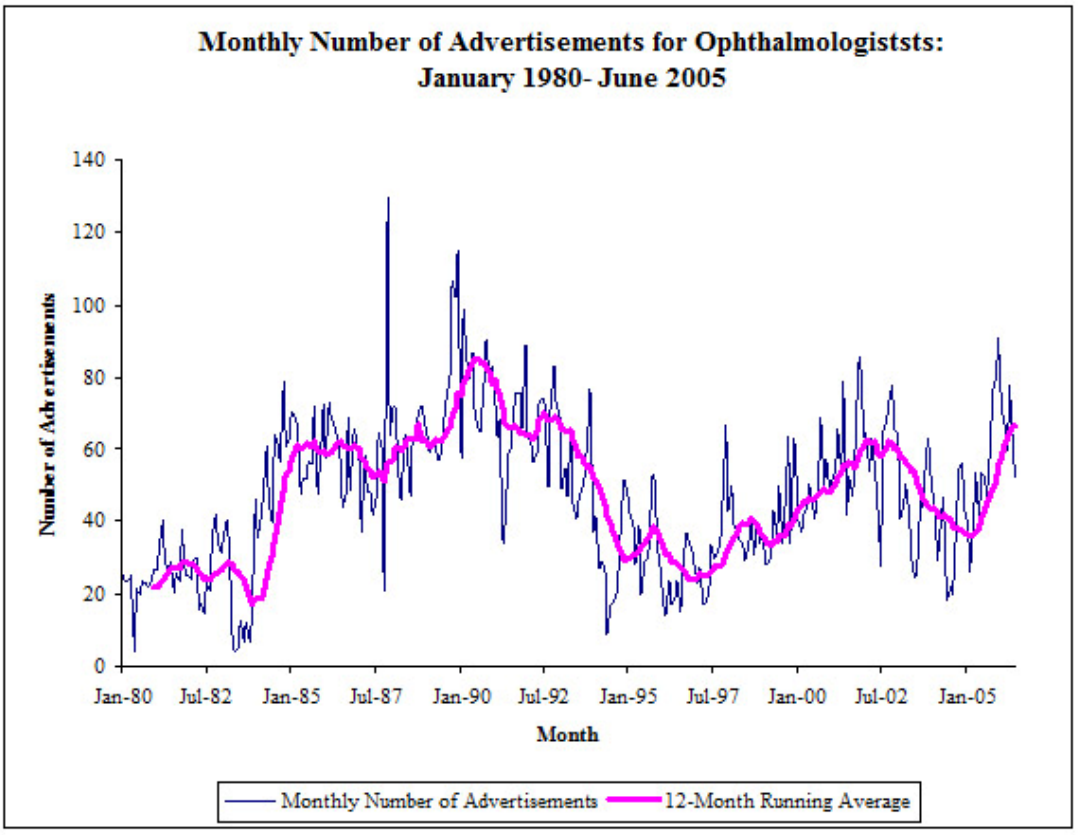

FIGURE 2

Monthly number of advertisements for ophthalmologists from January 1980 through June 2005.

Practice Type Trends

Between January 1980 and June 2006, 61.3% (9,735) of all advertisements were for private practice positions, 38.1% (5,822) were for academic positions, and 0.6% (86) were for government positions (Figure 3). A comparison of proportions test was used to analyze

changes in the HWI practice type composition over time, and significance was determined by a Student's *t* test. A comparison between the periods January 1980 through June 1990 (increasing total ads) and July 1990 through October 1996 (decreasing total ads) revealed an increase in the proportion of academic advertisements (24.8% to 32.4%, $P < .001$) and a decrease in the proportion of private practice ads (74.9% to 66.8%, $P < .001$). Between the periods July 1990 through October 1996 and November 1996 through January 2002, there was a further decrease in the proportion of private practice advertisements (66.8% to 51.7%, $P < .001$) with a concurrent increase in the proportion of academic ads (32.4% to 47.2%, $P < .001$). Between the periods November 1996 through January 2002 and February 2002 through February 2005, the proportions of private practice ads decreased even further (51.7% to 36.3%, $P < .001$), and the proportion of academic advertisements increased (47.2% to 63.4%, $P < .001$).

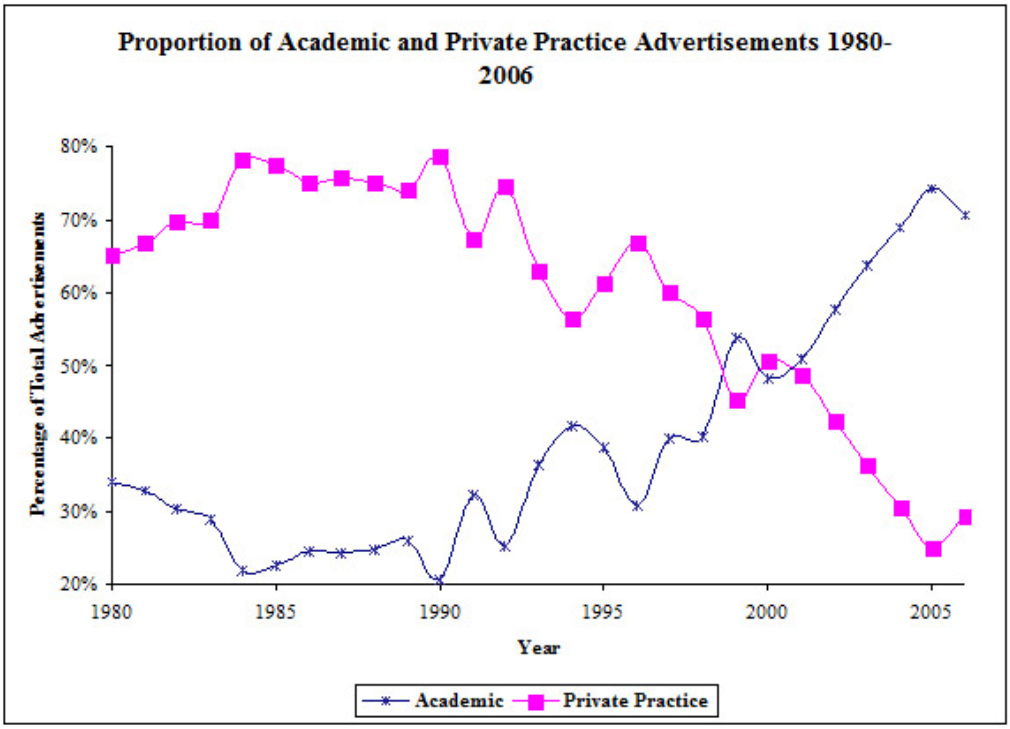

FIGURE 3

Academic and private practice ads as a percentage of total advertisements from 1980 through 2006.

The Internet has been increasingly utilized in recent years, and Internet-based job advertisements have also been increasingly used. A sensitivity analysis was conducted to assess how the incorporation of an external data series could impact the conclusions of the analyses above (Table 2). For example, to invalidate the conclusion that the proportion of academic advertisements increased significantly between February 2002 and February 2005, the new data series would have to contain at least 2,413 positions, if it was completely composed of private practice advertisements, which is 137.8% of the number of positions for that time period in the HWI. If the new series had 25% academic positions it would have to contain at least 65,338 positions to nullify the trend (3,731.5% of the HWI). The sensitivity analysis suggests that the conclusions of the HWI analysis are relatively robust.

TABLE 2. SENSITIVITY ANALYSIS OF THE INCORPORATION OF AN EXTERNAL DATA SERIES ON THE PROPORTION OF ACADEMIC OPHTHALMOLOGY ADVERTISEMENTS

TIME PERIOD	PERCENT ACADEMIC ADVERTISEMENTS					
	0%	5%	10%	15%	20%	25%
Jul 90-Oct 96	837 (22.7%)	1,036 (28.1%)	1,358 (36.9%)	1975 (53.6%)	3,620 (98.3%)	2,2387 (607.7%)
Nov 96-Jan 02	2,184 (78.7%)	2,704 (97.4%)	3,548 (127.8%)	5,162 (186.0%)	9,480 (341.5%)	5,9159 (2,131.1%)
Feb 02-Feb 05	2,413 (137.8%)	2,987 (170.6%)	3,919 (223.8%)	5,700 (235.5%)	10,467 (597.8%)	65,338 (3,731.5%)

Overall, there has been a steady increase in the proportion of advertisements for academic positions (Figure 3). The increase in demand for academic ophthalmologists may suggest that academic institutions have had a difficult time attracting qualified ophthalmologists. Although equal opportunity laws mandating broad advertisement for academic institutions may account for the

increased rate of advertisement for academic institutions, this effect would likely appear as an abrupt change in the demand curve at the point of introduction of the law. However, the demand for academic ophthalmologists has increased linearly over the course of 20 years (1985-2005), making legal changes an unlikely complete explanation for the long-term increase in demand for academic ophthalmologists.

Geographic Trends

Between January 1980 and July 2006, 27.4% of positions originated from the Midwest, 23.7% from the Southeast, 21.2% from the Northeast, 9.3% from the Southwest, 8.5% from California, 4.3% from the Northwest, 0.6% from Canada, 2.8% from foreign countries other than Canada, and 2.1% were unspecified. A comparison of proportions test was used to analyze the geographic components of the HWI over time, and significance was determined by a Student's *t* test. Comparing the period from January 1980 through June 1990 (increasing total ads) to the period from July 1990 through October 1996 (decreasing total ads), statistically significant decreases in the proportion of Midwestern (30.7% to 26.5%, $P < .001$), Californian (10.2% to 6.6%, $P < .001$), and Southwestern (9.2% to 5.3%, $P < .001$) ads, and increases in Northeastern (21.1% to 25.0%, $P < .001$), Southeastern (19.6% to 24.9%, $P < .001$), and Northwestern (3.0% to 4.3%, $P < .001$) ads can be seen. A comparison of the period July 1990 through October 1996 (decreasing ads) to the period from November 1996 through January 2002 (increasing ads) revealed a statistically significant decrease in the proportion of Northeastern ads (25.0% to 17.3%, $P < .001$), with statistically significant increases in the proportions of Southeastern (24.9% to 27.8%, $P = 4.58 \times 10^{-3}$), Californian (6.6% to 9.6%, $P < .001$), Southwestern (5.3% to 8.3%, $P < .001$), and Northwestern (4.3% to 6.8%, $P < .001$) ads. A comparison of the period from November 1996 through January 2002 (increasing ads) to the period from February 2002 to February 2005 (decreasing ads) revealed significant decreases in proportions of Californian (9.6% to 6.8%, $P < .001$) and Northwestern (6.8% to 4.4%, $P < .001$) ads, with corresponding increases in the proportions of Northeastern (17.3% to 21.0%, $P = 1.21 \times 10^{-3}$) and Southwestern ads (8.3% to 11.9%, $P < .001$).

These data suggest that the decrease in the total number of ads between July 1990 and October 1996 was driven by decreases in demand from the Midwest, Southwest, and California. The increase in demand between November 1996 and January 2002 was driven by an increase in demand from the Southeast, Southwest, Northwest, and California. The decrease in demand between February 2002 and February 2005 was driven by decreases in demand from California and the Northwest. The most recent data indicate that the demand is driven by the Northeast. Overall, these data indicate that none of the regions of the United States have experienced chronic and severe shortages of ophthalmologists.

Subspecialty Trends

Between January 1980 and July 2000, 38.9% of advertised positions were for comprehensive ophthalmologists, 22.8% for retina specialists, 9.0% for pediatric ophthalmologists, 6.9% for cornea specialists, 3.9% for oculoplastic surgeons, 3.5% for leadership positions, 2.5% for neuro-ophthalmologists, 1.5% for researchers, and the remaining 2.5% were for ocular pathologists, cataract surgeons, uveitis specialists, residency program directors, oncology specialists, and other subspecialists. A comparison of proportions test was used to analyze the subspecialty components of the HWI over time, and significance was determined by a Student's *t* test.

A comparison of the period January 1980 through June 1990 (increasing ads) and the period July 1990 through October 1996 (decreasing ads) revealed decreases in the proportions of ads for general ophthalmologists (50.7 % to 37.3%, $P < .001$) (Figure 4), neuro-ophthalmologists (2.6% to 1.8%, $P = .00317$), and ocular pathologists (1.1% to 0.6%, $P = .00337$), with increases in the proportions of ads for retina specialists (17.8% to 25.0%, $P < .001$), glaucoma specialists (4.9% to 10.5%, $P < .001$), pediatric ophthalmologists (7.8% to 9.0%, $P = .0230$), oculoplastic surgeons (2.8% to 3.6%, $P = .0128$), and researchers (1.0% to 1.8%, $P < .001$).

A comparison of the period from July 1990 through October 1996 (decreasing ads) with the period from November 1996 through January 2002 (increasing ads) reveals decreases in the proportion of ads for general ophthalmologists (37.3% to 30.4%, $P < .001$), glaucoma specialists (10.5% to 8.5%, $P = .00691$), ocular pathologists (0.6% to 0.2%, $P = .00342$), and residency program directors (0.3% to 0.0%, $P = .00230$). These decreases were offset by increases in the proportions of ads for pediatric ophthalmologists (9.0% to 10.4%, $P = .0312$), cornea specialists (5.7% to 9.1%, $P< .001$), oculoplastic surgeons (3.6% to 4.5%, $P = .0407$), leadership roles (2.9% to 5.4%, $P < .001$), neuro-ophthalmologists (1.8% to 2.6%, $P = .0123$), ocular oncologists (0.1% to 0.3%, $P = .0195$), and low vision specialists (0.0% to 0.1%, $P = .0415$).

A comparison between the periods November 1996 through January 2002 and February 2002 through February 2005 revealed that the proportions of comprehensive ophthalmologists (30.4% to 23.1%, $P < .001$), leadership roles (5.4% to 3.8%, $P = .00422$), and cataract surgeons (0.7% to 0.0%, $P < .001$) decreased. Furthermore, the proportions of advertisements for retina specialists (25.2% to 29.0%, $P = .00275$), glaucoma specialists (8.7% to 10.8%, $P = .0130$) and neuro-ophthalmologists (2.6% to 3.6%, $P = .0329$) increased in spite of the decrease in total advertisements. Between 1996-2001 and 2002-2005 a significant decrease occurred in comprehensive ophthalmology positions (73.3% to 65.3%, $P < .001$), with a concomitant significant increase in subspecialist positions (13.0% to 21.3%, $P < .001$).

Overall, these data indicate that since 1980, irrespective of the changes in total demand for ophthalmologists, demand for general ophthalmologists has decreased and demand for subspecialists has increased (Figure 4). Analysis of the demand for subspecialists reveals that the demand for retinal specialists has increased throughout the study period, whereas demand for leadership roles and cornea, cataract, low vision, and oncology specialists has generally tracked total demand. Interestingly, the

demand for glaucoma specialists has been counter-cyclic: when general demand increases, the demand for glaucoma specialists decreases, and vice versa.

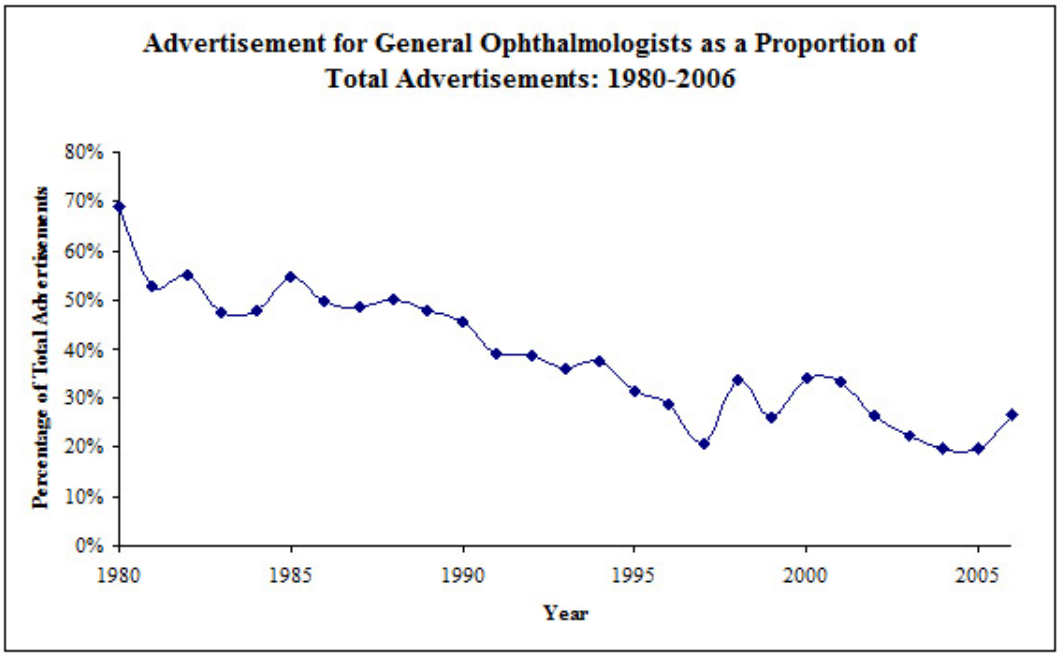

FIGURE 4

Advertisements for general ophthalmologist as a percentage of total advertisements from 1980 through 2006.

ECONOMIC DETERMINANTS OF THE DEMAND FOR OPHTHALMOLOGISTS

Academic Practice Demand

A statistically significant (P = .00191, adjusted R2 = 0.397) estimate of the year-to-year percentage change in the academic HWI (Figure 5) could be made with the following equation (Table 3, Equation 1):

$$\Delta\text{Academic HWIn} = 5.00*\Delta\text{Research funding}_{n} + 0.92*\text{S\&P}_{n-2} - 1.31$$

Δ refers to the percentage change in the variable that it precedes relative to the previous year. Symbolically $\Delta X = (Xn-Xn-1)/Xn-1$. Analysis of variation testing for the equality of group means was used to assess variance between the analyzed variables in the regression analysis, and statistical significance was determined by an F test of means.

The regression equation is best interpreted in the following manner: in a given year, n, for every unit percentage increase in national research expenditure, there is a 5.0% increase in the number of advertisements for academic ophthalmologists. Furthermore, for every unit percent gain in the S&P 500, there is, on average, a 0.9% increase in the number of advertisements for ophthalmologists 2 years later. Generally, the demand for academic ophthalmologists is positively correlated with both research funding and lagged stock market gains.

Private Practice Demand

Private practice demand was shown to be positively correlated with both GDP and out-of-pocket discretionary health care expenditure (Figure 6; Table 3, Equation 2).

THE IMPACT OF ECONOMIC RECESSIONS ON THE MARKETPLACE DEMAND

For the two previous economic recessions (July 1990-March 1991, *Recession 1*, and March 2001-November 2001, *Recession 2)*, a comparison of the demand for ophthalmologists in the year prior to the recessions, to that during the recessions, yields mixed results. A comparison of means test was used to compare aggregate demand over time, and a Student's t test was used to assess statistical significance. Recession 1 showed a statistically significant decrease in demand (84.5%, $P = .0407$), whereas Recession 2 showed a statistically insignificant increase in demand (124.9%, $P = .0691$). Similar results were obtained when the demand during the recession was compared to that during the subsequent year. Comparison of demand during the recession to that 1 year after the recession showed no significant changes in demand (Recession 1, 93.7%, $P = .112045$, Recession 2, 98.9%, $P = .682551$), whereas comparison of recession demand to demand 2 years later showed reduced demand (Recession 1, 85.5%, $P = .011$, Recession 2, 71.2%, $P = .0037$).

Three years following the recession, the demand was reduced even further (Recession 1, 42.3%, $P < .001$, Recession 2, 57.8%, $P < .001$).

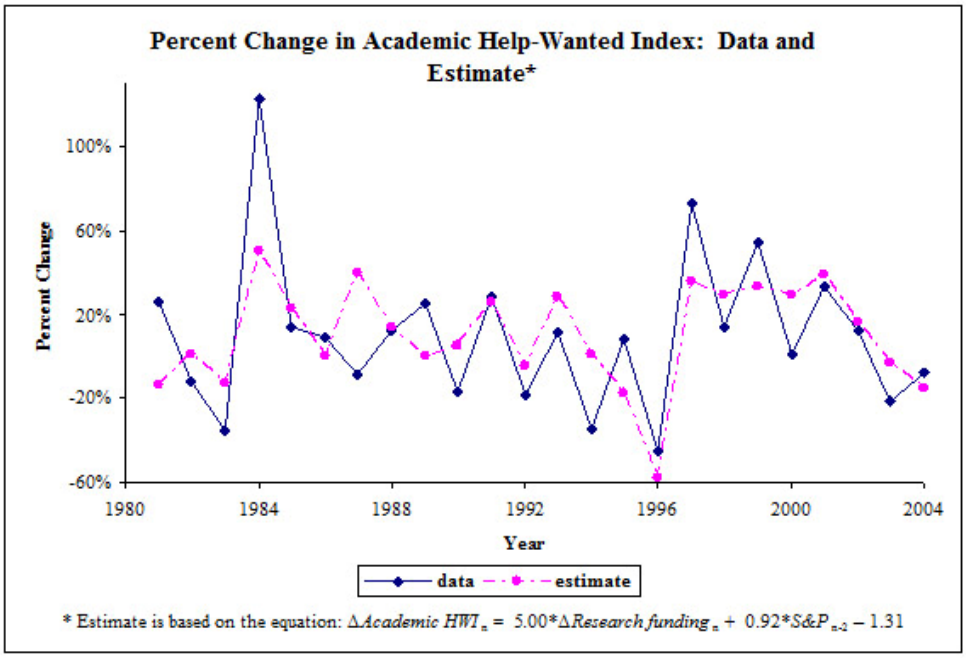

FIGURE 5

The data curve represents the year-to-year percentage changes in the academic help wanted index (HWI) from 1981 to 2004. The estimate curve represents an estimate of the data curve that was based on national research expenditure and stock market gains using the formula: $\Delta Academic\ HWI_n = 5.00*\Delta Research\ funding_n + 0.92*S\&P_{n-2} - 1.31$.

TABLE 3. MULTIPLE REGRESSION EQUATIONS RELATING HWI DATA TO MACROECONOMIC AND OPHTHALMOLOGIC VARIABLES

	EQUATIONS	*P VALUE*	R2
1	$\Delta Academic\ HWI_n = 5.00*\Delta Research\ funding_n + 0.92*\ S\&P_{n-2} - 1.31$	.00191	0.397
2	$\Delta Private\ practice\ HWI_n = 4.63*\Delta GDP_n + 1.04*\Delta Discretionary\ expense_n - 0.64$	<.001	0.444
3	$\Delta Radiology\ HWI_n = -9.10*\Delta CMS_n + 5.54*\Delta Durable\ equipment_{n-3} + 0.54$	.00175	0.663
4	$\Delta Offered\ fellowship_n = 0.11*\Delta Private\ specialist\ HWI_{n-1} + 0.0092.$	.0456	0.712
5	$\Delta Fellowship\ applicants_n = 0.30*\Delta Private\ specialist\ HWI_{n-1} + 0.013$	.0198	0.832
6	$\Delta Residency\ applicants_n = 0.12*\Delta Private\ practice\ HWI_{n-2} - 0.11\Delta Academic\ HWI_{n-2}. - 0.0010$	.0128	0.630
7	$\Delta Median\ academic\ compensation_n = 0.13*\Delta HWI_n + 0.0085$	.0226	0.817
8	$\Delta Mean\ academic\ base\ compensation_n = 0.24*\Delta Academic\ HWI_{n-1} + 0.021$	.0351	0.757
9	$\Delta Mean\ retina\ compensation_n = 0.058*\Delta Academic\ retina\ HWI_n + 0.018$	.0418	0.447
10	$\Delta Median\ academic\ retina\ compensation_n = 0.15*\Delta\ Academic\ retina\ HWI_{n-2} - 0.070$	.0401	0.735

CMS, Centers for Medicare and Medicaid Services; GDP, gross domestic product; HWI, help wanted index; S&P, Standard and Poor's 500 stock market index.

Analysis of published radiology HWI data yielded similar results.[40-45] A significant decrease in demand for radiologists was observed when recession demand was compared to demand 1 year after the recession (Recession 1, 94.8%, $P = .0097$, Recession 2, 88.4%, $P = .022$). A comparison of recession demand to demand 2 years later showed further decreases (Recession 1, 80.4%, $P = .035$, Recession 2, 78.0%, P = .0043). A comparison of recession demand to demand 3 years later showed an even further decrease in demand (Recession 1, 37.8%, $P < .001$, Recession 2, 64.7%, $P < .001$).

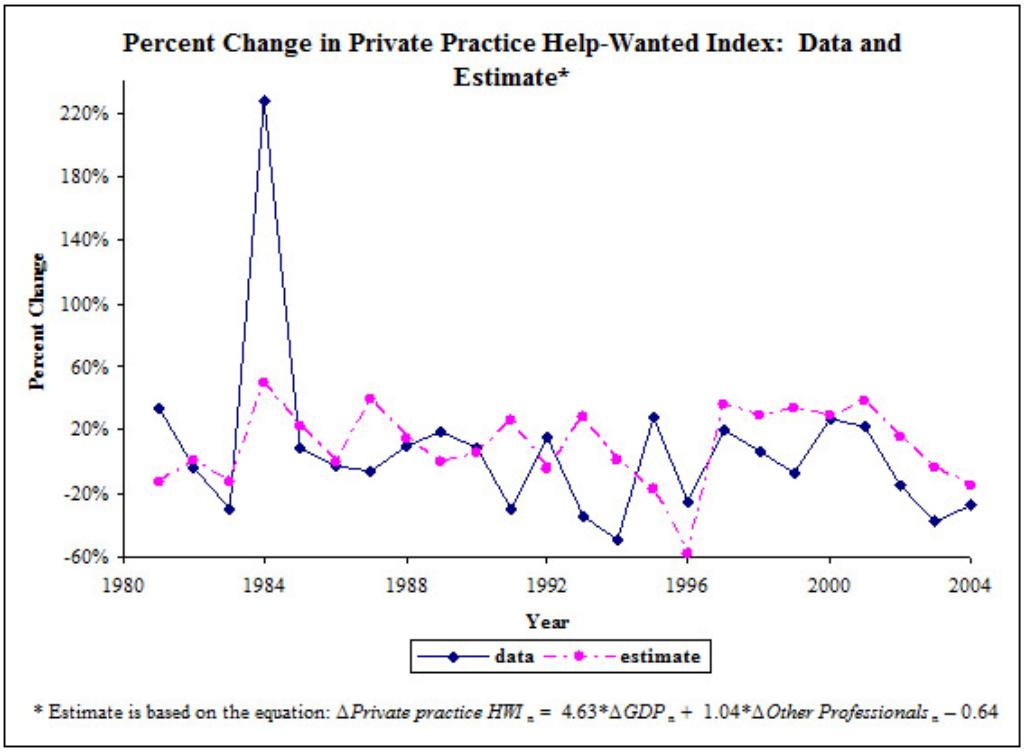

FIGURE 6

The data curve represents the year-to-year percentage changes in the private practice help wanted index (HWI) from 1981 to 2004. The estimate curve represents an estimate of the data curve that was based on national research expenditure and stock market gains using the formula: $\Delta Private\ practice\ HWI_n = 4.63*\Delta GDP_n + 1.04*\Delta Discretionary\ expense_n - 0.64$.

RESPONSIVENESS OF OPHTHALMIC COMMUNITY TO MARKETPLACE DEMAND

Training Programs and Applicants

The number of offered fellowship positions was significantly correlated to the demand for private practice ophthalmologists (Table 3, Equation 4). The number of applicants to fellowship programs was correlated to the demand for private practice subspecialists during the previous year (Table 3, Equation 5). Analysis of data from 1995 through 2005 demonstrated that applications to residency programs were positively correlated with the demand for private practice ophthalmologists 2 years previously and negatively correlated with the demand for academic ophthalmologist 2 years previously (Table 3, Equation 6)

Physician Compensation

The median compensation of academic ophthalmologists was significantly correlated to the demand for ophthalmologists (Table 3, Equation 7). However, the mean compensation for retina specialists was correlated to the demand for academic retina specialists (Table 3, Equation 9).

DISCUSSION

The most significant limitation of the HWI developed in this thesis is that it does not capture information about jobs that are not advertised in *Ophthalmology*, *American Journal of Ophthalmology*, and *Archives of Ophthalmology*. If ophthalmology practices increasingly shift their advertising away from journal advertising and toward other vehicles, such as informal networks, headhunter firms, or online placement services, the HWI will become less representative of the demand for ophthalmologists. Given general contemporary trends toward increased Internet utilization, future studies should attempt to incorporate Internet-based advertisements into the HWI. Since online ads for ophthalmologists have evolved and become popular in recent years, a long-run database (ie, 20 years or more) of online ads is not available at this time.

A second limitation of HWIs is that they are a leading indicator of the peaks in the market and a leading indicator of the troughs in the market. One study noted that the HWI peaks and troughs occurred within 3 to 5 months of the actual employment cycle extremes.[53] The distortion of the HWI at the extremes of the labor market cycle is a result of employers aggressively advertising when

competition for employees is perceived to be high and underadvertising when competition is perceived to be low. Therefore, in the absence of a statistical correction to the data, care must be taken in interpreting the HWI at the extremes of the labor market cycle.

A final limitation of HWIs is that they are descriptive, not prescriptive. For example, a HWI can indicate that the demand for ophthalmologists has decreased, but as a stand-alone tool, the HWI does not reveal the reasons for decrease in demand. As a result, the HWI must be carefully interpreted within the context of the market.

OPHTHALMOLOGY JOB MARKET AND RECESSION

Overall, the data presented in this thesis supports the contention that the ophthalmology profession is not "recession-proof."[11] National research expenditure, stock market gains, GDP, and discretionary health care expenditure have been positively correlated with demand for ophthalmologists. These factors tend to decline with economic recessions. Analysis of demand during and after recessions showed that the demand for ophthalmologists drops off significantly in the second and third years after economic downturn. When this observation is paired with correlations of the HWI data with the various macroeconomic variables, these data imply that the aggregate societal demand for the services of ophthalmologists is dependent on the ability of the society to purchase these services. The demand for academic ophthalmologists was correlated to both national research expenditure and the stock market gains. The correlation with national research expenditure is plausible if one considers that the National Institutes of Health (NIH) partially funds academic medical centers, faculty and staff salaries, research expenses, as well as research-related capital improvements.[54,55] The dependence of national research funding on the general economy can be seen in the reduction of the inflation-adjusted NIH budget following the 9/11 attacks, the wars in Afghanistan and Iraq, and Hurricane Katrina.[55]

The contention that the economy affects the entire medical community may be supported by the finding that in the radiology job market the demand fell significantly in all 3 years after a recession. However, radiology appears to have different underlying economic drivers. Unlike ophthalmology, the demand for radiologists is negatively correlated to CMS expenditure and positively correlated to durable goods expenditure. This implies that as Medicaid and Medicare spend more money, they may clamp down on radiology reimbursements, reducing the demand for radiologists. Furthermore, increased expense on durable equipment, such as MRI machines, tends to affect the demand for radiologists. Despite the fact that the specific economic factors that determine demand may vary between various medical specialties, demand tends to decline following economic downturn.

The specific relationship between demand for ophthalmologists, demand for optometrists, and the economy in general is not possible to discern from the content of this present study. A compelling hypothesis can be generated by extending the work of Cooper and associates.[56] Economists describe goods that are demanded less as income levels rise as inferior goods.[57] Cooper and associates[56] noted that as personal incomes increased, US citizens tended to substitute less expensive physician generalists with more expensive physician specialists. If a similar relationship exists between optometrists and ophthalmologists, one might speculate that as the economy worsened, the demand for ophthalmologists would decrease and that for optometrists would increase, and furthermore as the economy improved the opposite would occur. This analysis would involve HWI analysis of optometry positions, which is beyond the scope of current study.

SUBSPECIALTY TRENDS

According to the HWI, there has been a trend toward subspecialists. Growing demand for specialists suggests that fellowship training might become increasingly necessary to secure employment as an ophthalmologist. As fellowship training becomes more important, increased enrollment in fellowship programs and/or increased competition for fellowship positions will be expected (this may be discernable from San Francisco Matching Program fellowship data). Trends in the number of offered fellowship positions and in the demand for private practice subspecialists suggest that the number of offered fellowship positions is positively correlated with the demand for private practice subspecialists. This correlation is summarized in Equation 4 ($\Delta Offered\ fellowship_{n} = 0.11*\Delta Private\ specialist\ HWI_{n-1} + 0.0092$).

ECONOMIC DETERMINANTS OF THE DEMAND FOR ACADEMIC OPHTHALMOLOGISTS

Trends in the demand for academic ophthalmologists, research funding, and the stock market suggest that the demand for academic ophthalmologists is positively correlated with both national research expenditure and the stock market gains. This relationship is summarized in Equation 1 ($\Delta Academic\ HWI_{n} = 5.00*\Delta Research\ funding_{n} + 0.92*\ S\&P_{n-2} - 1.31$). The correlation of the demand for academic ophthalmologists and research expenditure is logically consistent with the fact that research is an important part of the work that academic ophthalmologists conduct and the contention that more funds to conduct research, on average, will enable institutions to hire more faculty.

On the surface, the correlation of the demand for academic ophthalmologists with the stock market seems surprising; however, this apparent contradiction is easily resolved when one considers the sources of funds available to academic medical institutions. Academic medical institutions have several types of funding, which include reimbursements for hospital care, faculty practice income, student tuition, gifts, philanthropy, investment income, endowment income, grants, contracts, and government appropriations.[58,59] Many of these sources of income are influenced by the economy and the stock market, but the clearest impact of the stock market can be seen in educational endowments, private foundations, and corporations.[60]

A survey of general medicine departments revealed that 74% of institutions had endowments.[61] There is some historical evidence

indicating that educational endowments have grown significantly when the stock market has done well and that a portion of these gains have been used in part to increase both faculty size and the compensation.[62]

With respect to private foundation grants, there is evidence that total spending of US grant-making nonprofit organizations, such as the Howard Hughes Medical Institute, the Rockefeller Foundation, and the Bill and Melinda Gates Foundation, has mirrored changes in the stock market, as measured by the Dow Jones Industrial Average.[63] These foundations cut back spending when the stock market does poorly; for example, when the stock market downturn reduced the size of their endowments, the Howard Hughes Medical Institute announced a 10% ($100 million) cut in their support of research and the Rockefeller Foundation reported a 20% ($120 million) reduction in grants.[63-65] Since the portion of these grants used to fund scientific research has remained relatively constant over time, scientific grants from nonprofit foundations can be said to grossly track the stock market.

Since 1972, industry has funded 3.9% to 7.4% of all academic scientific research.[66] Industry may fund academic life sciences more heavily; for example, in 1994, industry funded 11.7% of academic life sciences research but only 6.8% of all academic scientific research. Industrial support of academic scientific research tends to be applied research, project-specific, and of limited duration, usually 2 years or less.[60,66-68] The limited nature of the financial relationship between industry and academia suggests that it can be easily severed. There is some evidence that companies do cut their research and development budgets when the stock market does poorly.[69] Overall, given the impact of the stock market on academic scientific research, it is plausible that the stock market could impact the demand for academic ophthalmologists. Concurrent analysis of demand and the aggregate size of the faculty of academic ophthalmology departments could determine if demand is driven by turnover or expansion of department sizes.

ECONOMIC DETERMINANTS OF THE DEMAND FOR PRIVATE PRACTICE OPHTHALMOLOGISTS

The trend for the demand for private practice ophthalmologists is positively correlated with both GDP growth and discretionary health care expenditure. This correlation in summarized in Equation 2 ($\Delta Private\ practice\ HWI_n = 4.63*\Delta GDP_n + 1.04*\Delta Discretionary\ expense_n - 0.64$). The correlation between the demand for private practice ophthalmologists and GDP growth is discussed by Cooper and Getzen,[70] who report that the economy is the major factor determining use of medical services and that levels of use are closely tied to real GDP. They also demonstrate that the number of active physicians in the United States between 1929 and 2000 has been linearly dependent on real GDP (generally a 1% increase in GDP results in a 0.75% increase in demand for physicians), but this relationship varies depending on the type of physician.[71] Other researchers[72,73] have confirmed this relationship. Holahan and Pohl[74] observe that periods of GDP growth have led to a favorable job market, increased employment, and increased employment-based health insurance, and that periods of reduced GDP growth are characterized by the reduced fortunes of companies, which leads to reduced employment, reduced rates of employer-based health insurance, and individual employees assuming the cost of health insurance. Therefore, the positive relationship between GDP growth and the demand for private practice ophthalmologists probably reflects both the increased number of patients who are insured and can afford ophthalmic care during periods of high GDP growth and the reduced number of patients who are insured and can afford ophthalmic care during periods of low or negative GDP growth.

The relationship between the demand for private practice ophthalmologists and discretionary health care expense is difficult to interpret directly because discretionary health care expense aggregates optometrist data with that of other nonphysician professionals. If the discretionary health care expense variable is merely tracking how much money the average patient can afford to spend on health care, the interpretation of the correlation becomes clearer: the discretionary health care expense variable, much like GDP, becomes a measure of the aggregate patients' ability to pay for health care. However, if the other professional services variable is tracking the aggregate spending by patients on optometrists, the implication is that because ophthalmologists and optometrists see the same type of patients, their incomes depend on the aggregate demand for ophthalmic care and are thus correlated. At an aggregate level this possible correlation between the incomes of ophthalmologists and optometrists may exist.

RESPONSIVENESS OF THE OPHTHALMIC COMMUNITY TO MARKETPLACE DEMAND

Trends in the number of fellowship positions and the demand for subspecialists suggest that the number of ophthalmology fellowship positions is positively correlated with the previous year's demand for subspecialists. This correlation is summarized in Equation 4 ($\Delta Offered\ fellowship_n = 0.11*\Delta Private\ specialist\ HWI_{n-1} + 0.0092$). The suggestion that the number of available fellowship positions responds to the most recent demand for the fellowship graduates is equivalent to the suggestion of a built-in check against the oversupply and undersupply of subspecialists, based on the best available information. Penne and Lemke[26] suggest that projections about the oversupply of oculoplastic surgeons did not materialize, in part because of the dynamic nature of the number of offered fellowship positions. There is some evidence from gastroenterology and neuroradiology that the number of filled fellowship positions may change in response to perception of demand for the trained fellows and, moreover, that the number of fellowship applicants also responds to these changes.[75,76]

Trends in the number of applicants to fellowship programs and the demand for private practice subspecialists suggest that the number of ophthalmology fellowship applicants is positively correlated with the previous year's demand for subspecialists. This correlation is summarized in Equation 5 (ΔFellowship applicantsn = 0.30*ΔPrivate specialist HWI_{n-1} + 0.013). Earlier, Gedde and coworkers[77] reported that the perception of a favorable job market was a statistically significant factor determining application to ophthalmology fellowship programs. The correlation between demand and fellowship applications suggests that ophthalmology fellowship applicants use market demand information from the previous year to make their decisions to apply, which is in essence the

best available information about the job market. Unfortunately, the source of the market demand information cannot be specified by HWI analysis.

Trends in the number of applicants to ophthalmology residency programs, the demand for private practice ophthalmologists, and the demand for academic ophthalmologists suggest that the number of residency applicants is positively correlated with the demand for private practice ophthalmologists. The correlation is summarized in Equation 6 ($\Delta Residency\ applicants_n = 0.12*\Delta Private\ practice\ HWI_{n-2} - 0.11\Delta Academic\ HWI_{n-2} - 0.0010$). In contrast to fellowship applicants, who react to demand information that is 1 year old, residency applicants seem to react to demand information that is 2 years old; this can be explained by the fact that fellowship applicants (mostly residents) have greater exposure to the ophthalmic community and thus more up-to-date information about the demand for ophthalmologists than residency applicants (mostly medical students). Interestingly, the trends summarized by Equation 6 suggest that there is an increase in the number of applicants to ophthalmology residency programs when there is greater demand for private practice ophthalmologists, but there is a decrease in the number of applicants when there is a shortage of academic ophthalmologists.

According to the literature, the completion and publication of research in medical school, structured medical student research programs, the desire to teach, the desire for intellectual stimulation, mentors, role models, and career guidance are factors that are positively correlated with the decision to pursue an academic career.[78-84] In recent years there has been a high demand for academic ophthalmologists (Figure 3), which may mean that the current faculty members are likely to be working harder and have less time to pursue their own research endeavors and to provide medical students with gratifying research experiences, effective mentorship, and positive career guidance. Therefore, it is possible that increased need for academic ophthalmologists places demands on the current ophthalmology faculty that reduces their availability to effectively recruit medical students into the field. Another possible explanation hinges on the "generational" trend that lifestyle priorities may be becoming more important in determining the career choices of medical students.[85-89] Given the increased demand for academic ophthalmologists, the current faculty works harder, making their apparent lifestyles seem less appealing to students that may consider lifestyle factors in their choice of residency. Another potential explanation is based on the trend toward increased medical student indebtedness[90-92] and the trend toward medical students considering their educational debts and income potential as factors in determining their career decisions.[85,90,93-96] It is possible that as a result of their increased debt burdens and the reduced earning potential of academic physicians vis-à-vis private practitioners,[52] medical students may become less interested in academic medicine. Furthermore, the correlation between research funding and the demand for academic ophthalmologists (Equation 1) suggests that increased research funding for ophthalmology may be a policy tool that could be used to recruit more academic ophthalmologists.

Trends in the compensation and marketplace demand for ophthalmologists suggest that compensation for ophthalmologists is correlated with the demand for ophthalmologists. These correlations are summarized in Equations 7 through 10. As expected, when demand is higher, salaries are higher, and when demand is lower, salaries are lower. It is important to note that salaries depend on both supply and demand.

Overall, HWIs may be a useful technique for assessing demand for ophthalmologists. HWI data was used not only to portray the cyclical nature of the demand for various types of ophthalmologist during the 26-year period from 1980 to 2006, but also to highlight trends toward high demand for academic ophthalmologists and the emergence of an increasingly specialized ophthalmology workforce. Analysis of the HWI data has revealed key macroeconomic variables that impact the demand for ophthalmologists. It was demonstrated that the demand for academic ophthalmologists is correlated with both national expenditure on research and gains in the stock market. The demand for private practice ophthalmologists was demonstrated to be correlated to national economic well-being, as measured by GDP growth, and gross out-of-pocket expenditure on nonphysician health care professionals. HWI data analysis was also able to highlight the fact that in the past two recessions the demand for ophthalmologists has declined 2 to 3 years after a recession. This was shown to be also true for radiologists and potentially for all physicians. If historical patterns remain constant, the demand for ophthalmologists may decline for a few years after the recent recession.

Analysis of HWI data has also enabled the assessment of the response of the ophthalmic community to changes in demand. The number of ophthalmology fellowship applicants in a given year was demonstrated to be correlated to the demand for specialists in the previous year. The number of fellowship positions in a given year was shown to be correlated to the demand for specialists during the previous year. Likewise, the number of applicants to ophthalmology residency programs in a given year was demonstrated to be positively correlated to the demand for private practice ophthalmologists 2 years earlier, and negatively correlated to the demand for academic ophthalmologists 2 years earlier. Furthermore, the compensation for ophthalmologists was demonstrated to be correlated to demand, with compensation increasing when demand was high and decreasing when demand was low. Since HWIs are useful tools for assessing the marketplace need for ophthalmologists, an ongoing HWI will provide timely information about the demand for physicians in a rapidly changing health care system.

CONCLUSIONS

National research expenditure, GDP, stock market gains, and discretionary health care expenditure have been associated with marketplace demand for ophthalmologists. These factors tend to decline with economic downturns. Analysis of HWI over a 26-year

period reveals that in the past, economic recessions have resulted in reduced demand for ophthalmologists 2 to 3 years after economic downturn.

The demand for academic ophthalmologists is correlated with national research expenditure and stock market gains, whereas the demand for private practice ophthalmologists depends on discretionary health care expenditure and the GDP. Long-term trends in HWI data reveal a growing demand for both academic ophthalmologists and subspecialists. The ophthalmic community appears to be responsive to changes in demand for its services.

ACKNOWLEDGMENTS

Funding/Support: This work is supported in part by the Leir Foundation, Newman's Own Foundation, and Research to Prevent Blindness, Inc.

Financial Disclosure: None.

Contribution of Authors: Both authors contributed to the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, and approval of the manuscript.

Conformity With Author Information: This study did not utilize protected health information or review individual health information.

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