The Net Present Value and Other Economic Implications of a Medical Career

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Abstract

College graduates' career choices are driven by a complex mixture of factors, one of which is economics. The author comments on the report by Marcu and colleagues in this issue, which focuses strictly on the economics of this decision. Specifically, Marcu and colleagues modeled career choices as long-term financial investments in human capital, which consists of the knowledge and clinical skills physicians gain in undergraduate and graduate medical education. They distill the numerous factors that shape the economics of career choice into a commonly used criterion for long-term financial investments of any kind—namely, the so-called net present value (NPV) of the investment. For them, that investment is the decision to pursue a medical career rather than the next best nonmedical, alternative career. This NPV calculation determines the increase or decrease in wealth, relative to that of the next best alternative career, that a college graduate is thought to experience as of the moment she or he enters medical school simply by choosing a medical career rather than the next best alternative. Marcu and colleagues use this human capital model to explore how different plans to finance a medical school education impact the NPV, all other parameters being equal. The author of this Commentary explains in layman's terms how the NPV is calculated and then raises a number of other issues concerning the economics of a medical career, including medical school tuition, residents' salaries, and investments in human capital as tax deductible.

Editor's Note: This is an Invited Commentary on Marcu MI, Kellermann AL, Hunter C, Curtis J, Rice C, Wilensky GR. Borrow or serve? An economic analysis of options for financing a medical school education. Acad Med. 2017;92:966–975.

A college graduate's decision to pursue a medical career rather than the next best nonmedical, alternative career (e.g., one in finance or the law) is best understood by interdisciplinary teams of psychologists, sociologists, and economists because that decision is so complex that it requires insights from a variety of academic perspectives.

Economists focus mainly on one ingredient, viewing the decision to pursue a medical career as just another long-term financial investment; in this case, it is an investment in human capital or the knowledge and clinical skills physicians gain in undergraduate and graduate medical education, rather than in buildings and machines. In their report included in this issue, Marcu and colleagues take this narrow view because they are interested mainly in exploring how different arrangements for financing a medical school education impact the economics of career choice decisions.[1]

Their report is the product of a prodigious amount of research and modeling, carefully and thoughtfully executed. Unfortunately, the authors' rendition of their work is dense and at times cryptic. Given the readership of *Academic Medicine*, my goal in this Commentary is to explain more intuitively how I believe the authors performed their calculations.

Calculating Net Present Values

To help readers understand how Marcu and colleagues completed their analysis, I created Table 1, which models the cash flow available to a college graduate who makes the decision to pursue a career in general internal medicine rather than the next best alternative (i.e., a nonmedical career). The numbers in the table lean as closely as possible to the modeling parameters chosen by Marcu and colleagues.

Column 1 indicates the time in years: $t = 1$ denotes the first year of medical school, with $t = 0$ denoting the beginning of that year and $t = 1$ the end. I assumed that the student's annual cash flow in a given year came in only at one point in time—namely, at the end of that year. This assumption is a methodological convenience commonly used in finance. Assuming more realistic continuous cash flow makes the analysis seem more complicated without noticeably altering the final results, especially at the low growth and interest rates used in this model.

Column 2 shows the projected annual cash flow assumed to be earned by the student if she or he chooses the next best alternative career. If the student chooses a medical career, she or he forgoes that income from the alternative occupation, hence the term the *opportunity cost* of a medical career. The forgone income from the alternative career can easily rank as the largest component of the cost of going to medical school, rather than the tuition charges. The magnitude of this opportunity cost depends heavily on the assumed initial income from the alternative career, when that initial income is earned, and how fast it will grow—all of which are educated guesses for long-term human capital investments.

Column 3 shows the assumed cash flow if the student chooses a medical career. It is negative during the medical school years

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Table 1

Economic Considerations Related to the Decision to Pursue a Medical Career Rather Than the Next Best Alternative Career, According to the Results of a 30-Year Net Present Value (NPV) Analysis of Pursuing a Career in General Internal Medicine

Year[a]	Cash flow from alternative career ($)	Cash flow from medical career ($)	10-year loan program ($)	Differential cash flow ($)[b]	Present value equivalent ($)[c]
1	80,000	(60,000)	43,015	(96,985)	(92,367)
2	80,800	(63,000)	43,015	(100,785)	(91,415)
3	81,608	(66,150)	52,574	(95,184)	(82,224)
4	82,424	(69,458)	52,574	(99,308)	(81,701)
5	83,248	51,218	(26,234)	(58,264)	(45,651)
6	84,081	54,291	(26,234)	(56,023)	(41,806)
7	84,922	57,549	(26,234)	(53,607)	(38,097)
8	85,771	178,500	(26,234)	66,495	45,007
9	86,629	183,855	(26,234)	70,992	45,762
10	87,495	189,371	(26,234)	75,642	46,438
11	88,370	195,052	(26,234)	80,448	47,036
12	89,253	200,903	(26,234)	85,416	47,563
13	90,146	206,930	(26,234)	90,550	48,021
14	91,047	213,138	(26,234)	95,857	48,414
15	91,958	219,532	0	127,575	61,366
16	92,878	226,118	0	133,241	61,039
17	93,806	232,902	0	139,096	60,687
18	94,744	239,889	0	145,145	60,311
19	95,692	247,086	0	151,394	59,912
20	96,649	254,498	0	157,850	59,492
21	97,615	262,133	0	164,518	59,053
22	98,591	269,997	0	171,406	58,595
23	99,577	278,097	0	178,520	58,121
24	100,573	286,440	0	185,867	57,631
25	101,579	295,033	0	193,455	57,128
26	102,595	303,884	0	201,290	56,611
27	103,621	313,001	0	209,380	56,082
28	104,657	322,391	0	217,734	55,543
29	105,703	332,063	0	226,359	54,993
30	106,760	342,024	0	235,264	54,435
SUM	2,782,791	5,697,291	(71,162)	2,843,337	785,978
NPV[d]				785,978	

Note: Parentheses indicate a payment due; all other values are income.
[a]Year indicates the time in years, where t = 1 denotes the first year of medical school, with t = 0 denoting the beginning of that year and t = 1 the end.
[b]The differential cash flow was calculated as the cash flow from the medical career (Column 3) minus the forgone cash flow from the alternative career (Column 2) plus the cash flow associated with the loan program (Column 4).
[c]The present value equivalent was calculated as the discounted (5%) value of the differential cash flow (Column 5).
[d]The NPV in this row was calculated using the algorithm supplied by Microsoft Excel to be sure the other calculations of the NPV (see Column 6) were accurate.

(indicated by the numbers in parentheses) but turns positive when residency training starts. These negative numbers include tuition charges and certain other expenditures unique to a medical school program. Any expenditures that would also occur with the alternative career (e.g., room and board) were excluded from the analysis.

Column 4 shows the cash flow associated with a particular medical school loan program, here the simple Stafford loan program. The loan proceeds during medical school are shown as cash inflows to the student and the assumed subsequent 10 flat annual loan repayments as cash outflows. These repayments are akin to mortgage payments.

By the end of medical school (t = 4), the student's accumulated debt, including interest at 6.21% per year, is $191,178. That balance is then amortized over 10 years with the flat annual payments, also calculated at a borrowing rate on unpaid balances of 6.21%. In this model, the annual payment amounts to $26,234. Each payment covers not only the interest but also some repayment of the outstanding debt. Over the life of the loan contract, the student repays $71,162 more than the mere algebraic sum of the loans ($180,000), excluding interest charged during the medical school years (see the SUM row at the bottom of Table 1). The difference of $71,162 is the interest the student must pay over the entire loan period.

As Marcu and colleagues noted, flat repayment schemes are only one method of repaying the debt accumulated during medical school. A student could make the annual payments proportional to the income she or he earned that year, an approach I would prefer. Other schemes also exist—for example, annual payments that increase at a steady, predetermined rate.

The student's accumulated debt by t = 4 and the subsequent annual loan repayments listed in Column 4 are very sensitive to the loan's interest rate. Given that the U.S. Government currently can borrow at a rate of only 1.74% on 10-year Treasury bonds and at a rate of 2.48% on 30-year bonds,[2] the borrowing rate of 6.21% for Stafford loans must include a high premium for the risk that some students will default on the loan. In effect, that risk premium forces students who do repay their loans in full to also repay, through their high-interest payments, the loans of students who have defaulted. Although that may seem unfair, it is a common approach in all forms of lending, whether the borrower is an individual or a business corporation.

Column 5 shows the results of the cash flow from the medical career (Column 3) minus the forgone cash flow from the alternative career (Column 2) plus the cash flow associated with the loan program (Column 4). The results represent the so-called "differential cash flow" associated with the decision to invest in a medical career rather than pursue the next best alternative career. The lighter gray line in Figure 1 depicts this differential or nominal cash flow.

Finally, Column 6 shows the present value equivalent of the differential cash flow from Column 5, usually called the "discounted" value. The darker gray line in Figure 1 depicts these values. This idea of discounting is straightforward, although it is often misunderstood. Suppose one person promised another person a cash flow of \$10,000 due in exactly one year. If a bank offered that second person an annual interest rate of 5% on the money deposited with it, the person would need to deposit only \$9,523.81 (\$10,000/1.05) in the bank now (at t = 0, the beginning of the year). At 5% interest, that money would grow to a balance of \$10,000 by the year's end. So the present value equivalent, at t = 0, of \$10,000 receivable one year hence (at t = 1) is \$9,523.81. For \$10,000 receivable two years hence (at t = 2), the present value equivalent, at t = 0, would be only \$9,070.29 (\$10,000/1.05^2). For \$10,000 receivable 30 years hence (at t = 30), the present value equivalent, at t = 0, would be \$2,313.77 (\$10,000/1.05^{30}).

The sum from t = 1 to t = 30 of the numbers in Column 6 is the overall net present value (NPV) of the decision to pursue a medical career rather than the next best alternative career. That value is \$785,978. It is the sum of all of the present values of the extra annual income earned by the physician relative to what she or he would have earned in those years in the alternative, nonmedical career minus the present value equivalents of the extra expenditures on medical school and loan repayments and of the forgone income from the alternative career. It is truly a net differential cash flow. In Table 1, the NPV is calculated at the discount rate of 5% assumed by Marcu and colleagues. To be sure that my calculations of the NPV were accurate, I calculated the same value in two ways—once by adding up the numbers in Column 6 and a second time with an algorithm supplied by Microsoft Excel (see the NPV row at the bottom of Table 1).

Marcu and colleagues' choice to extend their analysis only to t = 30 implies a retirement age of 52 for a student who enters medical school at age 22. Is this assumption realistic? So short an investment horizon understates the NPV derived from their analysis. I recommend letting the analysis run to t = 43 (i.e., to age 65), as the NPV would look more optimistic and more realistic for students with debt.

A major, but often overlooked, insight that can be gained from Table 1 is that the NPV calculations for long-term investments in human capital yield merely one number drawn from a probability distribution of possible alternative values, each with its own probability of actually occurring. That probability distribution may have a wide belly—that is, possible NPVs may be widely dispersed across the estimated and reported NPV spectrum. After all, any NPV calculated in this way depends heavily on the assumed, forgone cash flow from the alternative career and on the assumed income stream from medical practice.

The calculated NPV also depends heavily on the discount rate used to calculate the present value equivalents in Column 6 from the differential cash flows in Column 5. The discount rate used here is 5%. Had a discount rate of, say, only 3% been used, the associated NPV would have been \$1,336,966, almost twice as much as the reported \$785,978. On the other hand, if a discount rate of 7%

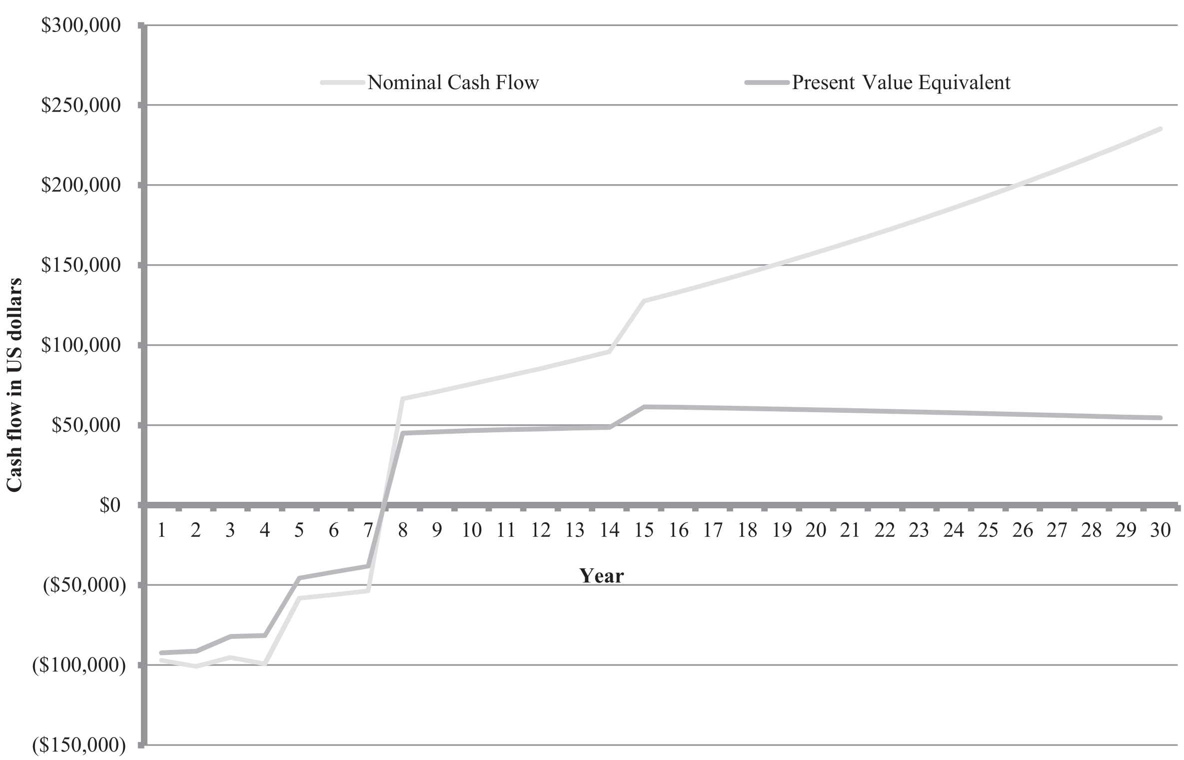

Figure 1 The differential or nominal cash flow and the present value equivalent of the decision to pursue a medical career rather than the next best nonmedical, alternative career, according to the results of a 30-year net present value analysis of pursuing a career in general internal medicine.

had been used, the NPV would have been only $435,477, a little over half the reported number. In this case, however, the sensitivity of the NPV to changes in the assumed parameter values fed into the model is not a problem because Marcu and colleagues were interested only in how differences in loan programs affected the NPV if all other things were equal. That is, they kept constant all other assumptions about parameter values from one repayment plan to the next.

Interpreting the Figures

Figures 1 to 4 presented by Marcu and colleagues are ingenious, but they require additional explanation.

Consider, for example, Figure 1 Panel A, regarding a career in orthopedic surgery in San Antonio, Texas. In your mind, draw a vertical line above year 5 on the horizontal axis. From the point where your line intersects with the line labeled federally guaranteed loans (FGLs), draw a horizontal line, parallel to the horizontal axis, to the left. Where that line cuts the vertical axis, you will find the NPV if, at the end of year 5, the student abandoned a medical career and all cash flows beyond year 5 were disregarded. Here, it is a negative number because up to that point all of the cash flows in Table 1 Column 5 have been negative.

A student with an FGL would just break even in terms of NPV (i.e., experience an NPV = 0), discounted back to t = 0 (i.e., the beginning of the first year of medical school), if she or he abandoned a medical career sometime between year 9 and 10.

The student would have a positive NPV (as of t = 0) of about $3.4 million if she or he practiced orthopedic surgery in San Antonio until t = 30 (age 52). This means that, relative to the alternative career, the student would be $3.4 million richer as of the moment she or he enters medical school (t = 0) simply by choosing to become an orthopedic surgeon practicing in San Antonio, assuming all assumptions made in Table 1 pan out. This finding is the information the NPV conveys.

Figure 1 also allows one to discern when two orthopedic surgeons practicing in San Antonio would have the same NPV if each abandoned her or his medical career at that point in time. This calculation depends solely on the students' loan and repayment plans, which is Marcu and colleagues' focus. In Figure 1 Panel A, for example, students with FGLs would break even with their colleagues in the USUim program (i.e., those attending the Uniformed Services University of the Health Sciences and transitioning to private practice immediately after the four-year service obligation), that is they would have the same NPV, when the two associated lines intersect. Here, that is about year 14. Students in the USUim program and self-financed students without loans would break even if they abandoned their medical careers about year 10, and so on. As Marcu and colleagues noted, self-financed students are better off than their colleagues with debt only later in life because they do not have the benefits of cash inflows from loans during medical school. Although intuitively one may believe that self-financed students would be better off than their colleagues with debt throughout their careers, this analysis shows that that is not true.

All other points in Figures 1 to 4 should be interpreted in this way.

Other Economic Implications of a Medical Career

What is a defensible tuition charge for medical school?

In Table 1, Column 3, I assumed the same fairly high tuition charge for medical school ($258,608) as Marcu and colleagues did. Has such a charge ever been justified carefully?

The faculty-to-student ratio at Harvard Medical School, for example, has been reported as 13.3 faculty per student.[3] Surely all of these faculty members cannot be engaged in teaching full-time. We could use time and motion studies that are more common to other industries to calculate precisely how much of a faculty member's time per year is actually devoted to teaching students and how much is devoted to research and other activities. We then could price out that faculty member's time at $300 to $500 per hour of actual teaching time. Doing so would allow us to calculate the actual faculty cost per student taught. Would that number support charging what medical schools do these days and validate the often-repeated claim that medical school tuition, high as it is, covers only a small portion of the cost of running the teaching operation of a medical school?

I do not know the answer to this delicate question, but I believe it is worthy of further study and debate. I do not subscribe to the notion that heavily indebted medical students should be asked to support faculty members' medical research or other nonteaching activities with their tuition payments. I view it as the financial obligation of society as a whole, which must decide how much of these nonteaching activities it wants to support with grants and contracts.

Are the salaries of residents too low?

Given the long hours that residents are asked to work during graduate medical education and the value they add to teaching institutions, especially as they progress and become more competent, it can be asked whether these hardworking individuals are paid enough per hour for their high-skill work. Economists have asked this question for some time. They tend to view residents not as an economic burden to teaching institutions, which have long been reimbursed for that assumed burden through special government grants, but rather as a source of cheap, highly skilled labor.[4–6]

To teaching institutions, this is a highly delicate issue too, but it is one that will not go away, as Congress seeks to control its budgets and economists continue to hammer away at that issue.

Should depreciation from investments in human capital be tax deductible?

Consider a family that wishes to establish a new restaurant. To accommodate guests, equip the kitchen, and perhaps establish a bar, the family must make hundreds of thousands of dollars in up-front investments, much of which may have to be borrowed. That debt could easily exceed the maximum debt incurred by medical students, against a much less certain future cash inflow. Viewed in this light, the debt of medical students takes on a different hue. But the family starting the restaurant would have one major advantage over physicians. They could calculate the annual depreciation charges on their up-front investment and deduct those charges from their annual taxable income. Physicians and others who invest in human capital are not granted this tax shield.

Why then, in an era when human capital is known to be the chief driver of economic growth and well-being, can investors in buildings and machines use depreciation to shield their income from taxation but investors in human capital cannot? Any debate on this topic is bound to be rancorous, as it may involve both federal and state fiscal policy and social envy. It is, however, one that I believe is worthwhile to have.

To be sure, physicians are granted special authority that amounts to a monopoly on certain clinical tasks, which only they are authorized to perform and other, nonphysician, clinical health workers are not. Perhaps that monopoly is thought to be a substitute for depreciation allowances. That protection, however, has been whittled away over time, as more and more nonphysician health workers have been granted ever-wider discretion to perform medical tasks. In some states, they are even allowed to compete with physicians to be providers of certain types of health care.

Do NPVs really affect students' career choices?

Finally, I return to a comment I made at the beginning of this Commentary. As Marcu and colleagues were quick to point out, choosing a career is a complex process in which economics play only a part. Still, are NPVs the economic criterion to which college graduates look? Or is the process more informal? Do they look at how physicians live, what cars they drive, how financially risky a medical career is relative to other careers (e.g., finance or marketing)?

To be sure, determining the economic variables that actually drive the process of occupational choice is important. But, even if NPVs do not affect this decision, it is nevertheless useful for policy makers and perhaps even for college graduates and medical students to have before them the information that Marcu and colleagues assembled.

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