When Practicing Isn't Enough: Can Human Capital Theory Explain Physicians' On-the-Job Investments?

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Abstract

We use physician practices to directly study on-the-job investments over the life cycle. Doctors' time allocation between patient care and other professional activities, along with complementary investments, evolve as human capital theory predicts. We test further predictions using a significant decline in Medicare reimbursements for surgeons relative to other physicians. Although surgeons increase patient care hours when their fees are cut, they offset this increase by reducing on-the-job investments. Surgeons become less likely to take new patients, suggesting an intention to reduce the scope of their practices in the future. New physicians become less likely to choose surgical specialties. Human capital theory explains these findings better than income-targeting models.

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Do workers make investments in their careers and human capital in the manner that human capital theory predicts? Beyond schooling, classic formulations by Becker (1962), Ben-Porath (1967), and Mincer (1974a,b) emphasize that training may continue both on and off the job throughout the working life. These investments can comprise a diverse set of activities, whether formal training or informal accumulation of experience, through which individuals improve their skills and earnings capacity. The empirical literature, however, has long lamented the paucity of data on human capital investment margins beyond formal schooling and accumulated work experience (Lynch, 1992; Kuruscu, 2006). Absent data on the relevant activities, the long-hypothesized life-cycle profiles of these investments have been inferred from wage and earnings profiles rather than estimated directly.[1] Data limitations have similarly inhibited efforts to analyze how these margins respond to changes in their returns. We make progress by connecting human capital theory to uniquely detailed data on physicians' ongoing human capital investments.

Physicians' practices are an attractive laboratory for connecting human capital theory to data. The first key benefit of this setting is that behaviors related to post-schooling investments in human capital can be documented over the life cycle. The survey data we analyze divide physicians' time into revenue-generating patient hours and hours spent on other medical activities—which look a lot like investments. We observe several aspects of physicians' activities, including the maintenance of board certification and acceptance of new patients, that influence future earnings capacity. Physicians have substantial autonomy in making these decisions, which is useful for testing theories about workers' choices. In contrast, the literature on employer-sponsored training tends to assume that employers choose the level and composition of that training (Barron, Black and Loewenstein, 1989; Altonji

[1]Lynch (1992) emphasizes that "Due to the lack of appropriate data, researchers have been unable to examine directly the impact of private-sector training on wages in any comprehensive way. Consequently, many have had to infer this impact from the shape of wage profiles." The impact of Kuruscu (2006), for example, was due in part to the fact that its approach contributed to the inferences that could be drawn in the absence of data on training activities themselves.

and Spletzer, 1991).

The second reason to study physicians is that they account for a substantial fraction of the highly educated work force. Because public policy decisions shape physician training and wages, effective management of the physician workforce requires knowing how physicians' investments in human capital respond to incentives.

To motivate our empirical analysis, we present a simplified variant of the canonical human capital investment model. Our framework has several predictions that we investigate in the data. First, it predicts that human capital investment activities decline over the life cycle. Second, it predicts that investment activities will decline when the returns to medical practice decline. Third, it predicts that a decline in the returns to medical practice will result in a sharper reduction in investment activities among late-career practitioners than among early-career practitioners.

This framework nests comfortably within standard human capital theory, which has two further predictions that we investigate. First, the human capital model predicts that earnings will exhibit an inverted U-shape over the life cycle (Mincer, 1974b). Second, a natural extension to the occupational choice margin generates the obvious prediction that a reduction in the returns to practicing in a particular specialty will reduce the number of physicians selecting to practice in that specialty. This margin is especially relevant in our setting because health care policy makers are perpetually concerned about the appropriate balance of practitioners in various specialties.

We investigate these predictions using data from the Community Tracking Study (CTS), which asks physicians a relatively detailed set of questions about their time use and the nature of their medical practices. We focus on several variables that capture variations in investment-type activities. Physicians' time use is divided into revenue generating patient hours and hours spent on other medical activities. The data also report whether a physician has maintained board certification. Board certification is distinct from the license required to practice medicine. Instead, it is an additional qualification that demonstrates a higher level of specialty-specific expertise and thereby helps attract patients. The continuing education required to maintain board certification thus maps directly into the investments contemplated by human capital theory: it is requires taking time away from current labor market earnings in order to improve one's future earnings capacity. Finally, the data describe whether physicians are actively taking new patients, which is essential for maintaining a profitable practice in the future.

We find that the human capital model's predictions for the life-cycle profiles of investment activities are borne out in our data. The maintenance of board certification, time spent on activities outside of patient care, and the propensity to accept new patients all decline with age. The steep, monotonic decline in the maintenance of board certification after its peak at ages 36–40 is particularly striking. Additionally, physician earnings exhibit the expected inverted U-shape over the course of working life.

We next analyze how investment activities responded to a sharp change in the returns to medical practice. Specifically, we analyze a 15.5 percent change in Medicare's payments for surgical procedures relative to primary care services. In past work, we found that private insurers largely adopted this payment change (Clemens and Gottlieb, 2017). Consequently, the returns to practicing in surgery declined substantially relative to the returns to practicing in primary care and other less procedure-intensive specialties. We use CTS waves that surround the payment reform to investigate the responses of surgeons relative to practitioners in other specialties.

The response of investment activities to changes in the returns to medical practice are consistent with the human capital model along two dimensions. We begin by reproducing two findings from Clemens and Gottlieb (2017): surgeon are less likely to maintain board certification and to accept new patients (relative to physicians in other specialties) following this payment change. To these prior results, we add the finding that surgeons spend less time on professional activities other than patient care. These findings support the prediction that human capital investments respond positively to the return on those investments.

We push further beyond prior empirical work to investigate how the responsiveness of investments to incentives varies over a physician's working life. We find that the investments of older physicians respond more strongly than the investments of relatively young physicians. This profile of responses matches the predictions of the basic human capital model.

The human capital model has a further prediction, which illuminates a classic debate over how physicians' supply of services responds to financial incentives.[2] The distinction between investment and revenue-generating activities delivers a nuanced prediction for the short-run response of service supply to the returns to medical practice. When a decline in returns leads physicians to pull back on time-intensive investments, the time available for patient care increases. We find this response in our data. When surgeons become less likely to take new patients and spend less time in investment activities, their hours spent on patient care increase. Changes in patient care hours and hours spent on other medical activities offset one another almost one for one.[3]

Our analysis thus highlights two distinctions of interest in the measurement of labor supply. The first distinction is between overall work-related time and time spent on current earnings. While revenue-generating activities exhibit a negative short-run wage elasticity in our data, the broader measure of labor supply that includes human capital investment does not. In our setting, it is worth noting that only the revenue-generating margin can be ob-

[2]The literature on physicians' responses to reimbursement rates is extensive and, as Newhouse (2003, p. 18) memorably described it, "tortured." At a very basic level, researchers have not agreed on whether cuts in reimbursement rates lead physicians to increase or decrease their labor effort. The traditional view, which is embedded in policymaking (Codespote, London and Shatto, 1998), is that physicians have backward-bending labor supply and offset payment cuts with increased volume (Rice, 1983; Jacobson, Earle, Price and Newhouse, 2010). But other researchers find more standard positively-sloped supply curves (Hadley and Reschovsky, 2006; Gruber, Kim and Mayzlina, 1999; Clemens and Gottlieb, 2014). Staiger, Auerbach and Buerhaus (2010) examine physicians' hours of total work over time, but not over the life cycle or across different activities.

[3]This is consistent with the assumption often imposed that individuals exhaust their time budgets on a combination of work and investment activities during the working portions of their careers.

served directly in administrative databases of health insurance claims. Our ability to analyze other margins is made possible by the richness of the CTS survey data.[4] This distinction highlights the importance of measuring labor supply comprehensively, or understanding the limitations of incomplete measures.

The second important distinction is between short- and long-run service supply. The relative reduction of surgeons' investment activities suggests that, over the long run, the stock of human capital in procedure-intensive specialties will decline. Conversely, the stock of non-surgeon human capital will rise. Indeed, this was arguably one of the intentions of the policy intervention we analyze; policy experts have long worried that the U.S. health care system generates an excess supply of intensive procedures and reactive forms of care relative to preventive care.

We conclude our analysis by investigating the extensive margin of medical specialty choice. Occupational choice is among the many margins emphasized in Ben-Porath and Mincer's early development of human capital theory. From a policy perspective, it is perhaps the most important margin as it affects the long-run availability of health care services. Because the supply of specialists is a slow moving stock, this is a challenging margin to investigate satisfactorily. Nonetheless, we observe an apparent shift in specialty counts among young physicians over the decade following the large payment change we analyze. By the early 2000s, young physicians had increased their propensity to enter non-surgical specialties relative to the specialty entry rates we observe during the mid-1990s.

The remainder of this paper proceeds as follows. Section 1 presents a simplified version of

[4]Recent research into physicians' supply responses has generally used administrative claims data (Jacobson et al., 2010; Clemens and Gottlieb, 2014), which has the advantages of being detailed, verified, and comprehensive (for the relevant population). However these "big data" also have limitations (Gottlieb, 2016). Most relevant to the current setting is that they provide no information on physicians' entrepreneurial decisions (e.g., acceptance of new patients) and human capital investments (e.g., maintenance of board certification and time spent on activities outside of patient care). Further, they typically provide information on a limited slice of the physicians' clinical decision making because they cover the care provided by a either single insurer or a subset of private insurers.

the canonical human capital model. Section 2 describes the data used in our analysis. Section 3 presents life-cycle profiles of the human capital investment activities available in our data. Section 4 describes the setting in which we estimate the response of investment activities to variations in their expected returns. Section 5 presents the results of this analysis, along with additional evidence on the evolution of physician specialty choice, while section 6 concludes.

1 Conceptual Framework

To understand how reimbursements can affect physicians' investments and patient care, we present a two-period model of time allocation and on-the-job investments. Building on Becker (1962) and Ben-Porath (1967), we assume that investing in tomorrow's production requires expending some of the time budget, or human capital budget, available today. Life-cycle behavior in Ben-Porath (1967) is independent of wages, since the opportunity cost of investing and the return on that investment are both proportional to wages. We introduce complementarity between on-the-job time investment and market goods into a simple model of on-the-job training. This generates a link between wages (reimbursement rates for physicians) and investment choices. The model shows that it is natural for short-run and long-run supply responses to have opposite signs.

Setup

Consider a doctor deciding how to allocate her time over two periods, the short-run and the long-run. If she continues to invest in her skills and in her medical practice during the first period, she will be more productive in the second period. These investments include efforts to recruit patients, such as by networking with colleagues to solicit referrals. She needs up-to-date equipment, incurs marketing expenses, and invests in other market goods. She also needs to maintain or expand her medical skills. This may require studying to retain a certification, attending conferences, or learning new techniques. If she reduces her investments, she has more time free for patient care in the short-run but will be less productive in the future.

The physician has a time budget of 1 in period 1. She divides this time between hours spent on investment h_1 and hours spent earning revenue e_1, with $h_1+e_1 = 1$. Her production is linear in the number of clinical hours; during period i, she treats $p_i(e_i) = a_ie_i$ patients in e_i hours, where $a_i > 0$ governs productivity. The reimbursement rate is r per unit of care.

In line with Ben-Porath (1967), time invested in period 1 increases earnings capacity in period 2. Time-1 productivity is an exogenously determined a_1, but we allow for investments to improve productivity at time 2. The physician can invest market goods m alongside time, with the two inputs potentially being complements. Her productivity throughout the T units of work time in period 2 is given by $a_2 = f(h_1, m)$. We assume that $f_h > 0, f_m > 0, f_{hh} < 0, f_{mm} < 0$, and $f_{hm} > 0$ where subscripts denote partial derivatives.

During period 2, there is no further investment, so the physician spends her time time budget on patient care. To account for physicians in different stages of their careers, we use T to denote the length of period 2, so she works for a total of $e_2 = T$ clinical hours during that period. She thus treats $p_2 = Ta_2 = Tf(h_1, m)$ patients at time 2. To eliminate any income effects, we assume that the physician's utility is simply the discounted sum of net earnings across the two time periods.

She faces two choices, both at time 1. She chooses the allocation of time between investment h_1 and earnings e_1, constrained by $h_1 + e_1 = 1$. She also chooses investment of market goods m, and we assume that this investment must come out of time-1 earnings.[5] We can

[5]Empirically, physicians overwhelmingly have positive net earnings in all time periods after medical school. So we assume that this borrowing constraint is not binding.

thus write her utility as:

$$u(h_1, m) = rp_1(e_1) - m + \beta r a_2 T p_2(h_1, m) \tag{1}$$

$$= r a_1(1 - h_1) - m + \beta r T f(h_1, m) \tag{2}$$

where $\beta \in (0, 1]$ is a comprehensive discount factor for time-2 earnings.

Time Allocation

The first-order conditions of equation (2) are:

$$r a_1 = \beta r T f_h(h_1^*, m^*) \tag{3}$$

$$1 = \beta r T f_m(h_1^*, m^*) \tag{4}$$

where h_1^* and m^* denote the optimal choices of time and money to invest. Our objective is to understand how a change in reimbursements affects time allocation and investments. So we totally differentiate the first-order conditions with respect to the reimbursement rate r, which yields comparative statics for these choices:

$$\frac{dh_1^*}{dr} = \frac{f_{hm}^*}{\beta r^2 T \left[f_{mm}^* f_{hh}^* - (f_{hm}^*)^2\right]} \tag{5}$$

$$\frac{dm^*}{dr} = \frac{-f_{hh}^*}{\beta r^2 T \left[f_{mm}^* f_{hh}^* - (f_{hm}^*)^2\right]}, \tag{6}$$

where asterisks denote the second derivatives evaluated at the optimal choices. The second order conditions ensure that the denominators of both (5) and (6) are positive. If time and money are complements, then $f_{hm}^* > 0$ in addition, so equation (5) is positive. The concavity of f ensures that (6) is positive as well.

Under these assumptions, investment inputs—both time and goods—are alway increasing in reimbursement rates. But since the time budget is fixed in period 1, period-1 earnings hours must be *decreasing* in reimbursement rates. Recall that $p_1 = a_1(1 - h_1)$ patients are treated at time 1, so:

$$\frac{dp_1^*}{dr} = \frac{-a_1 f_{hm}^*}{\beta r^2 T \left[f_{mm}^* f_{hh}^* - (f_{hm}^*)^2\right]} < 0. \tag{7}$$

This expression shows what appears to be a backward-bending labor supply curve. Whether the physician's labor supply is measured in terms of clinical hours ($e_1 = 1 - h_1$) or output ($p_1 = a_1 e_1$), an increase in reimbursements decreases contemporaneous patient care.

But looking ahead to time 2 changes the interpretation of this result. The physician would not invest time and money in period 1 if she didn't expect to reap a return on that investment in period 2. The model has no role for leisure, so the backward-bending supply cannot reflect a shift from consumption to leisure. Instead, the extra earnings in period 2 must offset the foregone earnings in period 1.

To see this mathematically, recall the first-order condition for time investment. Since $\beta \leq 1$, we must have $Tf_h^* \geq a_1$ for equation (3) to hold with equality. The derivative f_h^* is the period-2 productivity gain of a marginal hour invested at time 1, and this gain is used throughout T units of time in the rest of the career. Efficient time allocation requires that productivity gains at time 2 at least compensate the foregone marginal patients treated at time 1, given by a_1.

Total Patient Care and Policy Implications

Total patient care is given by $p_1 + p_2 = a_1(1 - h_1) + Tf(h_1, m)$, so its response to a reimbursement change is:

$$\frac{d(p_1^* + p_2^*)}{dr} = -a_1 \frac{dh_1^*}{dr} + Tf_h^* \frac{dh_1^*}{dr} + Tf_m^* \frac{dm^*}{dr} > 0. \tag{8}$$

Since $Tf_h^* \geq a_1$, the second term of (8) dominates the first term and the overall expression is positive. Even if we were to discount time-2 treatments by β, so the first and second terms would cancel out, treatments would increase through a productivity gain from additional investments in market goods (the third term). In other words, the increase in complementary investments of market goods ensures that productivity growth in period 2 more-than-offsets the foregone clinical time in period 1.

The distinction between the positive sign of equation (8) and the negative sign of (7) is crucial for those determining health care payment policies. Researchers estimating empirical analogues of equation (7), the short-run health care supply response, may very well find negative slopes. But the longer-run aggregate responses are likely to be most policy-relevant. Equation (8) makes clear that labor supply will slope up in the long run. So policymakers who rely on short-run estimates will be significantly misled about the consequences of their decisions.

Heterogeneity

Equations (5) and (6) also yield predictions for heterogeneity in the comparative statics. Consider specifically heterogeneity in the time remaining T in the physician's career. As T decreases, both equations (5) and (6) increase, meaning that investment is more responsive to reimbursement rates for those approaching the end of their careers.

To see the intuition for this result, recall that time investment is complementary with market goods, which yield a return at time 2 when invested at time 1. Any given decline in reimbursements r increases the effective cost of funds today (which don't depend on r) relative the future return (which does depend on r), more for someone who has less time to benefit from future returns. So a reduction in r makes it increasingly harder for a physician to justify time-1 investment of market goods as she has less time to reap time-2 returns. Since time investment is complementary with market goods investment, the more rapid decline in

m for a low-T physician also leads to a more rapid decline in her time investment.

Comparison with Income Effects

The traditional explanation for decreasing treatments in response to fee increases, or backward-bending labor supply, is physician "income targeting," which comes from a model with strong income effects (McGuire and Pauly, 1991). With or without large income effects, fee cuts unambiguously make a doctor worse off. So they unambiguously reduce the incentive to invest for the future.

To understand this intuition, recall that income targeting is a behavioral response to minimize the utility loss from fee cuts. It may occur when the marginal utility of income is sufficiently concave that it's worth sacrificing leisure to maintain one's income. Even when this occurs, the doctor is worse off—she is suffering in lost leisure instead of lost income. So the benefits of practicing in the future are unambiguously lower, and there is less reason to invest.

2 Connecting Data To Theory

This section presents the data we use to connect the empirical behaviors of physicians to basic human capital theory. Our primary data source is the Community Tracking Study (CTS), which documents a variety of characteristics of physicians' practices and time use. The CTS was conducted over four two-year waves, including 1996-97, 1998-99, 2000-01, and 2004-05. In each wave, the CTS surveyed roughly 12,000 physicians spread across 60 geographic areas (Center for Studying Health System Change, 1999). Our analysis involves both a cross-sectional investigation of physicians' investment activities andan analysis of changes in these activities across waves following a substantial change in Medicare's reimbursement rates.

The paucity of data on on-the-job investments has proven a roadblock to prior empirical analyses of human capital theory. The canonical empirical applications (Lillard, 1973; Mincer, 1974a,b; Heckman, 1976) infer investment activities from the life-cycle profiles of wages and earnings. More recent studies have emphasized the limitations of this approach (Lynch, 1992; Kuruscu, 2006). This motivates Lynch's (1992) use of the National Longitudinal Survey (NLS) to study early career training programs. The NLS does not, however, permit estimation of life-cycle profiles of investment behavior.

Because the CTS surveys physicians of all ages, it allows us to estimate life-cycle profiles for a variety of activities. Several of the activities and physician characteristics that the CTS tracks map quite directly into standard human capital theory. First, the CTS divides physicians' working time into time spent on patient care and time spent on other activites. Patient care corresponds to billable, revenue-generating work hours. The remaining time spent on "other medical activities" approximates the time physicians spend investing in their practices and human capital. While the aggregate is crude, this division of time into revenue generating activities and non-revenue generating activities represents a significant improvement, for the purpose of tracking investment activities, on the uni-dimensional "hours worked" concept that is available in standard employment surveys. In our analysis of both time spent on "other medical activities" and time spent on patient care, we use the continuous hours measure as it is provided in the data.

The CTS documents a common and easily interpreted credential that results from time-intensive human capital investments. Specifically, it tracks the maintenance of board certification. Importantly for our purposes, board certification is not required to practice medicine. It is a certification of expertise in a particular medical specialty or sub-specialty that extends beyond the licence required to practice. Information provided by specialty societies indicates that maintenance of certification tends to require an average of 25 certified hours of continuing education per year, completion of relevant paperwork, and passage of a knowledge-based examination. Board certification thus documents and signals continuing education activities that map directly into the time investments contemplated by the canonical human capital model. In our analysis of certification, we use this binary measure as it is provided in the data.

An additional investment margin of interest is the physicians' propensity to accept new patients. Accepting new patients is essential for maintaining a practice's revenue stream in future years. The CTS asks separately about physicians' willingness to accept patients insured privately, insured by Medicare, and insured by Medicaid. We both study these measures separately and aggregate these them into a comprehensive index that ranges from 0 to 1. We interpret this measure as a leading indicator for whether physicians are inclined to continue operating their practices for an extended period of time. That is, we take it as imperfectly predicting future labor supply, including plans to retire.

The CTS also asks about physicians' specialties, birth cohorts, and graduation years. The birth cohort and graduation year variables are presented in 5 year bins. We convert birth cohorts into age bins for the purpose of presenting the life-cycle profile of the investment activities described above. The information on specialties is essential for our empirical analysis of physicians' responses to changes in the returns to medical practice. This is because the reimbursement change we analyze involved a substantial change in the generosity of Medicare's reimbursements for surgical procedures relative to other medical activities.[6]

Our second data source is the Area Resource File (ARF) produced by the Health Resources and Services Administration in the Department of Health and Human Services. The ARF aggregates data from various sources on the numbers of physicians in each U.S. county. These numbers are provided separately by specialty, by age, and by physician practicing status (e.g. practicing medicine, teaching, working in administration). We aggregate these data to the national level separately for surgeons and non-surgeons to examine changes in

[6] When we examine changes in practice characteristics, we exclude the 916 survey respondents from the 2004-2005 CTS whose graduation years were between 1996 and 2004, as these individuals' specialty choices may have been affected by the payment changes we analyze.

new doctors' entry decisions.

3 Empirical Life Cycle Profiles of Physician Investment Activities and Incomes

This section uses CTS data to estimate life-cycle profiles of physician investment activities. For clarity, we present data from a single wave of the CTS, namely the 1996-97 wave. The patterns we present prevail across the full set of CTS waves.

Figure 1 shows that human capital and other entrepreneurial time investments exhibit the life-cycle profiles predicted by human capital theory. After modest upticks quite early in physicians' careers, the profiles of the activities we track decline nearly monotonically with age. As the theoretical literature has noted, this trajectory is expected due to declines in the time over which the returns to investment will be realized.

The life-cycle profile of the maintenance of board certification is particularly striking. In the 1996-97 CTS, board certification was maintained by 90 percent of physicians in their late 30s and early 40s. By their early 50s, the fraction maintaining board certification had declined to 80 percent. By their early 60s it had declined to 70 percent, and among older physicians it had declined to 60 percent. Maintenance of board certification, which maps quite directly into the time investments contemplated by theory, thus matches the theory's predictions remarkably well.

Figure 2 provides evidence that physicians with board certification have higher earnings than physicians without board certification. The figure shows that this holds both across age groups and when comparing surgeons with non-surgeons. This confirms that, at least as a matter of correlation, the continuing education associated with maintenance of certification predicts higher incomes.

The life cycle profile of time spent on medical activities other than revenue generating patient care also exhibits a downward trajectory. On average, physicians in their late 30s spent just over 11 hours per week in such activities. This level persists for a number of years, falling to just under 11 hours per week for physicians in their early 50s. By their late 50s and early 60s, physicians spend just under 9.5 hours per week on such activities. Older physicians spend an average of 8.5 hours per week on these activities. While the gradient is not steep, the pattern is clear. Physicians near retirement age devote less time than younger physicians to activities other than patient care.

It is perhaps least surprising, though of interest nonetheless, that physicians become less likely to accept new patients as they age. The decline again approaches monotonicity. Because the majority of physicians report taking "all" or "most" new patients of all insurance types, the index's range is modest. The decline we observe from the youngest physicians to the oldest physicians equals one quarter of a standard deviation of the index across all physicians in the sample.

Finally, we show that the life-cycle of physician earnings exhibits a familiar inverted-U shape. The CTS's income variable is categorical, with categories corresponding with $50,000 earnings bins. Peak life cycle earnings occur when physicians are in their late 40s and early 50s. Consistent with a point made early by Heckman (1976), late-life declines in earnings are driven in no small part by declines in labor supply as measured using weeks of work and hours of work per week.

4 Empirical Model for Testing Comparative Statics

We next analyze the responsiveness of physicians' investment activities to changes in their expected returns. The current section presents the setting and methodology associated with this investigation, while the subsequent section presents the results. We test the human capital model's predictions using a large shock to Medicare's reimbursements for surgical relative to medical services. This reimbursement change took place in 1998 and was not reversed. Further, our previous analysis of insurer pricing (Clemens and Gottlieb, 2017) shows that private insurers largely followed suit in reducing payments for surgical procedures relative to other services. Forward-looking physicians would thus have anticipated a large and persistent change in the returns to practicing in surgery-intensive specialties relative to other specialties. In describing the payment change of interest, this section draws heavily from Clemens and Gottlieb (2017, sec. 5).

4.1 Medicare's Payment System

Since 1992, Medicare has paid physicians and other outpatient providers through a system of centrally administered prices, based on a national fee schedule. This fee schedule, known as the Resource-Based Relative Value Scale (RBRVS), assigns relative values to more than 10,000 distinct billing codes according to the resources CMS believes the services to require. Medicare scales these relative valuations by multipliers called Conversion Factors (CFs). Our natural experiment involves a large, administrative change in the CFs for surgical and nonsurgical services. The fee schedule further adjusts payments to partially offset differences in input costs across geographic areas. For service j, supplied in year t by a provider in payment area a, the provider's fee is approximately:

$$\begin{aligned} \text{Reimbursement}_{a,j,t} = {} & \text{Conversion Factor (CF)}_{t,c(j)} \times \text{Relative Value Units (RVU)}_{j,t} \\ & \times \text{Geographic Adjustment Factor (GAF)}_{a,t}. \end{aligned} \tag{9}$$

Shock to Surgical *versus* Medical Payments

The Conversion Factor can be described Medicare's average payment in "dollars per unit of care." It is updated annually and is identical across broad categories of services, $c(j)$. From 1993 through 1997, Medicare maintained separate conversion factors for surgical procedures and other services. Because volumes of surgical care grew modestly from 1993 to 1995, payments per unit of surgical care rose more rapidly than payments per unit of non-surgical care. From 1995 to 1997, surgical procedures were reimbursed with an average "bonus" of 15.5 percent per unit relative to primary care and other nonsurgical RVUs.[7]

The gap in payments for surgical care relative to non-surgical care spawned political discontent among non-surgeons. Congress acted to eliminate the 15.5 percent bonus in 1998. This resulted in a large and permanent decline in payments for surgical care relative to other medical services.[8] The evolution of the surgical and nonsurgical Conversion Factors during this era is shown in Figure 3.

4.2 Estimation Framework

The financial impact of the payment change we analyze depends on the share of a physician's revenue that comes from surgical procedures. Overall, surgery-intensive specialties suffered a financial hit while medical specialties benefited (Clemens and Gottlieb, 2017, Table 4). Our analysis thus categorizes specialties broadly as either "surgical" or "non-surgical." We investigate whether the investment activities tracked by the CTS evolved differentially across these groups.

We present results both graphically and in tabular form. First, we separately present the evolution of investment activities across practitioners in surgical and non-surgical specialties. Second, we estimate the magnitude of differential changes in these activities using a standard difference-in-differences approach.

Let y_{it} be an outcome of interest for physician i, practicing in specialty $s(i)$, in year t. We begin by estimating the following empirical specification:

$$y_{it} = \beta \, \text{Surgeon}_{s(i)} \times \text{Post Implementation}_t + \lambda \, \text{Surgeon}_{s(i)} + \chi_t \, \mathbb{1}_t + \varepsilon_{it}. \tag{10}$$

In equation (10), $\text{Surgeon}_{s(i)}$ is an indicator for being in a surgical specialty, $\mathbb{1}_t$ is a set of time

[7]We owe our knowledge of this political history to Newhouse (2002, 2003).

[8]62 *Federal Register* 59048, 59102 (1997).

period fixed effects, and Post Implementation$_t$ is an indicator for time periods subsequent to the payment change on which our analysis focuses. ε_{it} is an idiosyncratic error term.

Human capital theory predicts that the investments of late-career physicians should respond more intensively to rate changes than the investments of early-career physicians. To test this prediction, implement a specification that allows the payment change's effects to vary with physician age. We do so by grouping physicians into three age groups ("Youngest," "Middle," and "Oldest") and interacting indicators for the "Youngest" and "Middle" age groups with all variables included in our difference-in-differences regressions. Letting S_i be an indicator for surgeons, A_i^1 an indicator for the youngest age group and A_i^2 an indicator for the middle age group, we estimate:

$$\begin{aligned} y_{it} = {} & \beta\, S_i \times \text{Post Implementation}_t + \gamma_1\, \text{Surgeon}_{s(i)} \times \text{Post Implementation}_t \times \text{A}_i^1 \\ & + \gamma_2\, \text{Surgeon}_{s(i)} \times \text{Post Implementation}_t \times \text{A}_i^2 \\ & + \alpha_1\, A_i^1 + \alpha_2\, A_i^2 + \lambda_0\, \text{Surgeon}_{s(i)} + \lambda_1\, \text{Surgeon}_{s(i)} \times A_i^1 + \lambda_2\, \text{Surgeon}_{s(i)} \times A_i^2 \\ & + \chi_0\, \text{Post Implementation}_t + \chi_1\, \text{Post Implementation}_t \times A_i^1, \\ & + \chi_2\ \text{Post Implementation}_t \times A_i^2 + \varepsilon_{it}. \end{aligned} \tag{11}$$

The omitted category is the oldest age group, so the coefficient β will estimate the effect of the price change for this group. The triple interaction coefficients, γ_1 and γ_2, will estimate differences between the investment responses of the oldest and the investment responses of other age groups.

5 Empirical Results

5.1 Baseline Results on Investment Margins

Figure 4 presents tabulations of unadjusted data on each of the primary outcomes we analyze. As before, the investment margins we analyze include hours spent on activities other than patient care, maintenance of board certification, and an index that describes physicians' stated willingness to accept new patients. We present each series separately for surgeons and non-surgeons such that the data can be translated directly into the difference-in-differences estimates of equation (10).

For each of the investment margins we analyze, we observe that changes in investment among surgeons are more negative than changes in investment among non-surgeons. We first observe that surgeons reduce their time spent on activities other than patient care to a greater degree than do non-surgeons. We next observe that surgeons experienced much smaller increases in their likelihood of maintaining board certification than did non-surgeons. Finally, we observe that physicians became significantly less likely to report that they were accepting all new patients, while this margin changed little for non-surgeons over the period we analyze.

Tables 1 and 2 present estimates of equation (10)'s difference-in-differences model on these and related outcomes. Column 1 of Table 1 presents the estimated differential change in hours spent on non-clinical professional activities. Surgeons' time spent on medical activities other than patient care declined by 0.9 hours relative to the time spent on such activities by non-surgeons. The dependent variable in column 2 is the indicator for the maintenance of board certification. Surgeons' probability of maintaining board certification falls by 4 percentage points, or 5 percent, relative to non-surgeons. Column 3 shows that the index of surgeons' propensity to accept new patients falls by 3 percentage points, or 4 percent relative to non-surgeons. In all cases, the differential decline in surgeons' investments in the future profitability of their practices is statistically distinguishable from zero with $p < 0.01$.

Table 2 provides further details on the new patients that physicians are willing to accept. We see a decline in surgeons' propensity to accept new patients across all major insurance categories—Medicare, private, and Medicaid. This indicates that changes in surgeons' practice patterns do not reflect shifts in their efforts to treat patients of different types. The evidence is suggestive of a broad-based intention to scale back on the number of patients they treat over the long run.

5.2 Evidence on the Age Profile of Investment Responses

This section presents estimates of equation (11) in which we allow changes in investment activities to vary across the life cycle. That is, we investigate whether declines in surgeons' investment activities are systematically larger among surgeons near retirement age than among early-career surgeons. The estimates appear in the remaining columns of Table 1.

The investments of physicians near retirement age respond more strongly to financial incentives than do the investments of young physicians. Relative to non-surgeons, surgeons near retirement age reduce their time spent on medical activities other than patient care by 1.8 hours. The differential change among young surgeon is only 0.3 hours, and the 1.5 hour difference is statistically distinguishable from zero at $p < 0.05$. The probability that surgeons near retirement age maintain board certification declines by 7 percentage points relative to non-surgeons near retirement age, while the differential change among young physicians is 3 percentage points. The 4 percentage point differences is statistically distinguishable from zero at $p < 0.1$. There is no evidence that surgeons' relative decline in the propensity to take new patients exhibits a gradient with age.

While the estimates vary in their degree of statistical significance, the age profile of the responsiveness of investments to their returns is generally consistent with standard human capital theory. Section 1's model predicts that the responsiveness of investments with respect to instances will tend to be decreasing with the amount of time remaining in working life. We find that this is strongly the case for overall hours spent on activities other than patient care. The economic magnitude of the gradient involving changes in board certification is substantial, though its statistical significance is weaker.

5.3 Traditional Labor Supply Responses

In this section, we consider human capital theory's implications for traditional measures of labor supply. The key insight is that time intensive human capital investments generate nuanced predictions for the relationship between financial incentives and standard measures of labor supply. Specifically, reductions in time intensive human capital investments leave more time available for revenue generating patient hours. In this setting, the short- and even medium-run supply of patient hours may thus exhibit a negative elasticity with respect to wages. Importantly, the model makes clear that this response is not informative about the long-run evolution of the supply of medical care.

The overall impact on aggregate labor supply, interpreted broadly, is shown in column 1 of Table 3. We see no significant change in hours worked. However columns 2 and 3 show that this masks a significant shift from investment time to patient care time for surgeons relative to non-surgeons. Column 2 indicates that, relative to non-surgeons, surgeons increased their weekly hours spent on patient care by 1.2 hours following the reduction in their reimbursement rates, with $p < 0.01$. Column 3, which repeats column 1 from Table 1, shows that this is offset by a 0.9-hour decline in other medical activities, which is also strongly distinguishable from zero. The coefficients in columns 2 and 3 add up to that in column 1.

These results appear consistent with the classic "target income" model of physician behavior. That model, which requires an assumption of large income effects, predicts that physicians work more hours when their reimbursements fall, so as to maintain their incomes. The standard source of evidence for studying how physicians respond to financial incentives is insurance claims databases. But these only provide evidence on patient care outcomes.

Our application of human capital theory reveals that this apparent increase in patient hours following a reduction in reimbursement rates is not a unique prediction of the target income hypothesis. This prediction is also generated by our simplified human capital model. We excluded income effects in our simplified model specifically to make this point. That is, a negative short-run elasticity of patient hours with respect to reimbursement rates can be generated by a model with no income effects.

The evidence presented in section 5.1 supports the human capital interpretation of the responses we observe. We build upon this evidence in the remaining columns of Table 3 by testing for heterogeneity in responses by age. Recall that our model predicts larger shift between investments and earnings for older physicians than for younger workers in response to a reimbursement change. Column 4 shows no significant change in total hours worked for any of these groups. Column 5 shows that surgeons' increase in patient care hours comes primarily from the oldest group, who respond by increasing patient care time by 1.9 hours per week. The middle-aged group's response is indistinguishable from the old, although the point estimate increases to 2.4 hours. The interaction with younger physicians, in contrast, almost entirely reverses the effect we find among the oldest. For both the oldest and youngest groups, column 6 shows that investment hours almost exactly offset the patient care coefficients in column 5. So the same data that show life cycle patterns consistent with human capital theory also show the pattern of responses to a reimbursement change that our model predicts.

Our results thus highlight two distinctions of interest in the measurement of labor supply. The first distinction involves the relevance of measuring labor supply comprehensively. While revenue-generating activities exhibit a negative short-run wage elasticity in our data, the broader notion of labor supply that includes human capital investment does not. The second important distinction is between short- and long-run service supply. The contraction of investment activities suggests that, over the long run, the stock of human capital related to surgically intensive specialties will decline. Conversely, the stock of general practitioner human capital will rise. In the following sub-section we conclude our empirical analysis by turning to an additional margin with high relevance for the long-run evolution of care access, namely young physicians' specialty choices.

5.4 Extensive Margin: Specialty Choice

If the returns to surgery and medicine shift the returns to investing in those specialties so dramatically, they might also be expected to influence entry decisions. In Figures 5, 6, and 7, we therefore investigate the entry of new physicians into medical practice. The Area Resource File (ARF) allows us to track counts of physicians across specialties and age groups. Several interesting facts emerge from these tabulations.

First, among physicians under the age of 35, the composition mix between surgical and non-surgical specialties evolves quite strikingly between 1995 and 2005. Figure 5 shows that 1995 and 1996 were years during which the number of young surgical specialists was unusually high relative to the number of young physicians in other specialty areas. The number of surgeons in this age group declined from an average of 27,000 in 1995 and 1996 to an average of just under 25,000 across subsequent years. By contrast, the number of young non-surgeons rose over the years following the increasing in Medicare's payments to non-surgical specialties. By the early 2000s, the number of young physicians in non-surgical specialties had risen from just under 60,000 to just under 70,000.

A similar pattern emerges in the counts of physicians between ages 35 and 44, as shown in Figure 6. From the mid-1990s to the early-2000s, the numbers of surgeons in this age group decline from an average of 40,000 to an average of around 37,000. The numbers of non-surgeons in this age group rise with a longer lag. From the mid-1990s to the mid-2000s, the numbers of non-surgeons rose from just under 96,000 to around 99,000. The movements we observe in Figure 6 are much smaller in percent terms than the movements we observe in Figure 5, which is consistent with the fact that a large fraction of physicians between the ages of 35 and 44 had selected their specialty before entering this particular age group.

Can shifts in counts of specialists ages 35 to 44 plausibly be a result of the payment policy changes on which our analysis focuses? Although most physicians choose their specialties at earlier ages, the data displayed in Figures 6 and 7 reveal that a significant amount of new entry occurs at ages 35 and above. Figure 6 shows, for example, that in 1995 there were roughly 40,000 surgeons and just under 96,000 non-surgical specialists between ages 35 and 44. Individuals in this age range in 1995 are in the 1951 to 1960 birth cohorts, which we can trace into subsequent years. Specifically, we can see in Figure 7 that by the time these cohorts are between ages 45 and 54 in 2005, there were roughly 41,000 surgeons and roughly 102,000 non-surgeons. An additional 7,000 individuals in these birth cohorts had thus entered either surgical or non-surgical specialties between 1995 and 2005. Entry into non-surgical specialties accounted for a disproportionate 85 percent of this net entry, consistent a significant role for the payment changes we analyze.

In contrast with Figures 5 and 6, Figure 7 shows that counts of physicians in the 45 to 54 year old age group evolved quite smoothly between 1995 and 2005. Over this time period, the numbers of surgeons and non-surgeons in this age group rose roughly in parallel. This further supports the view that the changes observed among individuals in the age groups within which entry is taking place are related to the payment policy changes on which our analysis focuses.

6 Conclusion

This paper contributes to the empirical literature on human capital investments on the job. We present data on physicians' practices that are unique in their ability to trace out the life cycle profiles of several human capital investment activities. As predicted by human capital theory, we find that physicians' investments in continuing education decline over the life cycle. The same is true of a broader metric describing time spent on medical activities outside of revenue-generating patient care. It is also true of physicians' propensity to accept new patients. The life cycle profiles are thus consistent with standard predictions of the theory and provide a novel look at human capital theory in practice.

We further investigate how human capital investments respond to changes in their returns. We find that investment responds negatively to declines in returns. Further, we find that the human capital investments of physicians who are approaching retirement respond to a greater degree than the investments of young physicians. Both the overall response and the gradient of responses over the life cycle thus join the life cycle profiles themselves in their consistency with canonical human capital theory.

Our results also reconcile the disparate findings in the physician supply literature. Doctors' investments exhibit standard, positively sloped, supply responses. But investments in one's medical skills and the practice's future require taking time away from clinical care today. So a reduction in investments can lead to increased patient care in the short-run—a phenomenon that resembles backward-bending labor supply. But policymakers interested in long-run supply should be aware that this short-run response may obscure the long-run impact of investments, which respond positively.

References

Altonji, Joseph G and James R Spletzer, "Worker characteristics, job characteristics, and the receipt of on-the-job training," *Industrial and Labor Relations Review*, 1991, *45* (1), 58–79.

Barron, John M, Dan A Black, and Mark A Loewenstein, "Job matching and on-the-job training," *Journal of Labor Economics*, 1989, *7* (1), 1–19.

Becker, Gary S., "Investment in Human Capital: A Theoretical Analysis," *Journal of Political Economy*, October 1962, *70* (5), 9–49.

Ben-Porath, Yoram, "The production of human capital and the life cycle of earnings," *Journal of Political Economy*, 1967, *75* (4, Part 1), 352–365.

Center for Studying Health System Change, "Physician Survey Summary File: User's Guide and Codebook," 1999. Community Tracking Study Physician Survey, 1996–1997 (ICPSR 2597). Available at http://doi.org/10.3886/ICPSR02597.v3.

Clemens, Jeffrey and Joshua D. Gottlieb, "Do Physicians' Financial Incentives Affect Medical Treatment and Patient Health?," *American Economic Review*, April 2014, *104* (4), 1320–1349.

_ and _ , "In the Shadow of a Giant: Medicare's Influence on Private Payment Systems," *Journal of Political Economy*, February 2017, *125* (1).

Codespote, Suzanne M., William J. London, and John D. Shatto, "Physician Volume & Intensity Response," Memorandum to Richard S. Foster, Office of the Actuary, Health Care Financing Administration August 13 1998. Available at https://www.cms.gov/ActuarialStudies/downloads/PhysicianResponse.pdf.

Gottlieb, Joshua D., "Making Big Data Informative Data," September 2016. *Parameters*. Available online at http://parameters.ssrc.org/.

Gruber, Jon, John Kim, and Dina Mayzlina, "Physician Fees and Procedure Intensity: the Case of Cesarean Delivery," *Journal of Health Economics*, August 1999, *18* (4), 473–490.

Hadley, Jack and James D. Reschovsky, "Medicare fees and physicians. medicare service volume: Beneficiaries treated and services per beneficiary," *International Journal of Health Care Finance and Economics*, June 2006, *6* (2), 131–150.

Heckman, James J., "A life-cycle model of earnings, learning, and consumption," *Journal of Political Economy*, 1976, *84* (4, Part 2), S9–S44.

Jacobson, Mireille, Craig C. Earle, Mary Price, and Joseph P. Newhouse, "How Medicare's Payment Cuts For Cancer Chemotherapy Drugs Changed Patterns Of Treatment," *Health Affairs*, July 2010, *29*, 1391–1399.

Kuruscu, Burhanettin, "Training and lifetime income," *The American Economic Review*, 2006, *96* (3), 832–846.

Lillard, Lee A., "Human Capital Life Cycle of Earnings Models: A Specific Solution and Estimation," Working Paper No. 4, National Bureau of Economic Research July 1973.

Lynch, Lisa M, "Private-sector training and the earnings of young workers," *The American Economic Review*, 1992, *82* (1), 299–312.

McGuire, Thomas G. and Mark V. Pauly, "Physician response to fee changes with multiple payers," *Journal of Health Economics*, 1991, *10* (4), 385–410.

Mincer, Jacob, "Progress in Human Capital Analysis of the Distribution of Earnings," Working Paper No. 53, National Bureau of Economic Research August 1974.

_ , *Schooling, Experience, and Earnings*, New York: Columbia University Press for National Bureau of Economic Research, 1974.

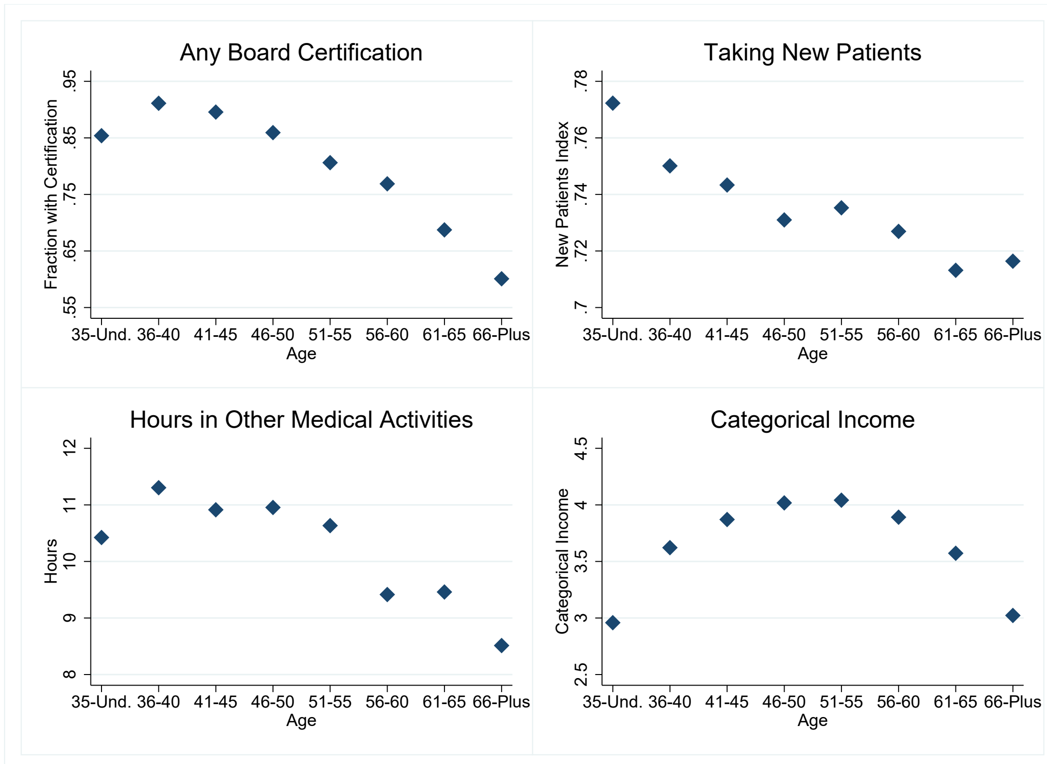
Newhouse, Joseph P., "Medicare Policy," in Jeffrey A. Frankel and Peter R. Orzag, eds., *American Economic Policy in the 1990s*, Cambridge, Mass.: MIT Press, 2002, chapter 13, pp. 899–955.

_ , *Pricing the Priceless: A Health Care Conundrum*, Cambridge, Mass.: MIT Press, 2003.

Rice, Thomas H., "The Impact of Changing Medicare Reimbursement Rates on Physician-Induced Demand," *Medical Care*, August 1983, *21* (8), 803–815.

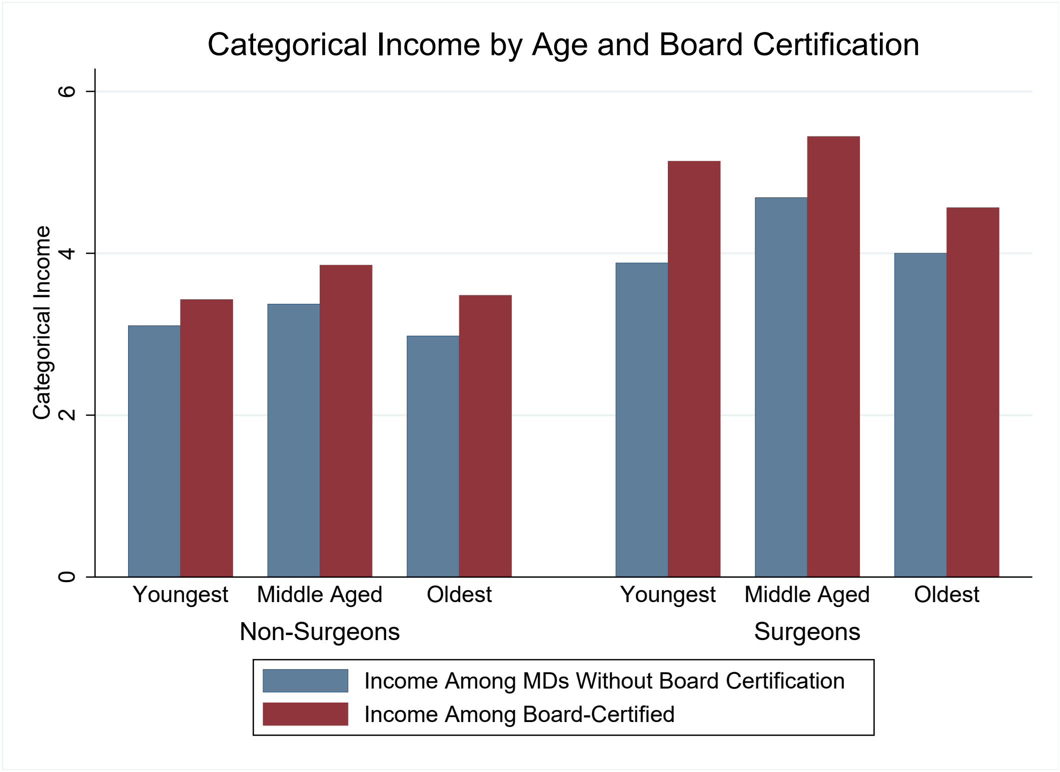
Staiger, Douglas O, David I Auerbach, and Peter I Buerhaus, "Trends in the work hours of physicians in the United States," *JAMA*, 2010, *303* (8), 747–753.

Figure 1: Cross-Sectional Relationship between Age and Investment Activities



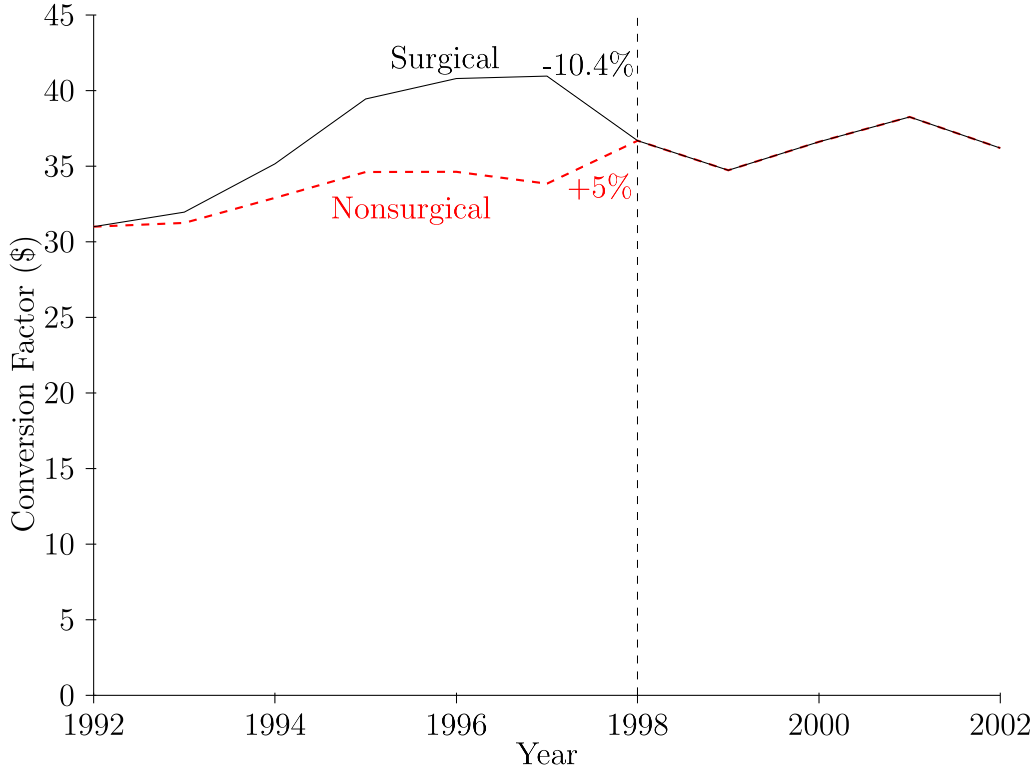
Note: This figure presents data on the investment activities and incomes of physicians by age. The investment activities include the maintenance of board certification, propensity to take new patients, and hours spent on medical activities outside of revenue-generating patient care per week. The "new patients index" aggregates across self-reported propensities to take new patients from Medicaid, Medicare, and from private insurers. It is a simple average of these three measures normalized to range between 0 and 1. Because a majority of physicians describe themselves as being willing to take either all or most patients new patients of all types, the range of the resulting index is fairly narrow. The income variable is categorical. A one unit changes corresponds with a $50,000 income differential with the exception of the modest fraction of observations in the bottom and top coded categories. Source: Authors' calculations based on data from the Community Tracking Study, 1996-1997 Wave Only.

Figure 2: **Cross-Sectional Relationship between Certification Status and Income**



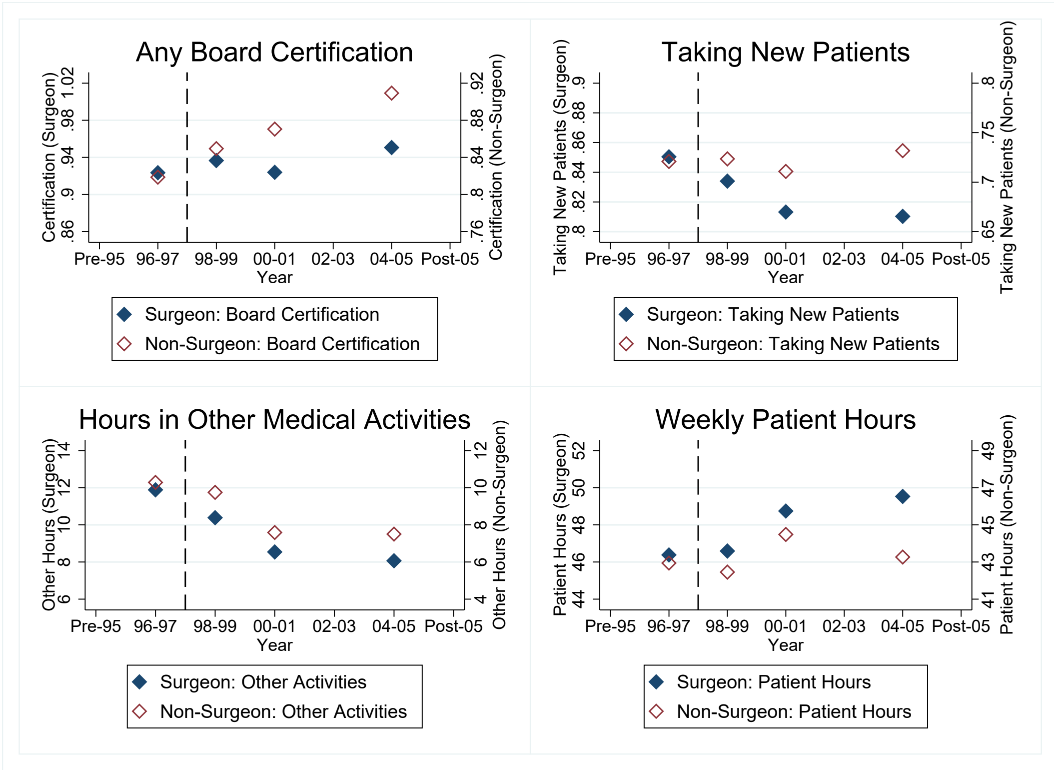
Note: This figure presents data on the incomes of physicians with and without board certification across age groups and specialties. The income variable is categorical. A one unit changes corresponds with a $50,000 income differential with the exception of the modest fraction of observations in the bottom and top coded categories. The relative prevalence of top-coded earnings suggests that income differences among certified and non-certified physicians would tend to be larger than one would otherwise infer from the figure. Source: Authors' calculations based on data from the Community Tracking Study, 1996-1997 Wave Only.

Figure 3: **Evolution of Medicare Surgical and Nonsurgical Conversion Factors**



Note: This figure shows the nominal Conversion Factors that Medicare applied to surgical and general nonsurgical services for each year from 1992 through 2002. Source: Clemens and Gottlieb (2017)

Figure 4: Responses of Surgeons and Non-Surgeons to Surgical Fee Cut

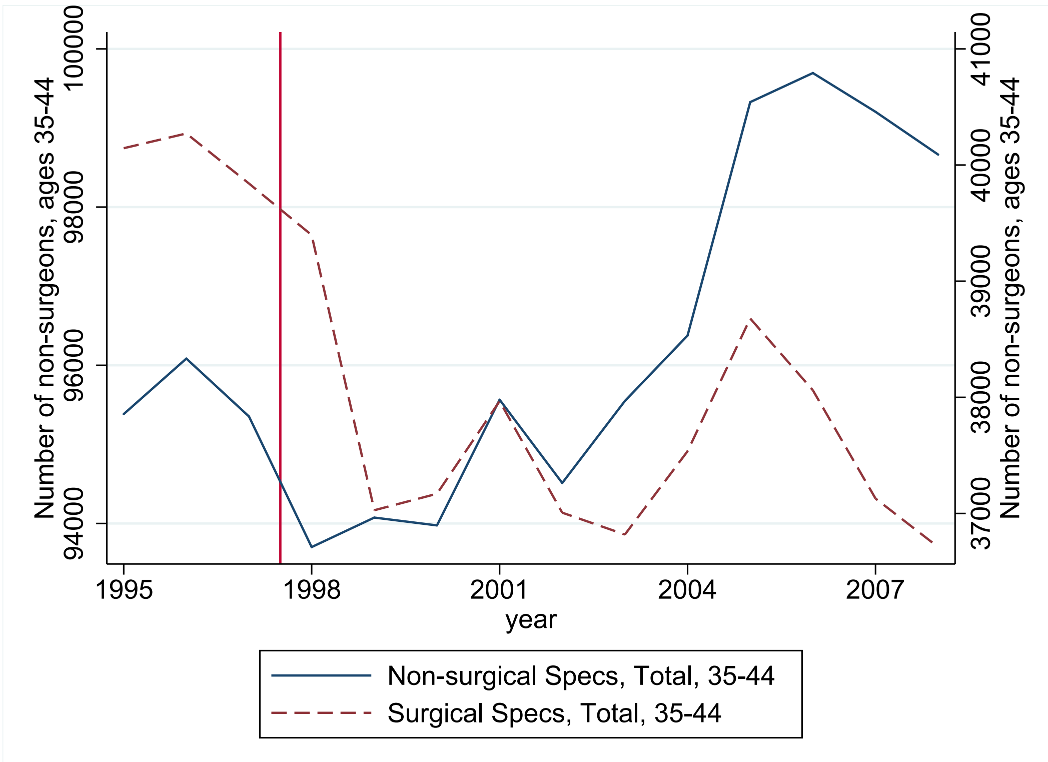


Note: This figure shows raw survey responses for surgeons and non-surgeons to a variety of questions about their medical practices. Note that within each panel, the values of surgeons' and non-surgeons' responses are indicated with reference to different axes. The payment reduction to surgeons took place between 1997 and 1998, as indicated with the dashed vertical line. Source: Authors' calculations based on data from the Community Tracking Study, various waves.

Figure 5: Specialty Choice: Physicians Aged $<$ 35

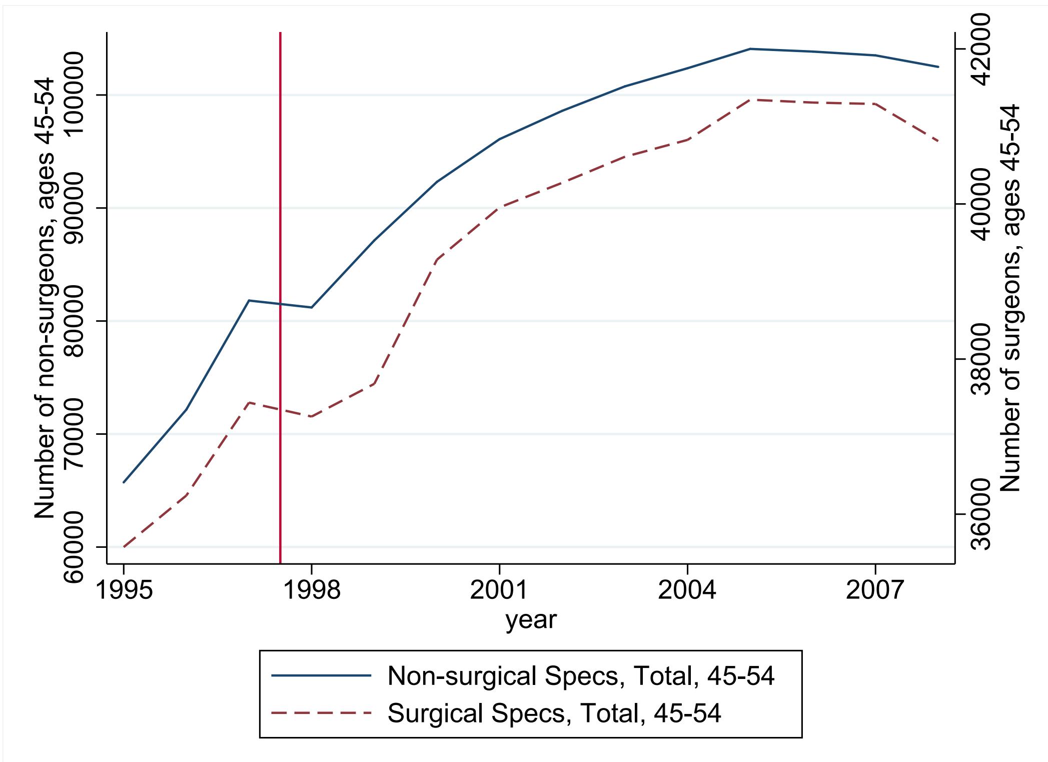
Note: This figure shows counts of physicians in surgical and non-surgical specialties. The counts are restricted to practicing physicians under the age of 35 and are allowed to vary across years. Source: Authors' calculations based on data from the Area Resource File.

Figure 6: **Specialty Choice: Physicians Aged 35 to 44**



Note: This figure shows counts of physicians in surgical and non-surgical specialties. The counts are restricted to practicing physicians between ages 34 and 44 and are allowed to vary across years. Source: Authors' calculations based on data from the Area Resource File.

Figure 7: **Specialty Choice: Physicians Aged 45 to 54**



Note: This figure shows counts of physicians in surgical and non-surgical specialties. The counts are restricted to practicing physicians between ages 34 and 44 and are allowed to vary across years. Source: Authors' calculations based on data from the Area Resource File.

Table 1: Changes in Physicians' Investments by Physician Age

	Other Hours Coeff./SE	Certified Coeff./SE	New Pat. Coeff./SE	Other Hours Coeff./SE	Certified Coeff./SE	New Pat. Coeff./SE
Surgeon x Post	-0.862**	-0.040***	-0.029***	-1.876**	-0.069***	-0.028*
	(0.304)	(0.009)	(0.007)	(0.595)	(0.019)	(0.014)
Surgeon x Post x Middle Aged				1.024	0.021	-0.015
				(0.818)	(0.023)	(0.019)
Surgeon x Post x Youngest				1.526*	0.041+	0.005
				(0.749)	(0.023)	(0.017)
N	42,950	42,776	42,950	42,950	42,776	42,950
Mean of Dep. Var.	10.52	0.83	0.74	10.52	0.83	0.74
R-Squared	0.020	0.012	0.019	0.024	0.068	0.023

Note: This table reports difference-in-difference regressions for measures of physicians' time allocation and investments, allowing for heterogeneity by age. Each column shows results for a separate outcome variable. The samples are divided on the basis of physician age, which the CTS reports through a categorical birth-year variable. The "Youngest" physicians include physicians in the three youngest age groups in each CTS wave, "Middle Age Group" physicians include those in the middle two age groups, and the "Oldest" (the omitted category) are those from the oldest three age groups. All regressions are fully saturated: they include direct effects of Surgeon, Post, and age group dummies (not shown) and two-way interactions of Surgeon $\times$ age group dummies, and Post $\times$ age group dummies (also not shown). The table shows the coefficient on the interaction between the respondent being a surgeon and time periods after the surgical fee cut, and its interactions with age group indicators. Stars indicate coefficients statistically distinguishable from zero, with **: $p < 0.01$, *: $p < 0.05$, +: $p < 0.10$. Source: Authors' calculations based on data from the Community Tracking Study, various waves.

Table 2: Changes in New Patient Acceptance by Insurance Type

	Take New Patients Coeff./SE	New Medicare Coeff./SE	New Private Coeff./SE	New Medicaid Coeff./SE
Surgeon x Post	-0.029***	-0.039**	-0.054***	-0.059***
	(0.007)	(0.012)	(0.013)	(0.015)
N	42,950	42,950	42,950	42,950
Mean of Dep. Var.	0.74	0.65	0.69	0.48
R-Squared	0.019	0.020	0.007	0.005

Note: This table reports difference-in-difference regressions for measures of whether a physician is accepting new patients, based on the patient's type of insurance. All regressions control for a fixed effect for surgical specialties and study wave fixed effects. The table shows the coefficient on the interaction between the respondent being a surgeon and time periods after the surgical fee cut, or β from equation (10) in the text. Stars indicate coefficients statistically distinguishable from zero, with **: $p < 0.01$, *: $p < 0.05$. Source: Authors' calculations based on data from the Community Tracking Study, various waves.

Table 3: Changes in Labor Supply Measures Following Surgical Fee Cut

	Tot. Hours Coeff./SE	Pat. Hours Coeff./SE	Other Hours Coeff./SE	Tot. Hours Coeff./SE	Pat. Hours Coeff./SE	Other Hours Coeff./SE
Surgeon x Post	0.350	1.212**	-0.862**	-0.005	1.871*	-1.876**
	(0.435)	(0.423)	(0.304)	(0.909)	(0.862)	(0.595)
Surgeon x Post x Middle Aged				1.531	0.507	1.024
				(1.165)	(1.128)	(0.818)
Surgeon x Post x Youngest				-0.218	-1.744+	1.526*
				(1.099)	(1.058)	(0.749)
N	42,950	42,950	42,950	42,950	42,950	42,950
Mean of Dep. Var.	53.95	43.44	10.52	53.95	43.44	10.52
R-Squared	0.018	0.015	0.020	0.042	0.030	0.024

Note: This table reports difference-in-difference regressions for measures of physicians' time allocation and investments, allowing for heterogeneity by age. Each column shows results for a separate outcome variable. The samples are divided on the basis of physician age, which the CTS reports through a categorical birth-year variable. The "Youngest" physicians include physicians in the three youngest age groups in each CTS wave, "Middle Age Group" physicians include those in the middle two age groups, and the "Oldest" (the omitted category) are those from the oldest three age groups. All regressions are fully saturated: they include direct effects of Surgeon, Post, and age group dummies (not shown) and two-way interactions of Surgeon $\times$ age group dummies, and Post $\times$ age group dummies (also not shown). The table shows the coefficient on the interaction between the respondent being a surgeon and time periods after the surgical fee cut, and its interactions with age group indicators. Stars indicate coefficients statistically distinguishable from zero, with **: $p < 0.01$, *: $p < 0.05$, +: $p < 0.10$. Source: Authors' calculations based on data from the Community Tracking Study, various waves.