The Costs and Returns to Medical Education

By Nicholas Roth* – UC Berkeley

Abstract:

By treating medical school tuition payments and the opportunity costs of foregone wages as investments in human capital, I calculate the internal rates of return and the net present values of those investments across a range of medical specialties. I calculate these values under two different sets of assumptions. I also use two different discount rates to calculate net present values. Radiation oncologists, radiologists, and orthopedic surgeons enjoy the greatest returns on their investments, while rheumatologists, general pediatricians, and endocrinologists experience the lowest returns. I also find physician median earnings to be very good predictors of net present values. It is not clear whether physicians experience increasing, decreasing, or steady returns to scale for investments in additional years of residency training. An analysis of physicians who sub-specialize may help to answer this question.

*Special thanks to Professor Ron Lee, Harrison Dekker at the UC Berkeley Data Lab, the Research and Data Department at AAMC (in particular Program Specialist Lauren Johnson), and especially to my father Robert J. Roth, M.D. for his invaluable insight and assistance.

Introduction

Health care policy in the United States continues to divide and provoke us. With the passage of the Patient Protection and Affordable Care Act on March 23, 2010, President Obama enacted massive social legislation to dramatically change the health care market. By 2019, it is projected that the percentage of U.S. citizens possessing health insurance will increase by ten to 95% in total.[i] It seems logical to think that we may need more doctors to accompany this anticipated rise in health care demand. Expanding the health care labor supply, however, does not seem to be an inexpensive, quick, or easy process. There are many things to consider when we think about trying to increase the supply of doctors.

In making sense of the health care labor market supply, it is crucial to understand the costs and returns on investments that we gain from training our doctors. Doctors must earn enough revenue to justify the expenses of medical school. They must also produce at a high enough efficiency to justify the investments that our government makes on behalf of medical students and residents. We need to understand the components of medical education costs and funding if we are to gauge the efficiency of our health care labor market.

In this paper, I seek to calculate the return on investment to medical school for different specialists. I use the models developed by Fein and Weber as well as Richard Scheffler to calculate the cost of medical training for aspiring physicians. I update these models for 2009 data and I calculate the rate of return for all specialties. I also calculate the net present value of investments in medical education to financially evaluate different medical specialties.

Literature Review

A great deal of literature already exists that discusses the nature of the physician labor supply. It will be useful to review and summarize the findings of these existing studies before continuing on.

In his seminal 1963 article, Kenneth Arrow discusses several aspects of the health care market that make it unique. He notes that an individual's demand for health care, unlike food and clothing, tends to be "irregular and unpredictable."[ii] He also observes that doctors, unlike most economic agents, cannot be motivated solely by financial considerations in administering care. Doctors have a moral consideration for their patients and treatments must be given based on the objective needs of the patient. Thirdly, Arrow points out the product uncertainty for patients; it is often hard to know the consequence of purchasing care from a particular doctor. Finally, Arrow notes that entry into the medical field is limited by licensing, but it is at the same time encouraged by the subsidies to medical education that medical students enjoy. These aspects of the health care market distinguish health services from other goods and services markets. We must treat the health care market as a special-case economic entity if we are to understand the economic forces at work in the health sector.[iii]

Richard Scheffler's *Is There a Doctor in the House?* is an important text that offers a historical evolution of the U.S. health care market.[iv] He analyzes many aspects of the changing health care market in the twentieth century. He notes that between 1900 and the mid-1960s, the U.S. suffered from a significant shortage of doctors. This spawned the government to increase medical school funding in 1963, and "by 1976 had resulted in the building of some forty new medical schools and the expansion of many older ones".[v] A landmark development in health care came after the passage of Medicare and Medicaid in 1965. These programs funded the education of medical residents and allowed the supply of doctors to increase. By 1980, many worried that an oversupply had resulted from government funding.

Scheffler notes that the rise of managed care organizations after 1983 dramatically changed the health labor market. Before this period, doctors had almost full autonomy over the prices they charged and the services they provided. Doctors could create "supplier-induced-demand"[vi] to supply more services and bring in more revenue than an efficient market equilibrium might otherwise allow. A managed care company enrolls members and creates contracts between its members and doctors and/or hospitals to provide services to members when needed. Managed care helped force doctors to "swallow the cost of patient care"[vii] and it created a more dynamic market between doctors and patients. Managed care appears to have reduced aggregate health care costs without reducing the level of care. It also reduced physicians' average wages and it took some autonomy away from physicians since they now had to gain permission from managed care organizations to perform procedures on patients enrolled in a managed care program. Managed care started its rise in prominence around 1983, and by 2000 it had claimed 30 percent of the health care market. That number has since declined to about 25 percent in 2008.

The nature and composition of the medical labor supply has also been affected by managed care and other factors. The rise of managed care saw the real incomes of primary care doctors rise as the incomes of specialists declined. By 2001, however, the demand for specialty training equaled that of primary care training, and since then the income and training demand for primary care has declined. Scheffler notes that doctors seemed to be decreasing their geographic distribution between 1983 and 1993, but their distribution improves between 1993 and 2000. He also finds a racial maldistribution. Blacks and Hispanics find themselves underrepresented in the physician population while Whites and Asians find themselves overrepresented.

A final point regards the increasing commonality of nurse practitioners and physician's assistants in the doctor's office. These occupations started in the mid-1960s and have increased tremendously in popularity over the last few decades. Scheffler notes that assistants can do about 70 percent of the work of a typical doctor, and when added to a practice they greatly increase a doctor's productivity. They also decrease cost since they are paid less than a typical doctor and it costs society much less to train an assistant than it does to train a doctor.

In recent decades researchers have discovered other important trends in the composition of the medical labor force. As of 2004, researchers found that the number of pediatric subspecialty fellows increased by 55.7 percent since 1995. They notice an increase in overall subspecialty training and a leveling off of primary care specialties since 2004. They anticipate a primary care workforce characterized by more women, more international doctors, and more graduates of osteopathic medical schools.[viii]

It must be noted that factors such as the ethnicity or race of doctors may have effects on earning patterns and earning potential. The paper "Does the Market Value Racial and Ethnic Concordance in Physician-Patient Relationships?" by Brown, Scheffler, Tom, and Schulman examines this factor. The authors start by constructing a variable "ALREC," defined as the percentage of doctors of a given race less the percentage of the population of the ethnicity. They investigate whether this variable correlates with more or less revenue for physicians for a given area. They find that Hispanics on average have a negative ALREC due to the low number of Hispanic in the medical field. Asians have a positive ALREC on average for the opposite reason. They find that both ethnicities tend to earn more when ALREC is negative, resulting in a 5.6 percent earnings-per-hour premium for Hispanics and a 4 percent earnings-per-hour discount for Asians.[ix] Other studies find that patients report the highest levels of satisfaction when racial concordance occurs.[x] Given that racial matching is most affected by the choice of location that a physician can independently select,[xi] it is likely that racial concordance is an important factor for a doctor's earning potential. These concordance factors should be kept in mind for researchers considering the return to investment for medical school for different races.

Other researchers found that the market for residents tends to respond to economic forces. After Congress passed the 1997 Balanced Budget Act, which capped government payments to hospitals for residents, hospitals added over 4,000 more residents than the government would support. This suggests that market forces are at work as hospitals try to hire residents until the marginal value of an additional resident is zero. It also suggests that hospitals profit from additional residents long after the point when our government stops funding resident education.[xii]

Jones and Korn investigate the costs of medical school in their article "On the Cost of Educating a Medical Student." The authors make an important distinction between instructional costs and total education resource costs. They define instructional costs to be those costs "related directly to the teaching program and its support."[xiii] These costs include faculty time spent teaching and preparing for teaching as well as programs such as the office of admissions, student affairs, etc. Total education costs include instructional costs plus the costs of research, scholarly activities, and patient care that instructors typically engage in. The authors find that most previous studies estimate an instructional cost between $40,000 and $50,000 per-student per-year in 1996 dollars. They document a greater variation in total education costs, with four of the six estimates they present falling between a range of $72,000 and $93,000 per-student per-year in 1996 dollars. It should be noted that total education costs are more controversial because they include costs that often receive alternate sources of support. The vast majority of costs come from the clinical years of medical education, and the authors predict that new strategies such as small-group learning will do little to alleviate the major costs of medical school.[xiv]

The returns to subspecialty training seem to be dependent on the subspecialty. A 1991 study found that gastroenterologists enjoyed an extremely large return to scale for their additional training while rheumatologists experienced a negative return. This suggests that procedure-based medicine appears to be more financially attractive than cognitive-based specialties.[xv]

Attempts to estimate the rate of return for medical students are numerous within medical economics literature. Sloan estimated a rate of return to training of 18.2% in 1966, which increased by 1.6% since his 1962 estimate.[xvi] Sloan adjusted physician's incomes for inflation but he used nominal interest rates, so he may have underestimated his returns.[xvii] Feldman and Scheffler offer a 22% estimated return to training for medical school in 1970.[xviii] They use estimates of student expenses less estimates of scholarships. They also assume that all doctors both live to age 65 and retire at age 65. Another estimate by Fein and Weber finds the rate of return to be 15% in 1966.[xix] This assumes no military service or real growth in earnings for the comparative group of white male graduates. These estimates and their corresponding methodologies will be very useful for my paper as I try to estimate the rates of return to training and the net present values for investments in medical education in 2009.

Methodology

I will carry out my analysis in several stages. I will first investigate the costs of gaining a medical education. This will include the costs of medical school, graduate medical education, and the costs of foregone wages in the period of schooling for medical students. I will then determine post-tax annual wage streams for different specialties that take into account wage growth rates. Finally, I will use these cost and revenue streams to calculate the internal rate of return and the net present value of an investment in medical school across different specialties. I will carry out this analysis twice under different sets of assumptions regarding salary growth rates, student financial aid, and student debt payments.

In investigating the costs of medical school, I will only include instructional costs and exclude the costs of scholarly activities and patient care. Such costs apply only indirectly to student education and their exclusion will make my estimates more conservative. In *Is There A Doctor In The House?*, Scheffler averages across three sources to estimate a per-student annual instructional cost of $73,807. This translates to an instructional cost of $73,544.41 in 2009 dollars.[xx]

Tuitions and fees cover a portion of a medical school's instructional costs. To estimate medical school tuitions I used reports published by the American Academy of Medical Colleges (AAMC). They publish data on tuitions that include student fees and health insurance costs for residents and non-residents of all U.S. accredited public and private medical schools. Since medical schools tend to charge differently depending on one's in-state residency status, I took a weighted average of tuitions for each school based on the proportion of in-state and out-of-state students that enrolled in a particular school in 2010.[xxi] By using these numbers, I assume that the proportions of in-state and out-of-state enrollees remain fairly stable over time. I also assume that all medical schools have a roughly equal incoming class size. I find the combined average of tuitions and fees of all medical schools to be $36,369.68. It should be noted that this number does not include expenses for food or housing. AAMC states that tuitions for public schools increased by 7.1% for residents and 6.3% for non-residents between the 2009-2010 and 2010-2011. Private schools saw an increase of 4% for residents and a 3.6% increase for non-residents.[xxii] When I adjust for these numbers, I find an average tuition of $33,586.77 for students attending medical school in 2009. Revenue from student tuitions makes up about 45.67% of the necessary funding for medical schools.

In order to accurately assess costs, we must also include the opportunity costs of foregone wages that one incurs by attending medical school. I will consider the opportunity cost as the average starting salary of a class of 2009 graduate. One estimate finds this number to be $49,353.[xxiii] This equates to $37,014.75 after taxes for a single individual filing in the 2009 fiscal year. By age 24, this wage increases to $38,865.49 if we assume an annual wage growth rate of 5%.

We now know enough information to assess the costs for a year of medical school. It costs society $112,409.90 to educate a first year medical student. Students incur a cost of $72,452.26 (64.45% of the total cost) via tuition and foregone wages. I assume that the wages of a college graduate increase by 5% annually, which will increase the opportunity cost of foregone wages as medical students continue through their education.

Residency/Internship Costs

In additional to medical school, future doctors must undergo graduate medical education. The length of internships, residencies, and fellowships all depend on the desired specialty of the future doctor. Table A below presents a list of specialties and the number of years of internship and residency that are required for these specialists to be board certified. I obtained this information from board certification websites, FREIDA online, and various other sources. Subspecialties also exist for many of the specialties listed in the table. Subspecialty training usually involves a post-residency fellowship that can last from one to three years. It should be noted that this chart is not exhaustive and it excludes professions related to the medical field, such as dentists and veterinarians.

Entering into a residency involves both earning a wage and foregoing an opportunity cost. Since a medical school graduate with one year of experience can work in an emergency room, we can use an E.R. doctor's salary as an implied opportunity cost.[xxiv]

Table A: Years of Training Required for Medical Specialists

Specialty	Internship	Residency + Extra Training/Fellowships
Immunology		4
Anesthesiology	1	7
Invasive Cardiology		7-8
Cardiology (Non-Inv.)		6
Dermatology	1	3
Emergency Medicine		1+
Endocrinology		6
Family Practice		3
Gastroenterology		5-6
Hematology/Oncology		4-5
Internal Medicine		3
Nephrology		5-6
Neurology		4-6
OB/GYN		4
Ophthalmology		4+
Orthopedic Surgery		5
Otolaryngology		5
Pathology		4
Pediatrics		4+
Physiatry		4
Podiatry		3
Psychiatry		4
Pulmonology		5
Radiation Oncology	1	4
Radiology	1	4-6
Rheumatology		5-6
Surgery		8-10
Urgent Care		3-4
Urology		5-7

I assume that an emergency room physician with one year of experience earns at the 25th percentile, which Medical Group Management Association (MGMA) reports to be $225,028. This equates to $150,768.76 after taxes for both single individuals and married couples filing jointly. I assume that this salary will increase by 5% annually. We can consider a recent college graduate's median post-tax salary of $37,014.75 as the opportunity cost for a first-year resident. An emergency-room physician's salary stream will serve as the opportunity cost for residents after one year of residency.

The AAMC publishes reports that detail resident stipends nationwide. I used their Autumn 2009 report to estimate annual resident stipends based on year of residency.[xxv] While residency programs pay different salaries depending on location, specialty, and other factors, the variation among salaries appears small and not worth exploiting. Table B presents the earnings, opportunity costs, and net costs associated with up to 8 years in graduate medical training.

Table B: Costs of Residency Training

Year in Residency	Expected Age	Median Salary Earned	Post-Tax Income	Yearly Op. Cost	Net Annual Cost
1	29	$46,717	$35,037.75	$37,014.75	-$1977.00
2	30	$48,406	$36,304.50	$150,768.76	$114,464.26
3	31	$50,406	$37,804.50	$158,307.20	$120,502.70
4	32	$52,599	$39,449.25	$166,222.56	$126,773.31
5	33	$54,689	$41,016.75	$174,533.69	$133,516.94
6	34	$57,000	$42,750.00	$183,260.37	$140,510.37
7	35	$58,909	$44,181.75	$192,423.39	$148,241.64
8	36	$61,059	$45,794.25	$202,044.56	$156,250.31

Physician Earnings, NPV, and Rate of Return

Table C presents the median salaries and standard deviations for physicians of selected specialties. I determined post-tax salaries by assuming the 2009 tax rates for married individuals filing jointly. All salary data comes from the Medical Group Management Association's Physician Compensation and Production Survey. I used their printed 2010 report based on 2009 data. The report surveyed almost 58,000 physician and non-physician providers in over 2300 medical organizations. It lists salary data for 149 identified specialties broken down by type of organization, location, and numerous other factors.

We now have enough data to make a first estimate of the rate of return to medical education as well as a net present value calculation. To estimate this rate, I will solve the equation below, as presented by Fein and Weber in *Financing Medical Education*, for r :

$$\sum_{i=1}^{n} \frac{R_i - C_i}{(1+r)^i} = 0$$

R_i represents the revenues earned in year i, C_i represents the costs incurred in year i, and r represents the internal rate of return. I assume a retirement age of 65, so n = = 43 since the first term in the series represents the revenue-cost stream of a 22 year-old. Solving for r equates the present value of a physician's lifetime cost stream

Table C: Physician Median Salaries

Specialty	Median Salary	Standard Deviation	Tax Rate: Married-Jointly Filing	Median Post-Tax Salary
Allergy/Immunology	$267,735	141606	0.33	$179,382.45
Anesthesiology	$423,657	128983	0.35	$275,377.05
Cardiology-Interventional	$497,500	220555	0.35	$323,375.00
Cardiology	$421,377	187285	0.35	$273,895.05
Dermatology	$385,088	207895	0.35	$250,307.20
Emergency Medicine	$262,475	90749	0.33	$175,858.25
Endocrinology/Metabolism	$206,340	87554	0.28	$148,564.80
Family Practice (No OB)	$183,999	80445	0.28	$132,479.28
Gastroenterology	$465,509	236292	0.35	$302,580.85
Hematology/Oncology	$367,564	225896	0.33	$246,267.88
Internal Medicine	$197,080	83982	0.28	$141,897.60
Nephrology	$290,986	152799	0.33	$194,960.62
Neurology	$237,918	130989	0.33	$159,405.06
OB/GYN	$392,189	152716	0.35	$254,922.85
Ophthalmology	$338,208	190441	0.33	$226,599.36
Orthopedic Surgery	$473,770	272148	0.35	$307,950.50
Otolaryngology	$370,534	219072	0.33	$248,257.78
Pathology (A and C)	$347,958	185073	0.33	$233,131.86
Pediatrics	$192,000	84320	0.28	$138,240.00
Physiatry	$241,115	140301	0.33	$161,547.05
Podiatry	$196,180	196180	0.28	$141,249.60
Psychiatry	$191,267	81120	0.28	$137,712.24
Pulmonology	$288,279	136430	0.33	$193,146.93
Radiation Oncology	$518,991	193364	0.35	$337,344.15
Radiology (Non-Inv.)	$468,594	167411	0.35	$304,586.10
Rheumatology	$226,206	104919	0.33	$151,558.02
General Surgery	$336,084	149482	0.33	$225,176.28
Urgent Care	$205,385	93154	0.28	$147,877.20
Urology	$390,687	198522	0.35	$253,946.55

with the present value of a physician's lifetime earnings. This will give us the internal rate of return for an aspiring physician graduating with an undergraduate degree in 2009. I will then calculate the net present value of an investment in medical school assuming the point-of-view of a 22-year old college graduate in base-year 2009. The net present value can be determined from the following equation:

$$\sum_{i=1}^{43} \frac{R_i - C_i}{(1+r)^i} = NPV$$

I will calculate the NPV using discount rates of r=5% and r=10%.

It is important to understand the implications of IRR and NPV as they are calculated. IRR measures the efficiency of an investment. One may use IRR to assess the desirability of several investments that require an identical initial cost.[xxvi] Using IRR to compare investments with different initial costs, however, can be misleading. The different medical specialties I will be analyzing do not share the same initial costs unless they require the same amount of post-graduate training. The net present value offers us an unbiased account of investments in medical specialties. The net present value terms will allow us to see the expected values of medical investments in 2009 dollars. These terms will also allow us to compare different specialties to each other on a level playing ground.

Results

Table D contains the results of my internal rate of return and net present value calculations. Once a physician started earning a salary, I subtracted the opportunity cost of foregone wages from that salary. I used the average wage of a same-aged person with a college degree to calculate the opportunity cost. I assumed a college-graduate post-tax starting wage of $37,014 in 2009 and I assumed an annual 5% growth rate for that starting wage. This growth rate includes an assumed 3% inflation rate and an assumed 2% age-related real growth rate. To produce a physician's revenue stream, I assumed a starting salary equal to the median wage as listed by MGMA. I assumed a 3% annual growth rate from inflation starting in 2009, but no real age-related growth rate for physicians. In addition, I assumed no costs or revenues in the first two periods. These periods corresponds to years 2009 and 2010 when a potential medical student would be 22 and 23, respectively. I also assumed that resident stipends, medical school tuitions, taxation rates, and average starting salaries for college graduates remain unchanged throughout the time series. Finally, I assumed that no physician took any time off in between medical school, residency, and the beginning of professional practice.

The figures shown in Table D may be overestimates for several reasons. They assume no interest payments on student loans. Including these numbers would decrease both the net present values and rates of return, although these losses could be somewhat offset if we include the average amount of aid awarded to students. The estimates also assume that a physician earns the median salary throughout his or her lifetime before we take inflation into account. This assumption can be

Table D: IRR and NPV of Various Specialties*

Specialty	NPV; r=5%	NPV; r=10%	IRR	Years of Grad. Education Assumed	Median Annual Earnings (Post-Tax)
Radiation Oncology	$4,795,970.56	$1,411,241.33	23.4%	5	$337,344.15
Radiology (Non-Inv.)	$4,470,770.01	$1,450,090.60	35.3%	6	$304,586.10
Orthopedic Surgery	$4,226,224.35	$1,218,517.21	22.2%	5	$307,950.50
Gastroenterology	$3,837,485.46	$1,012,668.57	19.5%	6	$302,580.85
Interv. Cardi.	$3,635,537.81	$809,967.19	16.6%	8	$323,375.00
OB/GYN	$3,449,286.38	$1,028,408.96	22.4%	4	$254,922.85
Dermatology	$3,356,122.59	$995,823.84	22.2%	4	$250,307.20
Cardiology	$3,286,550.60	$815,881.42	18.1%	6	$273,895.05
Otolaryngology	$3,069,181.91	$827,132.43	19.3%	5	$248,257.78
Hematology/Oncology	$3,030,611.07	$814,085.34	19.2%	5	$246,267.88
Pathology	$3,009,449.92	$874,571.00	21.1%	4	$233,131.86
Urology	$2,933,006.68	$716,698.52	17.5%	6	$253,946.55
Ophthalmology	$2,877,595.80	$828,453.48	20.7%	4	$226,599.36
Anesthesiology	$2,816,181.88	$558,862.45	15%	8	$275,377.05
Pulmonology	$2,000,951.27	$465,789.42	16.1%	5	$193,146.93
General Surgery	$1,959,222.38	$296,233.50	13%	8	$225,176.28
Immunology	$1,924,554.27	$495,116.03	17.4%	4	$179,382.45
Nephrology	$1,836,012.96	$357,732.33	14.3%	6	$194,960.62
Physiatry	$1,564,558.73	$369,203.37	15.8%	4	$161,547.05
Internal Medicine	$1,330,284.38	$337,287.65	16.4%	3	$141,897.60
Podiatry	$1,316,675.80	$332,364.84	16.3%	3	$141,249.60
Urgent Care	$1,288,642.01	$272,698.26	14.6%	4	$147,877.20
Psychiatry	$1,242,388.07	$305,491.73	15.9%	4	$137,712.24
Neurology	$1,174,766.69	$141,354.57	11.9%	6	$159,405.06
Family Practice	$1,132,491.21	$265,737.25	15.3%	3	$132,479.28
General Pediatrics	$1,094,121.62	$204,662.48	13.6%	4	$138,240.00
Rheumatology	$1,028,830.98	$93,600.44	11.3%	6	$151,558.02
Endocrinology	$973,164.42	$75,384.83	11.1%	6	$148,564.80

*Table sorted from highest to lowest NPV values (for r = 5%)

improved upon. It is well known that a physician's income grows over time because of increased experience as well as inflation.

Scheffler notes that a doctor's wage distribution rests on two factors: "the value added from work experience and the depreciation of a doctor's medical experience as new techniques replace those he or she learned in medical school."[xxvii] He goes on to state that physicians between forty-two and fifty-one earn 16% more on average than younger doctors. In addition, physicians between fifty-one and sixty-two make 1% more on average than those in the forty-two to fifty-one age bracket.[xxviii] It would seem that an accurate revenue stream should take these growth rates into account.

In Table E I recalculate the values found in Table D with several new assumptions. Firstly, I take student aid into account. In 2011, approximately 88.8% of professional degree students received some sort of aid. Of those students, the average aid awarded amounted to $27,500.[xxix] When weighted, the total aid for all students on average amounts to $24,420 annually. To incorporate this number, I subtract it from student tuition payments.

I also consider interest payments on student loans. Creditors offer many different types of loans to students, and this makes it very difficult to infer a general loan payment structure. For my purposes, I assume that a typical student accrues $100,000 in interest payments from loans for medical school. I assume that this student pays $5,000 in interest payments annually during the first three years out of medical school and $12,140 annually for an additional seven years.

Table E: IRR and NPV under new assumptions*

Specialty	NPV; r=5% (in dollars)	% Change in NPV From Previous Table	NPV; r=10% (in dollars)	IRR	Years of Grad. Edu. Assumed	Median Annual Earnings (Post-Tax)
Radiology-Non Inv.	4,301,284.34	-3.94	1,454,997.87	38.9%	6	304,586.10
Radiation Oncology	3,884,215.26	-23.47	1,174,969.87	23.4%	5	337,344.15
Orthopedic Surgery	3,432,448.10	-23.12	1,018,503.70	22.2%	5	307,950.50
OB/GYN	3,165,309.35	-8.971	986,424.22	23.7%	4	254,922.85
Gastroenterology	3,039,129.76	-26.26	824,607.32	19.4%	6	302,580.85
Dermatology	2,814,241.98	-19.25	861,402.98	22.5%	4	250,307.20
Interv. Cardiology	2,742,582.17	-32.55	618,964.75	16.3%	8	323,375.00
Hematology/Onc.	2,674,775.11	-14.26	756,089.52	20.0%	5	246,267.88
Cardiology	2,545,288.83	-29.12	626,938.91	17.5%	6	273,895.05
Otolaryngology	2,476,977.88	-23.90	687,583.75	19.3%	5	248,257.78
Urology	2,417,153.57	-21.34	615,119.70	17.6%	6	253,946.55
Pathology	2,379,780.39	-26.45	706,683.60	20.9%	4	233,131.86
Ophthalmology	2,317,505.29	-24.16	684,506.35	20.6%	4	226,599.36
Anesthesiology	2,263,428.92	-24.42	466,393.98	15%	8	275,377.05
Immunology	1,624,740.39	-18.45	437,800.64	17.7%	4	179,382.45
Pulmonology	1,596,370.70	-25.34	382,592.05	16%	5	193,146.93
Physiatry	1,584,174.67	1.23	423,354.48	17.5%	4	161,547.05
General Surgery	1,555,543.41	-25.95	240,990.87	12.9%	8	225,176.28
Psychiatry	1,367,594.87	9.15	390,270.34	18.3%	4	137,712.24
Internal Medicine	1,300,797.79	-2.26	365,812.76	17.9%	3	141,897.60
Nephrology	1,295,712.08	-41.69	237,407.32	13.6%	6	194,960.62
Podiatry	1,212,135.56	-8.624	333,349.30	17.4%	3	141,249.60
Neurology	1,145,951.56	-2.51	186,966.53	12.9%	6	159,405.06
Family Practice	1,127,405.78	-0.45	302,325.71	16.8%	3	132,479.28
Urgent Care	1,038,686.99	-24.06	229,096.77	14.6%	4	147,877.20
Rheumatology	957,454.53	-7.45	123,478.90	12%	6	151,558.02
General Pediatrics	924,561.29	-18.33	188,454.60	13.9%	4	138,240.00
Endocrinology	832,606.04	-16.88	81,428.72	11.4%	6	148,564.80
Endocrinology	832,606.04	-16.88	81,428.72	11.4%	6	148,564.80

*Table sorted from highest to lowest NPV values (r=5%)

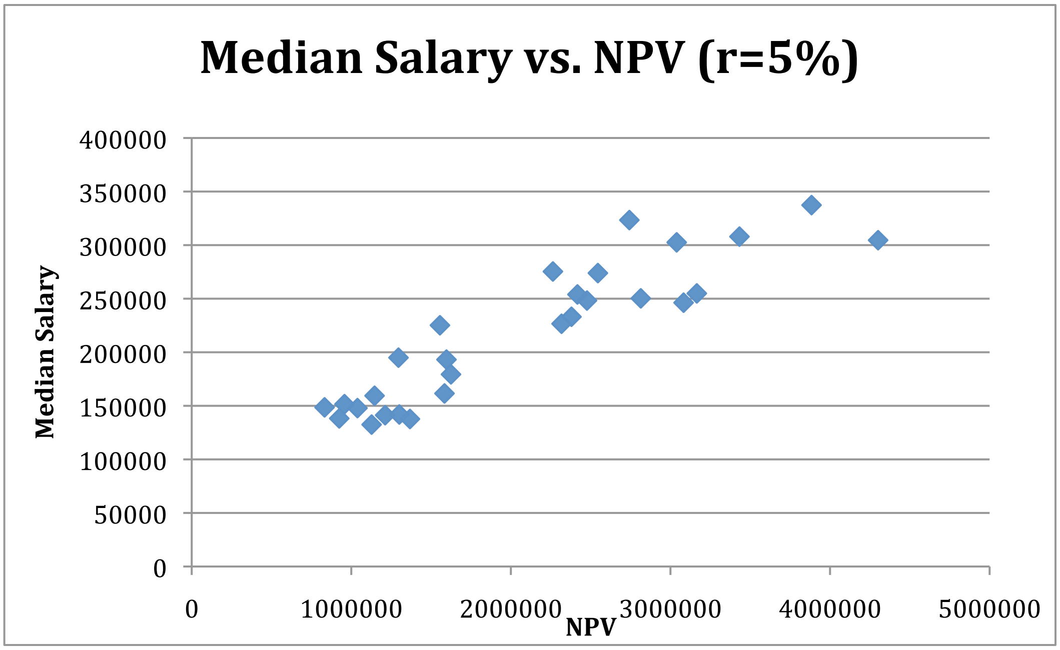
These sums do not include payments on the original principle; they only include interest payments. These assumptions are similar to a sample repayment schedule presented by AAMC. This repayment schedule assumes an initial Federal Stafford loan of $160,000 dollars with public service loan forgiveness with an assumed $100,000 starting salary after residency.[xxx] To keep my estimates conservative, I assume no debt forgiveness. To take these interest payments into account, I will add them to the opportunity cost of foregone wages for residents and physicians for the appropriate years.

In addition, Table E takes into account real growth rates for physicians. To do this, I assume that a starting physician will earn a salary at the 25th percentile of physicians in his or her specialty. I inflate the 25th percentile salary by 3% annually from 2009 until I reach the year at which the physician in question starts practicing. Once we reach that year, I assume a growth rate of 6% until the physician turns forty-two. After that age, I assume a one-time growth rate of 16% and then no growth rate until the physician turns fifty-two. After fifty-two, I assume a one-time growth rate of 1% and then no additional growth rate for the rest of the revenue stream.

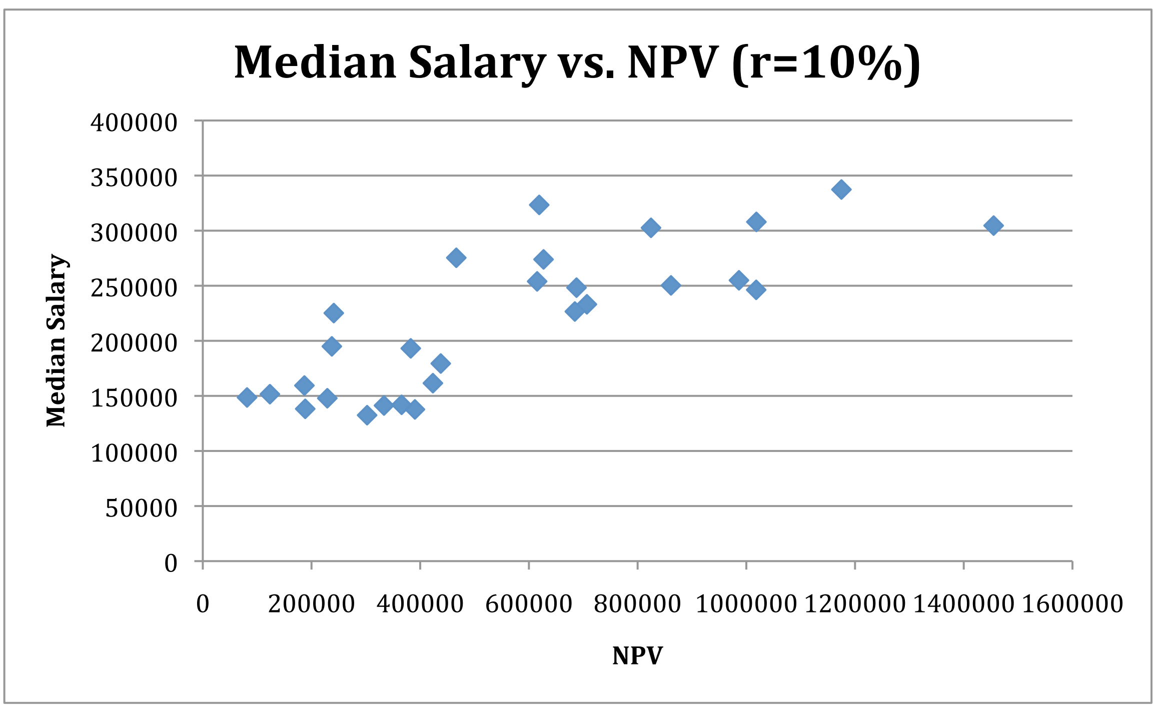
Interestingly, the net present values show a significant amount of variation under my new assumptions of debt load and changing salary growth. Many specialties saw a decrease of about 25% from my earlier calculations. The rates of return, however, remained fairly stable. It would seem that the interest payments weigh heavily on the net present values of medical education investments, although these values remain substantively positive.

Knowing the net present values of medical education investments will help us to analyze the predictive power of medical earnings on the worth of education investments. The two graphs below illustrate the relationships between median salaries in 2009 and the net present values I calculated with assumptions of student aid, interest payments, and different revenue streams. The relationships are very strong. With a discount rate of 5%, variations in earnings explain over 91% of the variation in net present values across specialties. With a discount rate of 10%, variations in earnings still manage to explain over 80% of the variation in net present values.

We can infer several trends from this information. These correlations seem to hint at increasing returns to scale for additional years of graduate medical education. Specifically, these correlations suggest that physicians receive increases in earnings that overcompensate for the opportunity costs of additional training. This assumes, of course, that additional years of residency and fellowship training result in higher earnings than lesser-trained physicians. The correlation between median earnings and the years of training necessary for the specialties I analyzed, however, is only .4588. While this correlation is significant, it reveals some inconsistencies between further training and earnings. If further training does not result in increased earnings to justify that training, then some physicians may find it profitable to avoid specialization. The link between longer training and higher earnings seems to be complicated, and a study of subspecialty earnings would be necessary to give a proper account of this relationship.



Correlation = .9124



Correlation = .8021

Conclusions

Medical education remains a very profitable investment. Even under conservative conditions, the lowest-earning physician still finds a net present value of over $81,000 on an investment in medical school with a 10% discount rate. Under a 5% discount rate, the highest earners I considered enjoy a net present value of over 4.3 million dollars on their investments under the same assumptions. The median earnings of different specialists tend to predict the net present values of medical school investments very well.

It should be noted that while I have not included subspecialties, we can make some guesses as to the net present values of these professions. Physicians can undergo fellowship training to sub-specialize in many of the fields considered in my analysis. Sub-specializing often leads to very high earnings. For example, while a general pediatrician earns a median salary of $192,000, a pediatrician specializing in cardiology earns a median salary of $322,506. Similarly, while a general surgeon earns a median salary of $336,084, a neurological surgeon earns a median salary of $600,525. Given the correlation between median salaries and net present values, it seems likely that at least some sub-specialty training fellowships will be highly profitable in the long run.

Of all the professions considered in my analysis, non-invasive radiologists enjoy the highest net present values and the second highest median earnings. Radiation oncologists and orthopedic surgeons trail in a close second and third, respectively. Endocrinologists see the lowest net present values of all specialties considered, followed by general pediatricians and rheumatologists.

Endocrinologists earn a higher median salary than general pediatricians, but they also undergo two more years of training. This suggests that endocrinologists receive negative returns to additional training when compared with general pediatricians.

I do not intend for these net present value and rate of return figures to incontrovertibly describe the financial gains of different specialties. I base my figures on many general assumptions. An increase in tax rates, a rise in average tuitions, a higher debt load, and a decision to take additional years off in-between graduation and medical school will all adversely affect both the net present values and rates of return on investments. Where you practice, how many hours a week you practice, racial concordance, and numerous other factors will also affect your long-run earnings. The net present values and rates of return described in this paper serve as baseline terms. An individual can use these figures and assume greater or lesser yields based on conditions specific to him or her.

Becoming a physician is, of course, a monumental decision. One should consider much more than financial incentives before deciding to pursue a career in medicine. The road to the medical community is long, personally demanding, and intellectually challenging. Evidence in this paper shows, however, that if you are lucky enough to gain acceptance to medical school, you will be rewarded significantly over the long run.

References

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[i] Leonhardt, David. "In Health Bill, Obama Attacks Wealth Inequality." *New York Times* 23 Mar. 2010, Online.

[ii] Arrow, Kenneth. "Uncertainty and the Welfare Economics of Medical Care." *American Economic Review*. 53.5 (1963): 948

[iii]Arrow, Kenneth. "Uncertainty and the Welfare Economics of Medical Care." *American Economic Review*. 53.5 (1963): 941-973.

[iv] Scheffler, Richard. *Is There a Doctor in the House?*. Stanfurd, CA: Stanford University Press, 2008.

[v] Ibid – pg. 11

[vi] Ibid – pg. 19

[vii] Ibid – pg. 21

[viii] Brotherton, S.E., S.I. Etzel, and P.H. Rickey. "U.S. Graduate Medical Education, 2004-2005: Trends in Primary Care Specialties." *Journal of the American Medical Association*. 249.9 (2005): 1075-1082.

[ix] Brown, Timothy, Richard Scheffler, Kevin Schulman, and Sarah Tom. "Does the Market Value Racial and Ethnic Concordance in Physician–Patient Relationships?." *Health Services Research*. 42.2 (2007): 706-726. Print.

[x] LaVeist, Thomas, and Amani Nuru-Jeter. "Is Doctor-Patient Race Concordance Associated with Greater Satisfaction with Care?." *Journal of Health and Social Behavior*. 43.3 (2002): 296-306; Tamyra Carroll, and LaVeist, Thomas. "Race of physician and satisfaction with care among African-American patients." *Journal of the National Medical Association*. 94.11 (2002): 937-943. Print.

[xi] Stinson, Martha, and Norman Thurston. "Racial Matching among African-American and Hispanic Physicians and Patients." *Journal of Human Resources*. 37.2 (2002): 410-428.

[xii] Adamache, W., J. Cromwell, and E.M. Drozd. "BBA impacts on hospital residents, finances, and Medicare subsidies." *Health Care Financing Review*. 28.1 (2006): 117-129.

[xiii] Jones, R.F., and D. Korn. "On the Cost of Educating a Medical Student." *Academic Medicine*. 72.3 (1997): 200-210.

[xiv] Ibid

[xv] Meenan, R.F., and M.J. Prashker. "Subspecialty Training: Is It Financially Worthwhile?." *Annals of Internal Medicine*. 115.9 (1991): 715-719.

[xvi] Sloan, Frank A. "Economic Models of Physician Supply." *Doctoral Dissertation, Harvard University*. (1968)

[xvii] Institute of Medicine (U.S.). Division of Health Sciences Policy, First. *Medical education and societal needs: a planning report for the health professions*. Washington, D.C.: National Academies, 1983. 228.

[xviii] Feldman, R., and R. Scheffler. "The Supply of Medical School Applicants and the Rate of Return to Training." *Quarterly Review of Economics and Business*. 82. (1978): 91-98.

[xix] Fein, Rashi, and Gerald Weber. *Financing Medical Education*. New York, New York: Carnegie Commission on Higher Education, 1971. 245-253.

[xx] I made this calculation using an online inflation calculator found at: http://146.142.4.24/cgi-bin/cpicalc.pl (last accessed April 26, 2010)

[xxi] Proportions calculated using two sources: Fischman, Josh, and First U.S. News and World Reports. *Ultimate Guide to Medical Schools*. 4th. Naperville, Il: Sourcebooks, 2010; http://www.medicalschoolfinder.com (last accessed April 26, 2011)

[xxii] https://services.aamc.org/tsfreports/select.cfm?year_of_study=2011 (last accessed May 4, 2011)

[xxiii] http://www.employmentwebsites.org/salary-offers-college-class-2009-are-flat (last accessed May 5, 2011)

[xxiv] Scheffler, Richard. *Is There a Doctor in the House?*. Stanford, CA: Stanford University Press, 2008. 203

[xxv] https://www.aamc.org/data/stipend (last accessed May 5, 2011)

[xxvi] Brigham, Eugene, and Michael Ehrhardt. *Financial Management: Theory and Practice*. 12th ed. Mason, OH: Thomson Higher Education, 2008.

[xxvii] Scheffler, Richard. *Is There a Doctor in the House?*. Stanford, CA: Stanford University Press, 2008. 210

[xxviii] Ibid

[xxix]http://www.educationplanner.org/education_planner/paying_article.asp?sponsor=2859&articleName=Paying_for_Graduate_School (last accessed May 7, 2011)

[xxx] https://www.aamc.org/download/152968/data/10debtfactcard.pdf (last accessed May 7, 2011)