How Would Medicare for All Affect Health System Capacity? Evidence from Medicare for Some

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Executive Summary

Proposals to create a national health care plan such as "Medicare for All" rely heavily on reducing the prices that insurers pay for health care. These changes affect physicians' short-run incentives for care provision, and may also change health care providers' incentives to invest in capacity, thereby influencing the availability of care in the long term. We provide evidence on these responses using a major Medicare payment change combined with survey data on physicians' time use. We find evidence that physicians increase their time spent on capacity building when remuneration increases, and that they are subsequently more willing to accept new patients—especially those who may be the residual claimants on marginal capacity. These forces imply that short-run supply curves likely differ from the long-run supply curves. Policymakers need to account for how major changes to payment incentives would influence the investments that determine health system capacity.

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Investments in a health system's capacity determine the amount of care it can provide. Countries and regions that have invested in more physicians and more hospital beds provide more care, as well as more intensive treatments, to their residents (Fisher et al., 2000). While this marginal care may not always be efficient, the Covid-19 pandemic reveals a source of value from having these investments in place, even if high capacity is excessive under normal conditions (Fisher et al., 2003).

To have high capacity in place when it is needed, the health system's incentives must be conducive to forward-looking investments during ordinary times. As policymakers consider proposals such as "Medicare for All," a critical question is thus what incentives such systems would create for these investments. We take up precisely this question.

At prevailing private-sector prices, fully covering all 330 million Americans would likely be unaffordable. To maintain affordability, national health insurance proposals like Medicare for All have thus assumed significant reductions in payment rates to health care providers (Chown et al., 2019). Blahous (2018) estimates that provider payments would fall by 40 percent, or $384 billion per year, under the version of Medicare for All proposed by Bernie Sanders. Schulman and Milstein (2019) suggest that such cuts would bring payment rates below hospitals' current costs, requiring them to make major operational changes to reduce their costs and remain solvent.

Lowering payments would undoubtedly save money in the short term. But what would it do to physicians' incentives to invest for the long term? Knowing they face lower payment rates, would they reduce investments in their practices, and hence in the health system's capacity? Existing evidence from the hospital and pharmaceutical industries suggests that payment rules influence investments in physical capital and innovation (Acemoglu and Finkelstein, 2008; Finkelstein, 2004; Acemoglu and Linn, 2004). But the health sector is intensive in labor and human capital. Physicians' investments in their human capital and entrepreneurial capital may thus be as consequential as traditional capital investments for

how the market evolves. We study how a change in the level of government payments to physicians—such as that which Medicare for All would entail—influences these critical investment outcomes.

High price levels mechanically affect spending by raising the cost of each service patients consume, and beyond that may influence the number of services physicians provide (Clemens and Gottlieb, 2014). Existing research on physicians' responses to payment rates focuses on time spent treating patients. An extensive, controversial literature argues for backward-bending labor supply—that when payment rates are cut, the supply of physician care expands. More recent work tends to find standard upward-sloping responses.[1]

We argue that both of these views miss an important element of physicians' decisions: how much to invest in future productivity. As the literature on human capital theory has long understood (Becker, 1962; Ben-Porath, 1967; Mincer, 1974a,b), overall work effort includes both revenue-generating activities and investments in human capital, which influence future productivity. These activities are just as important among physicians as elsewhere in the economy, and provide a natural channel by which government policy can influence the long-run supply of medical treatments.

We exploit time use data that divide physicians' overall working time into patient care hours, which generate revenues, and time spent on other medical activities. These other activities include the recruitment of new patients, investments in physicians' professional networks, and investments in continuing education, such as studying to maintain board certification. Many of these investments augment the physician's human capital. Others, like

[1]The classic cites on backward-bending labor supply include Rice and Labelle (1989), Rice (1983; 1984), Gruber and Owings (1996), Yip (1998), and Jacobson et al. (2013). McGuire and Pauly (1991) provide the canonical model and McGuire (2000) and Chandra et al. (2011) review this literature. The physician literature has also found evidence of standard upward-sloping labor supply, especially in more recent work (Gruber, Kim and Mayzlina, 1999; Hadley and Reschovsky, 2006; Clemens and Gottlieb, 2014; Alexander, 2015; Johnson and Rehavi, 2016; Brekke, Holmås, Monstad and Straume, 2017; Foo, Lee and Fong, 2017). Nevertheless, the traditional view, that physicians have backward-bending labor supply and offset payment cuts with increased volume, is embedded in policymaking (Codespote et al., 1998).

the development of new patient relationships or investments in managerial capacity, set the stage for increases in care provision over longer time horizons. In both cases, the investments would increase the physician's future earnings potential. We examine how investments and labor supply vary over a physician's career and in response to government-induced price shocks, which influence physicians' earnings per treatment.

The Medicare policy shock we employ changed the price of physicians' output—that is, the care they provide—differentially across specialties. We find that a substantial reduction in reimbursements led physicians in adversely affected specialties to reduce the extent of their investment activities. We observe that they are less likely to accept new patients and to obtain or maintain board certification.

Notably, we find the patient acceptance results to be even stronger for Medicaid than for Medicare. This suggests that the increases in capacity benefit patients whose own payments may not change. At baseline, Medicaid is a less attractive payor than Medicare: it offers physician lower rates, and requires more cumbersome paperwork (Gottlieb et al., 2018), so physicians are less likely to treat Medicaid beneficiaries (Dunn et al., 2020). If physicians prefer to treat privately insured and Medicare patients, then Medicaid patients may be the residual claimants on excess capacity. So even when an expansion is driven by Medicare rates, this could relax otherwise-binding capacity constraints and increase Medicaid access to care.

Our results are consistent and complementary with existing evidence on investments in physical capacity. The literature finds that both hospitals' and physicians' capital investments respond positively to payment rates, consistent with standard profit maximization. Acemoglu and Finkelstein (2008) study hospitals' capital investment decisions when government payments for those investments change. They find that hospitals respond strongly to payments for capital investments, and invest in new technologies when it is profitable to do so. In the physician context, Clemens and Gottlieb (2014) find that the overall level of

Medicare payments influences physicians' treatment intensity and technology choices.[2] In this paper, we find the same for physicians' investments in their careers. If these investments increase care-giving capacity in the future, overall health care supply responses can be very different in the short-run and long-run. Policy decisions based exclusively on the short-run responses would miss a crucial part of their impacts.

Physician behavior has broad implications for government spending and overall economic performance. In 2016, the United States spent $725 billion, or 3.5 percent of GDP, on physician care and similar medical services alone.[3] Recurrent concerns about physician shortages (Cooper et al., 2002; Staiger et al., 2009; Petterson et al., 2012) highlight the need to understand doctors' investments. Our analysis suggests that some aspects of physicians' investments in their careers may be quite responsive to government payment policies. While we are able to examine some important margins, others remain under-explored. More research is needed to understand how physicians choose their specialties, locations, and the structure of their practices.

The remainder of the paper is structured as follows: Section 1 describes the data and measures of on-the-job investments and labor supply. Section 2 demonstrates that the life cycle behavior of these measures is consistent with standard human capital theory. Section 3 introduces the Medicare policy change and our empirical strategy for identifying how investments and labor supply respond to pricing changes. Section 4 presents the results and

[2]Additional related work has considered the effects of reimbursements and other payments on the types of patients physicians choose to treat (Chen, 2014; Garthwaite, 2012; Baker and Royalty, 2000), the drugs they choose to prescribe (Carey et al., 2015), the number of staff members they hire (Buchmueller et al., 2016), and whether they enter private practice and/or sub-specialize (Chen et al., 2018).

While market size is a different concept from payment levels, an increase in market size has a similar effect: it can increase the profitability of fixed investments. An important related literature studies this sort of shock, often using increases in insurance coverage. Finkelstein (2007) finds that hospitals' investments and even entry decisions depend on the number of patients in an area with generous insurance coverage. Finkelstein (2004) finds that investments in new vaccines respond to expected profitability of those investments. Acemoglu and Linn (2004), and a substantial subsequent literature, finds a similar result for pharmaceuticals.

[3]This comes from the "Physician and Clinical Services" component of the 2018 National Health Expenditure Data (Centers for Medicare and Medicaid Services, 2019).

section 5 concludes.

1 Measuring Physicians' On-the-Job Investments and Labor Supply

We use data from the Community Tracking Study (CTS) to study physicians' investment and labor supply behavior. The CTS measures a variety of characteristics of physicians' practices and time use, and was conducted over four two-year waves: 1996/97, 1998/99, 2000/01, and 2004/05. In each wave, the CTS surveyed roughly 12,000 physicians across 60 randomly chosen geographic areas (Center for Studying Health System Change, 1999). We use the restricted-use data, which contain detailed responses to certain questions, plus a linked identifier that allows us to create a panel of physicians.[4] The survey focuses on physicians whose primary focus is direct patient care; research and federally-employed physicians are excluded, as are specialties not providing direct patient care. We examine three measures of investment behavior:

Non-Patient Hours: Physicians report their weekly total medical hours and the time spent providing direct patient care. We define non-patient hours as the difference between total and patient care hours. To clarify the substance of this measure, we present the exact wording of the questionnaire that is used to elicit time allocation. For total hours, the survey asks:

> Thinking of your last complete week of work, approximately how many hours did you spend in all medically related activities? Please include all time spent in administrative tasks, professional activities and direct patient care. Exclude time on call when not actually working.

For patient care hours, respondents are asked:

[4]Each wave contains a subset of respondents from the previous wave, resulting in an unbalanced panel. Appendix Table A.2 shows that observable characteristics are balanced across individuals of differing panel lengths.

> Thinking of your last complete week of work, about how many hours did you spend in direct patient care activities? (If necessary, read:) INCLUDE time spent on patient record-keeping, patient-related office work, and travel time connected with seeing patients. EXCLUDE time spent in training, teaching, or research, any hours on-call when not actually working, and travel between home and work at the beginning and end of the work day.

The residual measure of non-patient hours therefore includes training, professional activities, and only administrative work unrelated to direct patient care.[5] This includes obtaining or maintaining board certification, recruiting patients, building professional relationships, attending conferences, staying apprised of new treatment procedures, adopting and implementing new physical capital, remaining compliant with evolving medical regulations, hiring and managing employees, and building overall organizational capacity within one's practice. Each of these endeavors contribute towards individual human capital and broader practice capacity over the long-run. So we adopt this broad definition of non-patient hours as ongoing investments throughout the paper.

Board Certification: Physicians can obtain board certifications in their primary specialty and sub-specialties, neither of which is legally required to practice medicine. Instead, these certifications may act as a signal of quality, making the physician more attractive to potential clients or employers.[6] Obtaining board certification entails fees ranging from $1,000 to $3,000 (Drolet and Tandon, 2017), an initial written and oral exam, re-certifying exams at intervals of 6–10 years, and other maintenance of certification requirements.[7] Given certifi-

[5]Research is unlikely to constitute a meaningful component of non-patient hours because the CTS explicitly excludes doctors focused on research from its samples. The questionnaire wording also excludes from non-patient hours the time physicians spend on-call but not actually working.

[6]In a survey of internists, Lipner et al. (2006) find that a majority of those maintaining certification report doing so for "positive professional reasons," with a minority reporting that certification is required by an employer.

[7]Maintenance of certification (MOC) often entails online training modules in medical knowledge or activities that are supposed to improve patient quality. For instance, the American Board of Internal Medicine requires physicians to earn 100 points every five years, by undertaking either online training

cation's voluntary nature, and the associated time and monetary costs, it proxies effectively for ongoing investments in practice capacity. Appendix Figure A.1 provides evidence that physicians with board certification have higher earnings than physicians without board certification.[8] This confirms that, at least as a matter of correlation, the continuing education associated with board certification predicts higher incomes.[9]

Willingness to Accept New Patients: Respondents report their willingness to accept new patients, on a four point integer scale, for each type of patient: Medicare, Medicaid, and privately insured. We construct a summary index by adding together the response for each patient type, and rescaling such that it ranges from zero to one. One indicates a complete willingness to accept new patients of any type, and zero a complete refusal. Building and maintaining a customer base is one form of ongoing investment physicians often must make to ensure current and future profitability. As such, a physician's desire to accept new patients proxies for ongoing investments, and in turn, long-term care supply.[10]

In addition to on-the-job investment measures, we examine income-generating patient care hours, total labor supply, and annual income:

Patient Care Hours: As described above, patient care hours involve direct face-to-face time with patients, patient record-keeping and related office work, and travel time connected with seeing patients. These are the activities that generate revenue for a practice.[11]

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modules, or "Quality Improvement/Practice Improvement" activities, each of which typically garners 10–20 points. MOCs became a regular part of certification beginning in the early 2000s.

[8]This holds both within age groups and when examining surgeons or non-surgeons separately.

[9]Cassel and Holmboe (2008) provide a history and overview of board certifications. The evidence is mixed on whether certification affects clinical outcomes, health care costs, or other aspects of care. Lipner et al. (2013) provides an overview of some of this research, largely correlation-based, and concludes that there are positive correlations between board certification and knowledge, practice infrastructure, and communication. Conversely, Gray et al. (2014) and Haynes et al. (2014) find no effect of MOC requirements or re-certification, respectively, on clinical outcomes.

[10]Appendix B.2 discusses the details of the original question and how we rescale it.

[11]Patient care hours are an imperfect proxy for the supply of medical care. For a given amount of time, a more efficient doctor can supply more medical care. Thus variation across doctors in treatment hours may understate variation in medical care supply. Medical care is also vaguely defined. Time spent answering patients' questions may not constitute medical treatment in the strict sense, but does improve the quality of service provided.

Total Labor Supply and Income: We measure total labor supply as the time spent on all medically-related activities. This is the sum of patient care hours and non-patient hours. Respondents also report their total income net of expenses for the year preceding the survey wave. So in the 1996/97 survey wave, income is requested for the 1995 calendar year.[12]

The restricted-use CTS data provide each respondent's primary specialty at a detailed level—specifying 126 unique specialties—as opposed to the aggregated categories available in the public-use version. This allows us to leverage disaggregated variation in Medicare reimbursement rates across specialties. Similarly, income in the restricted-use data is reported to the nearest $1,000, while the public-use version reports income in $50,000 bins. Appendix Tables A.1 and A.2 show summary statistics for the variables discussed above, and for additional variables that describe physicians' practice types.

2 Life Cycle Patterns of Human Capital Investments

Figure 1 shows cross-sectional life cycle patterns for time-use, willingness to take new patients, board certification, and annual income. After modest upticks early in physicians' careers, the investment activities we track decline nearly monotonically with age. This lines up with theoretical predictions (Ben-Porath, 1967), since the horizons over which investments pay off decline with age, and the opportunity cost of time increases when productivity is high.

On average, physicians in their late 30s spent just over 11 hours per week on non-patient hours. This level persists for a number of years until falling to just over 9 hours per week among those in their late 50s and early 60s. While the gradient is not steep, the pattern is clear: physicians gradually devote less time to medical activities other than patient care as they approach retirement. By comparison, patient care hours hit a high mark during the

[12]The questionnaire phrasing for income is reported in Appendix B.2.

same age, but do not begin a strong descent until age 60. That non-patient hours decline earlier than revenue-generating patient hours is consistent with on-the-job investments being crowded-out when the time horizon for investments to payoff is shorter.

The willingness to take new patients also decreases nearly monotonically with age. Our measure declines from just under 0.8 for physicians 29–39 years old to 0.72 for doctors 65 or older. Because most 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 is equivalent to 1 standard deviation of the index. To the extent that a patient relationship is an ongoing commitment, this signals a desire to decrease practice activity both in the present and in the future.

Board certification follows a similar trajectory. Figure 1 Panel D shows that 90 percent of physicians in their late 30s and early 40s are board certified. The share falls to 80 percent among those in their early 50s, 70 percent among those in their early 60s, and 60 percent among older physicians. Maintaining board certification, which maps quite directly into the time investments contemplated by theory, thus matches the predictions well. That said, board certification rates have risen over time, which would contribute to the observed age gradient if younger doctors are leading the trend. Furthermore, a precondition for declining certification rates in old age is the ability to lose one's certification. However, a segment of the CTS sample hold lifetime certifications which are exempt from re-certification requirements. For both these reasons, the age profile of board certification should be interpreted with caution. We discuss robustness of the life cycle profiles in Appendix A.1.

The returns to investments in physicians' practices and human capital may accrue over a variety of different time horizons. So it is not clear which age groups should be most sensitive to the expected returns from these different investment activities. As a signal of quality, for example, board certification may generate returns by both increasing a physician's capacity to recruit new patients and improving their bargaining position in negotiations with private

insurers. While improved bargaining position may be valuable through the last years of a physician's career, the need to recruit new patients may decline in advance of retirement. The precise timing with which the return to board certification might fall below its costs is thus unclear and may vary substantially across physicians.

The remaining panels of Figure 1 show life cycle profiles for total hours, patient care hours, and income. All three exhibit an inverse U-shape. Total hours peak between age 40 and 50, and then begin a steady decline. Patient care hours peak around age 40, remain steady until age 60, then trend downwards. Finally, income follows the trajectory of labor supply. It rises until age 50, then begins to decline. Consistent with a point made early by Heckman (1976), declines in earnings are driven in no small part by declines in labor supply.

Age is an imperfect measure of career horizon. To further support our interpretation that non-patient hours reflect ongoing investments, we leverage the panel component of the CTS to measure the decline in non-patient hours as physicians approach their year of attrition from the panel.[13] The survey does not explicitly measure retirement, but Appendix Figure A.4 shows that attrition increases steeply with age, from a base hazard rate of 40–45 percent for mid-career doctors, to 60 percent for old physicians. The steady increase in attrition rates with age suggests that attrition from the panel among older physicians is partially attributable to retirement.

To quantify the relationship between retirement hazard and investment decisions, we estimate the following descriptive regression:

$$\begin{aligned} y_{it} = \alpha_0 &+ \alpha_2 \cdot (\text{Two Years Before Attrition}_{it}) + \alpha_4 \cdot (\text{Four Years Before Attrition}_{it}) \\ &+ \alpha_8 \cdot (\text{Eight or More Years Before Attrition}_{it}) \\ &+ \psi \, \text{Surgeon}_i + \varphi_{a,s} \, \text{Age}_{it} \times \text{Surgeon}_i + \epsilon_{it} \end{aligned} \tag{1}$$

[13] Only the restricted-use version of the CTS provides physician identifiers, enabling us to exploit the panel component.

The outcome variable y_{it} in equation (1) is non-patient hours, either in levels or as a share of total hours, for physician i of specialty $s(i)$ in survey wave t. We include a fixed effect ψ for whether a physician is classified as a Surgeon or Non-Surgeon based on the CTS classification, and differential age fixed effects $\varphi_{a,s}$ for Surgeons and Non-Surgeons.[14] The estimates of interest are the fixed effects for years-to-attrition. The base group is physicians in their final period in the sample. So the coefficients $\hat{\alpha}_2$, $\hat{\alpha}_4$, and $\hat{\alpha}_8$ estimate the differences in investment levels for physicians 2, 4, or $\geq$8 years prior to attrition, relative to those making their final appearance. If attrition partly reflects retirement, and investments decline in the years approaching retirement, then the estimates should be positive, and declining towards zero as the physician approaches attrition.[15]

Figure 2 plots the estimates of how years-to-attrition relate to non-patient hours, both in levels and as a share of total working hours. Both hours measures decline monotonically as an individual approaches her final year in the panel. This is consistent with the interpretation of these non-patient hours as activities that contribute to the physician's long-run earnings capacity. Some of these activities, like the continuing education required to maintain board certification, can be described as classic investments in human capital. Others, like time spent cultivating new patient relationships, may more generally set the stage for continued work in future periods. We will emphasize these interpretations throughout the rest of the paper.

[14] Allowing age fixed effects to vary with specialty assuages concerns that the decrease as physicians approach retirement is driven by differing retirement patterns *and* different levels of non-patient hours between Surgeon and Non-Surgeons.

[15] The four waves of the CTS took place in 1996/97, 1998/99, 2000/01, and then 2004/05. The gap between waves 3 and 4 slightly complicates the analysis of behavior in the years leading up to attrition from the sample, as estimated in equation (1) and plotted in Figure 2. To deal with the gap, we use the structure of fixed effects shown in equation (1): 2, 4, and $\geq$ 8 years prior to attrition. The first two fixed effects are in 2-year intervals due to the bi-annual frequency of the CTS. The final fixed effect is for 8 or more years because the difference between third and final CTS wave was 4 years (2000/01 to 2004/05). To avoid confounding the interpretation of the fixed effects, we restrict the sample to (i) all individuals observed in the first wave, and (ii) individuals who initially appeared in the second wave, but drop out of the sample before the final wave.

Figure 2 also shows that the decline in investments prior to attrition only holds for physicians aged 60 or greater. For physicians younger than 45, non-patient hours do not vary with years to attrition.[16] So Figure 2 also suggests that higher attrition rates among older doctors reflect retirement decisions to a much greater extent than among mid-career physicians.

3 Empirical Model for Testing Comparative Statics

Having traced out the basic life-cycle pattern of physicians' investment activities, we next analyze how these investments respond to changes in their expected returns. We rely on a large Medicare reimbursement change that took place in 1998 and was not reversed. In order to reduce payment discrepancies and support primary care, Congress eliminated a policy that had increased reimbursements per unit of effort for surgical procedures relative to non-surgical services. This change reduced payments for all procedures by 10.4 percent while increasing payments for non-procedural services by an average of 5 percent.[17] Because this change was almost simultaneously adopted by many private insurers (Clemens and Gottlieb, 2017), the effect on the average prices—and hence hourly wages—for surgeons relative to non-surgeons was substantial.[18] 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.

We adapt Clemens and Gottlieb's (2017) approach to analyzing this payment shock to more fully exploit the resulting variation in payments across physician specialties. The payment change applies at the level of each individual service — so an office visit experiences

[16] Appendix Figure A.5 shows a similar pattern for total hours worked and patient care hours. Appendix Figure A.6 reveals a similar pattern for certification status, while physicians' propensity to take new patients is flat over the years immediately preceding retirement.

[17] Clemens and Gottlieb (2017) present a more detailed description of the institutional history and decision-making behind this payment change. In Appendix Figure A.3, we show how the payment rates per unit of effort (called "Conversion Factors") evolved for surgical and non-surgical care during this time period.

[18] The 1998/99 CTS began in August 1998, well after the policy's announcement and implementation.

a price increase, while a cataract surgery would face a price decline. Since many specialties provide a combination of procedural and non-procedural services, each specialty's overall price change reflects the share of procedures in its output mix.

To estimate specialty-level average payment changes, we rely on data from the Physician/Supplier Procedure Summary (PSPS) file released by the Centers for Medicare and Medicaid Services. This file reports state-level aggregate data on Medicare's purchases of care from physicians and other professional suppliers at the service line level. For each state and individual medical service, the file reports how many services Medicare purchased and how much it spent. To estimate the overall percent change in payments by specialty, we look at each specialty's composition of services as of 1997. We take a weighted average of the Conversion Factor change, where each specialty's weight depends on the share of Medicare spending that comes from surgical procedures. Denote this weighted average by $\Delta p_{s(i)}$.[19] These values, reproduced in Table 1, provide a specialty-level payment shock and hence wage shock for forty-six different specialty groups. We use the specialty-level payment change to estimate two types of regressions. The first is a dynamic difference-in-differences specification:

$$y_{it} = \beta_{98-99}\,\Delta p_{s(i)} \times \mathbb{1}_{t=1998-99} + \beta_{00-01}\,\Delta p_{s(i)} \times \mathbb{1}_{t=2000-01} + \beta_{04-05}\,\Delta p_{s(i)} \times \mathbb{1}_{t=2004-05} + \phi_i \mathbb{1}_i + \phi_{98-99}\,\mathbb{1}_{t=1998-99} + \phi_{00-01}\,\mathbb{1}_{t=2000-01} + \phi_{04-05}\,\mathbb{1}_{t=2004-05} + \varepsilon_{it}. \quad (2)$$

The unit of observation for this regression is the physician (i)-by-survey wave (t); in other words, each observation in this regression is one survey response ($N = 31{,}760$ in our baseline regression). Each physician reports her specialty $s(i)$ and the main regressor of interest

[19] An alternative estimate is provided by Congressional Research Service (1998) in Table 2. They provide two estimates of the percent change in payments by specialty: one that only incorporates the Conversion Factor change, and one that also accounts for contemporaneous changes in the weights (Relative Value Units) assigned to different procedures. Our results are quite similar when using either the Congressional Research Service (1998) estimates or our own calculations.

is that specialty's Medicare price change $\Delta p_{s(i)}$ interacted with survey wave fixed effects. Physician fixed effects are denoted by $\mathbb{1}_i$ and time fixed effects by $\mathbb{1}_t$ for each wave t. By including physician fixed effects, we use only variation in outcomes within a physician. The omitted time category is the 1996/97 survey wave prior to the policy change; as this is the only wave of the CTS prior to the policy change, we cannot separately estimate pre-trends. The resulting coefficients $\hat{\beta}_{98-99}$, $\hat{\beta}_{00-01}$, and $\hat{\beta}_{04-05}$, which we will present graphically, are our estimates of how the price change impacts physicians' choice of the outcome variable y_{it} in each time period after the change. We estimate all regressions using survey weights that account for the CTS sampling design,[20] and cluster standard errors at the individual (panel unit) level to account for auto-correlation of individual-level shocks.

We also estimate a pooled regression that combines all of the post-implementation survey waves and controls for flexible age trends. Letting $\text{PostImplementation}_t$ be a dummy variable indicating $t \geq 1998$, we estimate:

$$\begin{aligned} y_{it} = \beta\, \Delta p_{s(i)} \times \text{PostImplementation}_t + \xi_s \mathbb{1}_i \\ + \phi_{98-99}\, \mathbb{1}_{t=1998-99} + \phi_{00-01}\, \mathbb{1}_{t=2000-01} + \phi_{04-05}\, \mathbb{1}_{t=2004-05} + \varepsilon_{it}. \end{aligned} \tag{3}$$

4 Empirical Results

4.1 Baseline Results on Investment Margins

Figure 3 shows the dynamic results we obtain from estimating equation (2) at the individual level (physician-by-CTS wave). In each panel, 1996/97 is the omitted base year. Subsequent dots indicate the coefficient for survey waves after the price change, and blue bars indicate the 95 percent confidence interval. We find that payment increases lead to

[20] The survey over-samples primary care physicians and some regions.

increased non-patient hours (panel B) and increases in the propensity to accept new patients (panel D). The estimates are larger over the medium run than over the short run. In contrast, Panel A shows no change in patient care hours. The effect on total hours in panel E is the sum of the effects on patient and non-patient hours, and is positive in 2000/01 but close to zero otherwise.

Panel C examines the effect on board certification. Certification may respond to the payment shock via changes in initial certification or via propensities to re-certify. The effect of the price change on these margins is identified by the just over 700 changes in certification status we observe within a physician in the CTS sample.[21] Using this variation, we find no effect of the Medicare price shock on the propensity to be board certified.

Figure 4 checks whether physicians and specialties that increase their non-patient hours tend to simultaneously reduce their patient care hours. Panel A shows a binned scatterplot estimated at the individual physician level, while Panel B aggregates to the specialty level. We indeed find a strong negative relationship between changes in patient care hours and non-patient hours. This suggests that, rather than increasing overall labor supply as the target-income hypothesis would suggest, doctors facing payment cuts reallocate time from investments towards current earnings.

The CTS reports two variables for which we can assess the potential relevance of pre-existing trends: net income and annual weeks worked. These variables are reported for the years prior to the respective survey waves: 1995, 1997, 1999, and 2003. This provides two pre-periods and two post-periods surrounding the 1998 policy change. Panels A and B of Figure 5 show the dynamic responses of these variables around the payment change by estimating equation (2)'s dynamic difference-in-differences model with 1997 as the base period.[22] Changes in weeks of work from 1995 to 1997 exhibit no correlation with the

[21] Just over 500 of these changes are switches from not-certified to certified

[22] For these regressions, we restrict to physicians that had been practicing for at least two years as of the survey because the measures of weeks worked and annual income are lagged by one to two years.

payment changes enacted in 1998 (panel B), while changes in income were modestly positively correlated with the subsequent payment changes (panel A). Given the absence of a clear pattern in these results, it is difficult to know with certainty how these findings might extend to the outcomes on which we focus.

We now turn to pooled results that combine all post-implementation waves into a single period. Each panel in Table 2 reports the coefficient estimates $\hat{\beta}$ from equation (3) for the same four outcome variables and 95 percent confidence intervals. The coefficient should be interpreted as a semi-elasticity, as it relates a percentage change in Medicare reimbursements (on the right-hand side) to the level of an outcome (such as, in Panel A, patient care hours). The table also reports the sample means of the outcome variables in the pre-policy period and uses them to convert the estimates to elasticities.

The statistically insignificant coefficient of 5.54 in column 1 implies that a ten percent increase in prices increases total hours worked per week by 0.54, corresponding to an elasticity of 0.102. We can rule out elasticities greater than 0.23 and smaller than -0.03. Columns 2 and 3 show that this increase is driven by an increase in non-patient hours. We estimate elasticities of -0.0009 for patient hours and 0.49 for non-patient hours, suggesting moderate increases in the time physicians spend on activities that build their ongoing capacity.

Columns 4 and 5 shows that physicians also become more willing to take new patients when prices rise. We estimate that a 10 percent increase in prices results in a 0.016 point increase in our index (from 0 to 1) of physicians' willingness to take new patients, corresponding to an elasticity of 0.218. In contrast, there is no effect on the probability of holding board certification.

Economic theory makes it quite natural to find upward-sloping supply responses to Medicare payments. But it is less obvious how increased payment rates for Medicare patients will influence treatment for some of society's least advantaged members, such as Medicaid patients. Medicaid pays less than Medicare, and imposes significant hassle on physicians as

well, making them less likely to treat Medicaid beneficiaries. So Medicaid patients can likely be considered as the residual claimants on spare capacity: providers may be unlikely to expand capacity specifically for Medicaid patients, but nevertheless willing to use existing space capacity for this population. So when Medicare payments drive a capacity expansion, this subsequent relaxation of capacity constraints may incidentally benefit Medicaid patients. In addition, higher incomes could make physicians simply more generous.

To examine these possibilities, Table 3 decomposes the types of new patients that physicians are willing to accept. Payment declines predict declines in the propensity to accept new patients for both Medicare and Medicaid patients, but with the Medicaid effect twice as strong as Medicare. This indicates that changes in practice patterns do not merely reflect shifts in supply of care to patients covered by different payers. Instead, the evidence suggests that increased capacity benefits those who may have otherwise had the least access to care.

Table 4 presents results for weeks worked and income. The elasticity of 0.014 for weeks worked is statistically insignificant and economically modest. The estimated elasticity for log income suggests that a ten percent increase in prices causes a 2.5 percent increase in income in the short-run, but recall that income is very poorly measured.

A final consideration for the interpretation of these results is measurement error. We proxy for each physician's change in reimbursement rate using the specialty-level estimate described in section 3. But individual doctors are sure to be heterogeneous in how the payment change affects their average fees. This would appear as measurement error in our regressions, attenuating the estimated responses towards zero.[23]

The results presented in this section highlight the importance of distinguishing between revenue-generating work hours and overall labor supply. Revenue-generating patient care

[23]The hours variables also likely contain substantial measurement error. One source of error is rounding. Appendix Figure A.7 demonstrates that the percent of responses that are a multiple of five range from 63 to 81 percent for the hours variables. We expect such measurement error to widen the confidence intervals, but otherwise be innocuous.

hours exhibit a very modestly negative wage elasticity in the years following the payment shock, which could be interpreted as slightly backward-bending labor supply. Yet the positive relation between wages and investments contradicts the notion that physicians scale back overall work in response to increased wages. This raises the question of how current policy affects long-run service supply. If investments increase the efficiency or quality of care in the long-run, then price changes will have longer-lasting effects that are missed by examining short-run responses.

5 Conclusion

We investigate how changes in Medicare's payment rules affect physicians' investments in their careers. We find that these investments respond positively to their returns. Over the medium run, physicians respond to an increase in reimbursement rates by increasing the time spent on investment activities. Consistent with this time investment, they become more willing to accept new patients when reimbursements increase. The increase in capacity seems to especially benefit those most likely to be residual claimants on physician capacity, such as Medicaid beneficiaries. One reason physicians may be well-positioned to respond to government payment rules is the structure of the industry. Many physicians run individual or small practices, and can choose how to allocate their time and resources.[24]

Our results imply that policymakers and researchers must pay close attention to physicians' investments in human capital and overall practice capacity, and to the intended lengths of their careers, which drive the health system's long-run capacity to deliver services. Because investments respond positively to payment rates, a policymaker seeking to alleviate a shortage will have long-run success by increasing payment rates rather than decreasing

[24]In recent years, physician practices have been merging and growing (Welch et al., 2013). But this trend mostly occurred after the time period we consider (Liebhaber and Grossman, 2007; Robinson, 1998), and even now one-third of physicians work in small practices (Muhlestein and Smith, 2016). Appendix Table A.1 shows the distribution of practice types for our sample.

them. In contrast, payment reductions make sense when one thinks too much care is being provided.

These results are an important input for policymakers considering major health system reforms. A major cut in payment rates would reduce providers' incentives to increase capacity. This could reduce the amount of care available, and thus the system's slack capacity. This slack capacity is expensive at normal times, but could have spillover benefits for Medicaid patients and in situations when healthcare demand increases.

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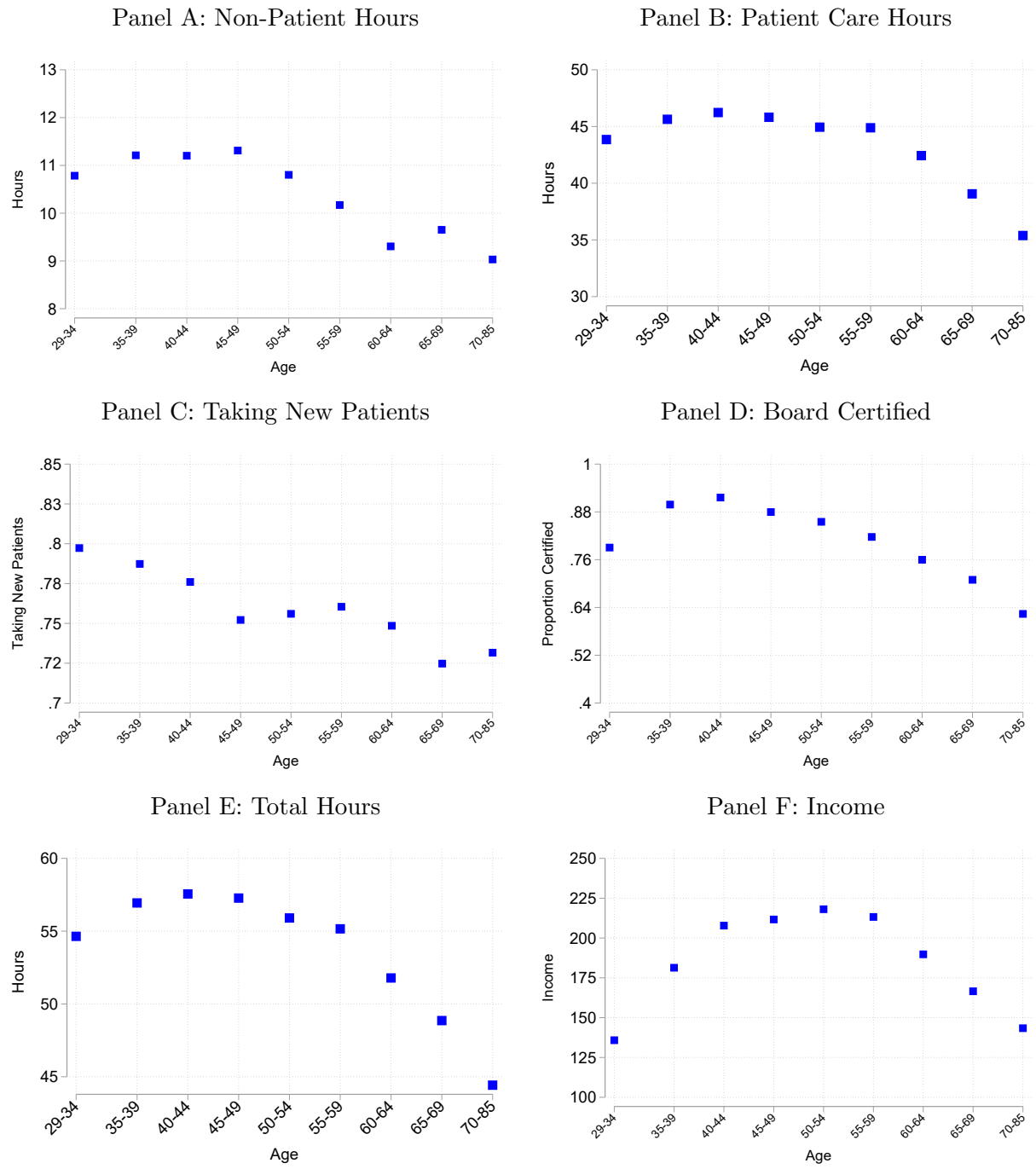
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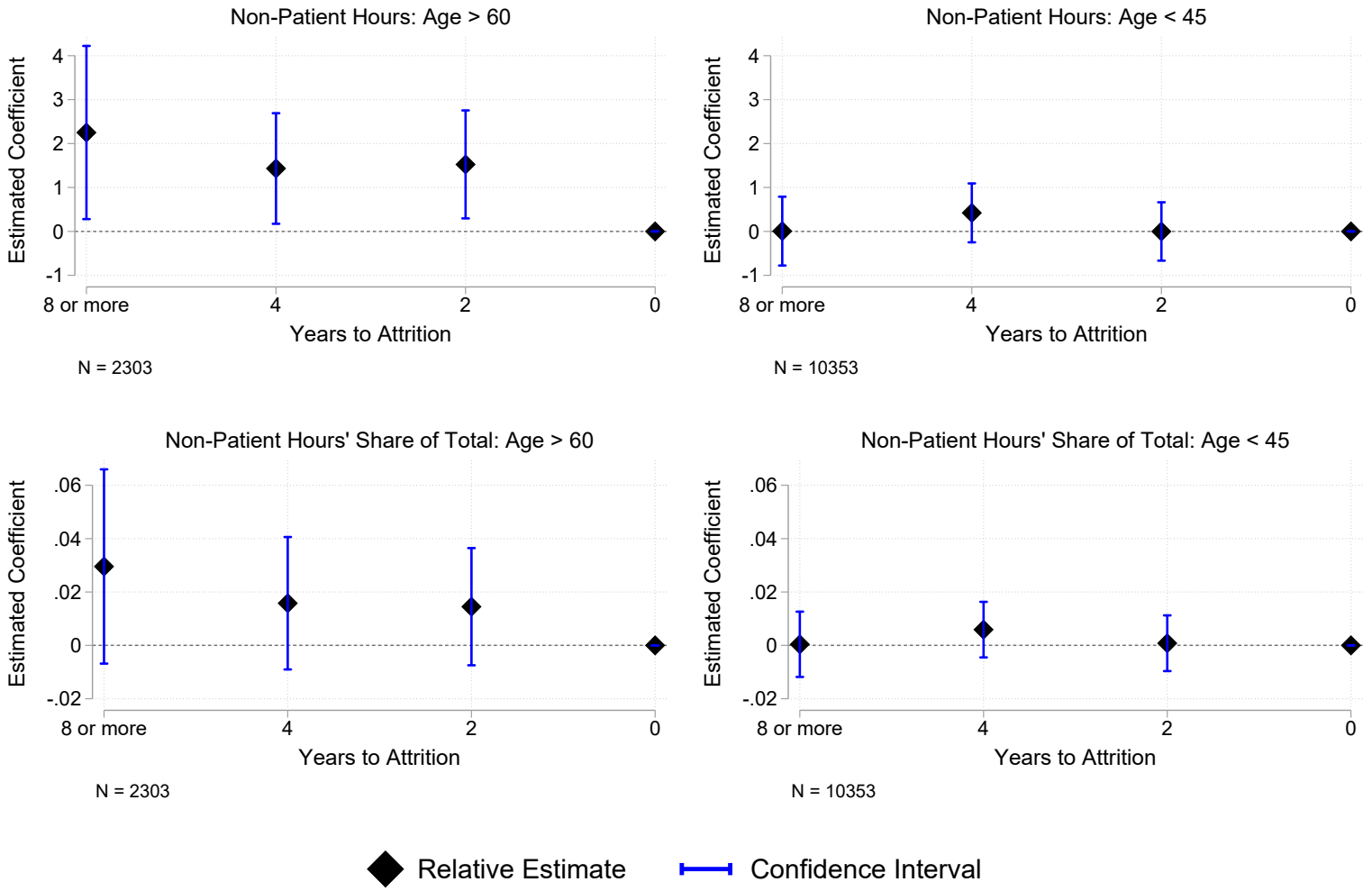
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Figure 1: Age Profile of Investment Activities and Labor Supply



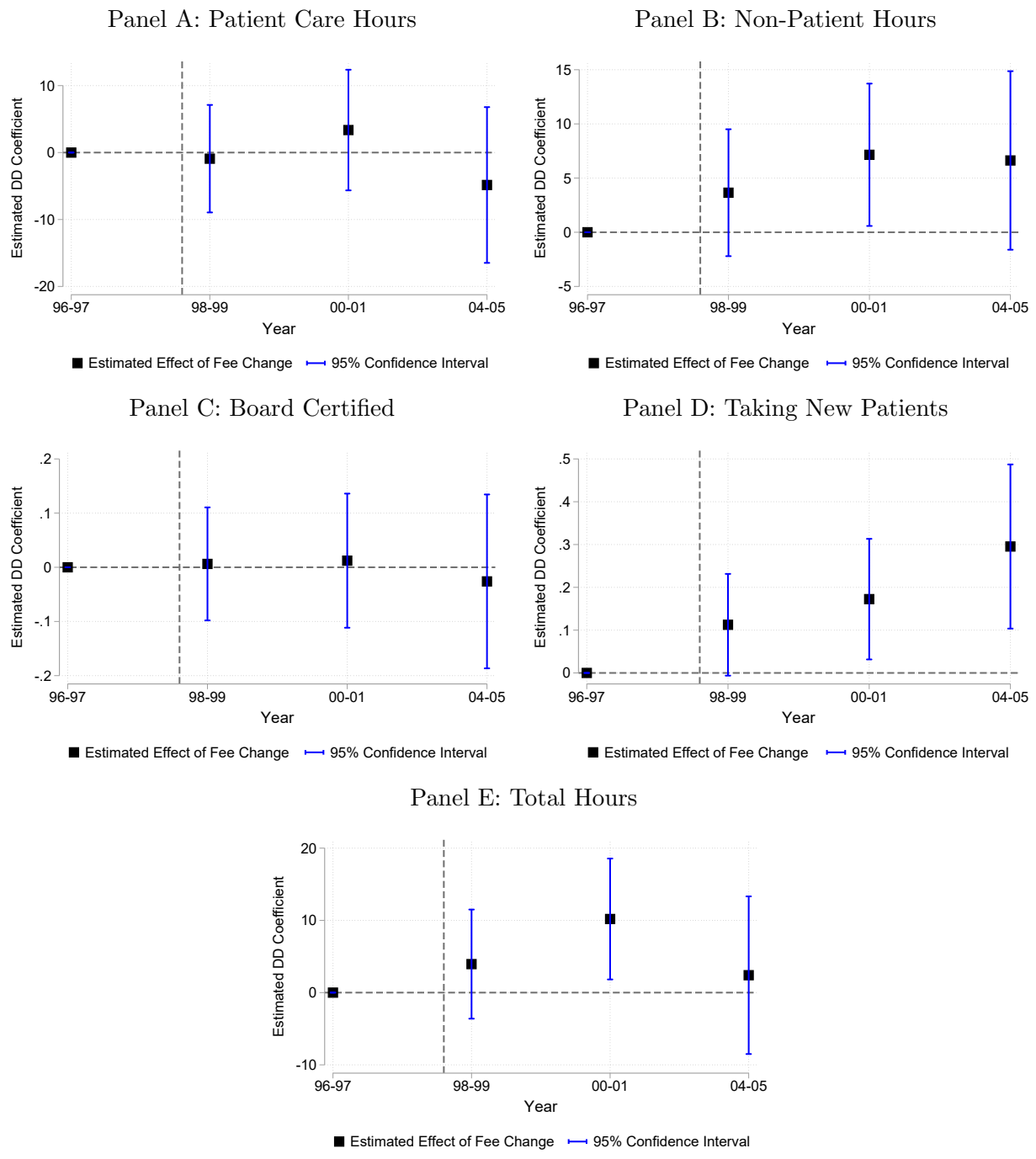
Note: This figure plots the age profile of investment activities and labor supply. Physicians are binned into five-year age bins, and the upper tail groups together those aged 70 to 85. For each variable, the mean values within each bin are plotted. Only data from the 1996-97 wave is used. Source: Authors' calculations based on data from the Community Tracking Study, 1996/97 wave only (Center for Studying Health System Change, 1999).

Figure 2: Non-Patient Hours Before Retirement



Note: The estimated coefficients from equation (1) are shown above for non-patient hours in levels and as a share of total hours. The base group is physicians who are in their final observed period. So coefficients $\hat{\alpha}_2$, $\hat{\alpha}_4$, and $\hat{\alpha}_8$ estimate the differences in the outcome variable for physicians 2, 4, or $\geq$8 years *prior* to attrition, relative to those making their final appearance in the sample. For physicians age 60 or older, weekly non-patient hours decline as they approach their final year in the Community Tracking Study panel. For young physicians, the number of years until attrition from the panel does not predict non-patient hours. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

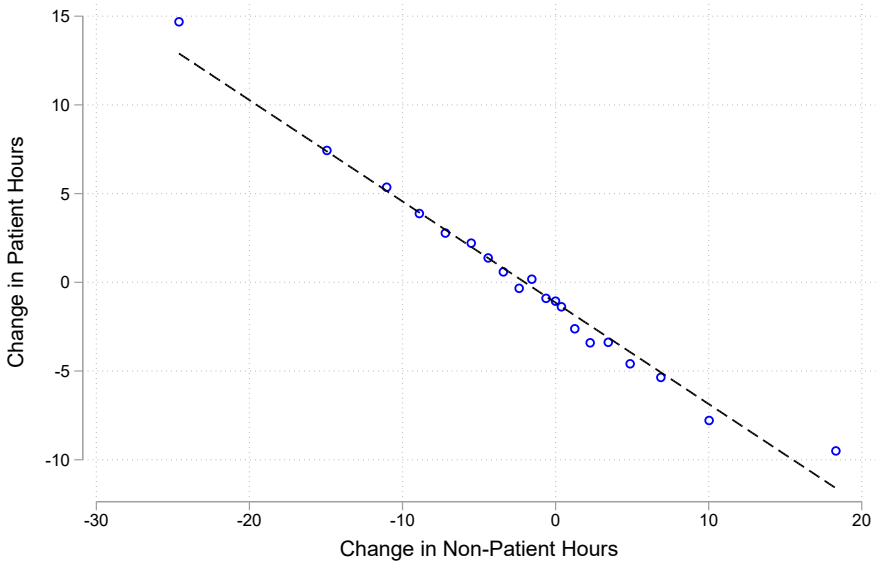
Figure 3: Dynamic Responses to Medicare Fee Change



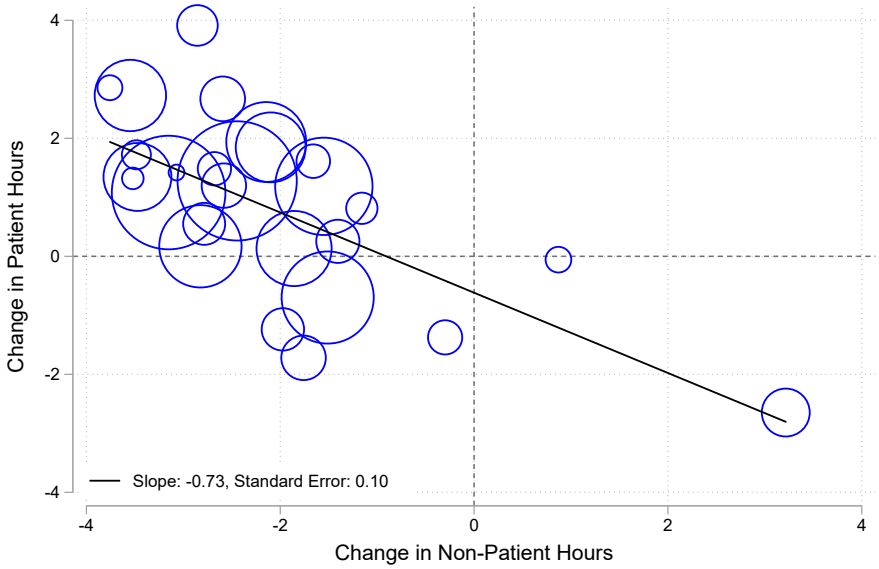
Note: This figure plots the estimates of $\hat{\beta}_{98-99}$, $\hat{\beta}_{00-01}$, and $\hat{\beta}_{04-05}$ from equation (2). The coefficients represent the change in the outcome variable associated with a 1 percentage point increase in the Medicare reimbursement rate for each wave after the change. Standard errors are clustered at the individual (panel unit) level and 95 percent confidence intervals are shown in blue. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

Figure 4: Changes in Patient Care and Non-Patient Hours

Panel A: Individual Physician Changes

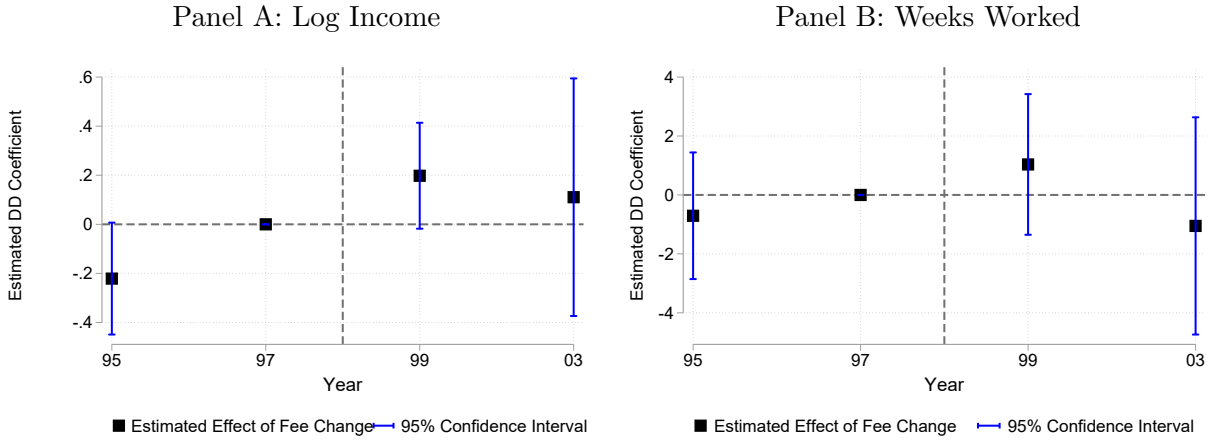


Panel B: Specialty Aggregates



Note: In order to investigate whether physicians are trading off patient care against non-patient hours, Panel A plots the change in patient hours against that in non-patient hours by physician. We restrict the sample to physicians observed in both the 1996/97 wave at least one subsequent wave. For these physicians, we calculate the changes in patient hours and in non-patient hours between the 1996/97 response and the average of all responses in subsequent waves. We display a binned scatterplot of this relationship, by forming 20 equally sized bins grouped based on the change in non-patient hours. Panel B shows the same exercise, but where changes are calculated at the specialty level, following the procedure for computing the Δy_s used in equation (**??**). Aggregating to the specialty level should mitigate the effects of any potential measurement error that might create a bias in the individual-level relationship shown in Panel A.

Figure 5: Income and Weeks Worked Responses to Medicare Fee Change



Note: Income and weeks worked are reported for the years 1995, 1997, 1999, 2003, allowing only a narrow look at potential differing pre-trends. Panels A and B plot the dynamic estimates from equation (2), except the coefficients of interest are $\hat{\beta}_{95}$, $\hat{\beta}_{99}$, and $\hat{\beta}_{03}$. The coefficients represent the change in the outcome variable associated with a 1 percentage point increase in the Medicare reimbursement rate for each year relative to 1997. Standard errors are clustered at the individual (panel unit) level and 95 percent confidence intervals are shown in blue. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

Table 1: Predicted Medicare Fee Changes by Specialty

Specialty	Change (%)	Specialty	Change (%)
Cardiac Surgery	-9.18	Critical Care (Intensivists)	5.41
Radiation Oncology	-8.83	Pediatric Medicine	5.55
Thoracic Surgery	-8.08	Preventive Medicine	5.81
Plastic/Reconstructive Surgery	-7.45	Addiction Medicine	5.83
Colorectal Surgery (Proctology)	-7.25	Hematology	5.91
Neurosurgery	-6.44	Physical Medicine and Rehab.	5.93
General Surgery	-5.54	Rheumatology	6.10
Orthopedic Surgery	-5.49	Hematology-Oncology	6.25
Surgical Oncology	-5.09	Medical Oncology	6.26
Dermatology	-4.97	General Practice	6.36
Hand Surgery	-4.90	Pulmonary Disease	6.62
Vascular Surgery	-4.85	Emergency Medicine	6.76
Maxillofacial Surgery	-4.76	Internal Medicine	6.92
Ophthalmology	-3.44	Neurology	7.11
Sports Medicine	-2.87	Family Practice	7.23
Gastroenterology	-2.77	Intensive Cardiac Rehab.	7.30
Nephrology	-2.59	Neuropsychiatry	7.50
Gynecological Oncology	-2.22	Infectious Disease	7.85
Obstetrics & Gynecology	-0.68	Allergy Immunology	7.97
Otolaryngology	0.11	Geriatric Medicine	8.00
Urology	0.61	Psychiatry	8.10
Osteopathic Manipulative Med.	3.17	Endocrinology	8.11
Cardiology	4.95	Psychologist, Clinical	8.37

Note: This table shows the predicted Medicare fee changes by specialty. We estimate these using data provided in the Physician/Supplier Procedure Summary (PSPS) file released by the Centers for Medicare and Medicaid Services. This file reports state-level aggregate data on Medicare's purchases of care from physicians and other professional suppliers at the service line level. For each state and individual medical service, the file reports how many services Medicare purchased and how much it spent. To estimate the overall percent change in payments by specialty, we look at each specialty's composition of services as of 1997. We take a weighted average of the Conversion Factor change, where each specialty's weight depends on the share of Medicare spending that comes from surgical procedures.

Table 2: **Changes in Hours and Capacity**

	Total Hours	Patient Hours	Non-Patient Hours	Taking New Patients	Certified
Price Change × Post	5.54	-0.38	5.25*	0.16**	0.00
	[-1.43,12.52]	[-7.86,7.10]	[-0.16,10.66]	[0.05,0.27]	[-0.10,0.10]
N	31,760	31,760	31,760	31,760	31,756
Outcome Mean (1996/97)	54.48	43.87	10.52	0.74	0.83
Elasticity	0.102	-0.009	0.499	0.218	0.002

Note: Estimates from equation (3) are shown for Total Work Hours, Patient Care Hours, Non-Patient Hours, Board Certification, and Willingness to Take New Patients. The coefficients displayed are from the interaction between a Post-1997 indicator and the predicted percentage change in Medicare payments by specialty, scaled to be between zero and one. The coefficients thus represent the change in the outcome variable associated with a 100 percent increase in the Medicare reimbursement rate. The implied elasticities are obtained by dividing the coefficient by the mean of the outcome variable in the 1996/97 wave. Standard errors are clustered at the individual level. Stars indicate coefficients statistically distinguishable from zero, with **: $p < 0.05$, $*$: $p < 0.10$. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

Table 3: **Willingness to Take New Patients by Patient Type**

	New Patients	New Medicare	New Private	New Medicaid
Price Change × Post	0.161**	0.141*	0.067	0.275**
	(0.057)	(0.072)	(0.075)	(0.087)
N	31,760	31,760	31,760	31,760
Mean of Dep. Var. (1996/97)	0.74	0.77	0.83	0.62
Implied Elasticity	0.22	0.18	0.08	0.44

Note: Estimates from the baseline pooled difference-in-difference are shown for willingness to take new patients by patient type: Private, Medicare, and Medicaid. The coefficients displayed are from the interaction between a Post-1997 indicator and the predicted percentage change in Medicare payments by specialty. The predicted change is scaled between zero and one. The coefficients represent the change in the outcome variable associated with a 100 percent increase in the Medicare rate. The implied elasticities are obtained by dividing the coefficient by the mean of the outcome variable in the 1996/97 wave. Standard errors are clustered at the individual level. Stars indicate coefficients statistically distinguishable from zero, with **: $p < 0.05$, $*$: $p < 0.10$. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

Table 4: Changes in Annual Income and Weeks Worked

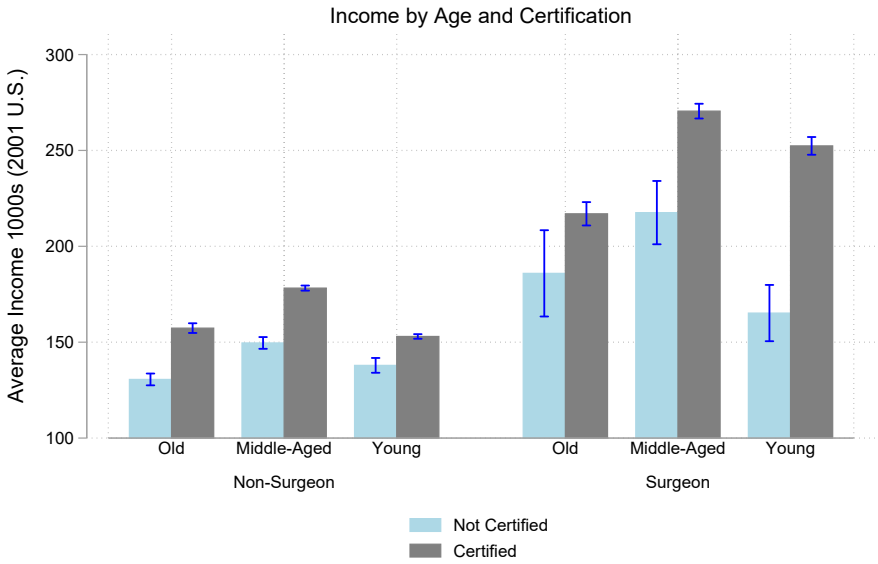
	Log Income	Weeks Worked
Price Change × Post	0.25*	0.66
	[0.01,0.50]	[-1.42,2.74]
N	30,298	30,235
Outcome Mean (1996/97)	5.11	47.59
Elasticity	0.251	0.014

Note: Estimates from the baseline pooled difference-in-difference are shown for log income and annual weeks worked. The coefficients displayed are from the interaction between a Post-1997 indicator and the predicted percentage change in Medicare payments by specialty. Income and weeks worked are reported for the years 1995, 1997, 1999, 2003, so the Post-1997 indicator captures two survey waves. Respondents that had been practicing for fewer than 2 years at the time of survey are excluded. The predicted change is scaled between zero and one. The coefficients represent the change in the outcome variable associated with a 100 percent increase in the Medicare rate. The implied elasticity for log income is the coefficient itself. The implied elasticity for weeks worked is obtained by dividing the coefficient by the mean of the outcome variable in the 1996/97 wave. Standard errors are clustered at the individual level. Stars indicate coefficients statistically distinguishable from zero, with **: $p < 0.05$, $*$: $p < 0.10$. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

Appendix for Online Publication Only

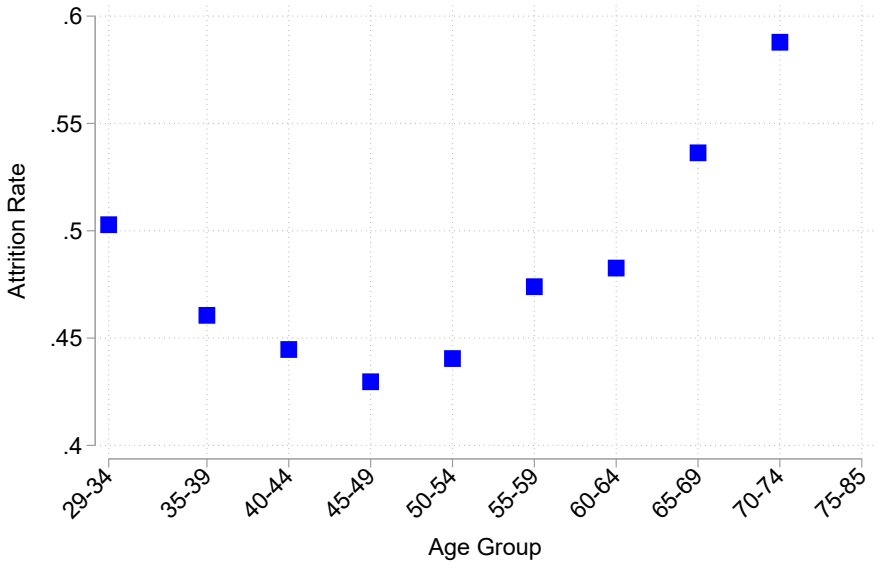
A Supplementary Results and Robustness

Appendix Figure A.1: Cross-Sectional Relationship between Certification Status and Income



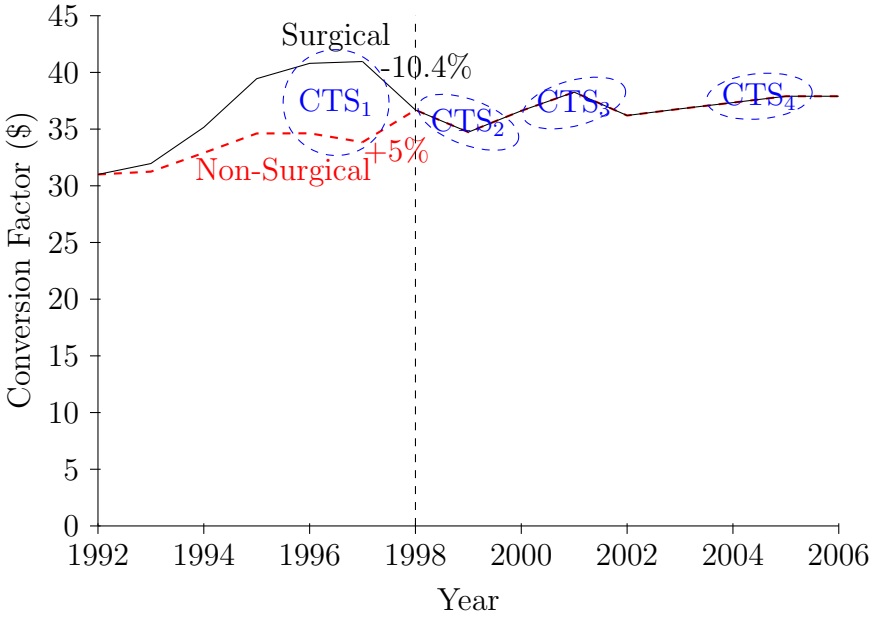
Note: This figure presents data on the incomes of physicians with and without board certification across age groups and specialties. At all age groups, and for both surgical and non-surgical specialties, certification is correlated with higher incomes. 95 % confidence intervals of the means are shown. Source: Authors' calculations based on data from the Community Tracking Study, 1996/97 wave only (Center for Studying Health System Change, 1999).

Appendix Figure A.2: Attrition Rates by Age



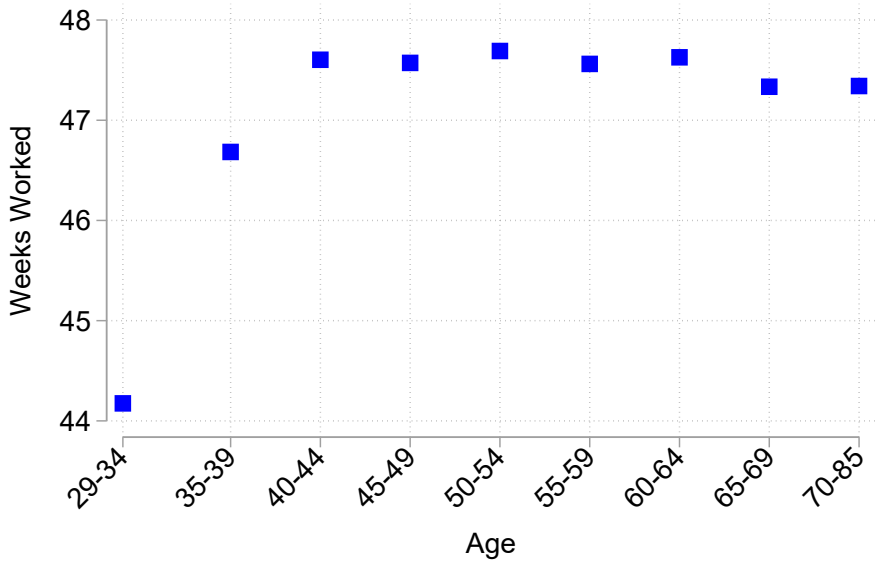
Note: This figure plots raw sample attrition rates by age group. Doctors aged 40–55 have a hazard rate of between 0.4 and 0.45, with this rate steadily rising to 0.65 by ages 75–85. This is suggestive of retirement driving increases in sample attrition for older physicians. Assuming that attrition among doctors aged 45–49 is unrelated to retirement, and that retirement is the sole reason for increased attrition among older physicians, then we can infer that 19% of attrition among doctors aged 65–69, and 25 percent among physicians aged 70–74, is caused by retirement. To see this, note that the 10 percentage point differential between ages 45–49 and 65–69 is 19% of total attrition for the 65–69 age group. Similarly, the 15 percentage point differential between ages 45–49 and 70–74 is 25% of attrition among the 70–74 group. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

Appendix Figure A.3: Evolution of Medicare Conversion Factors



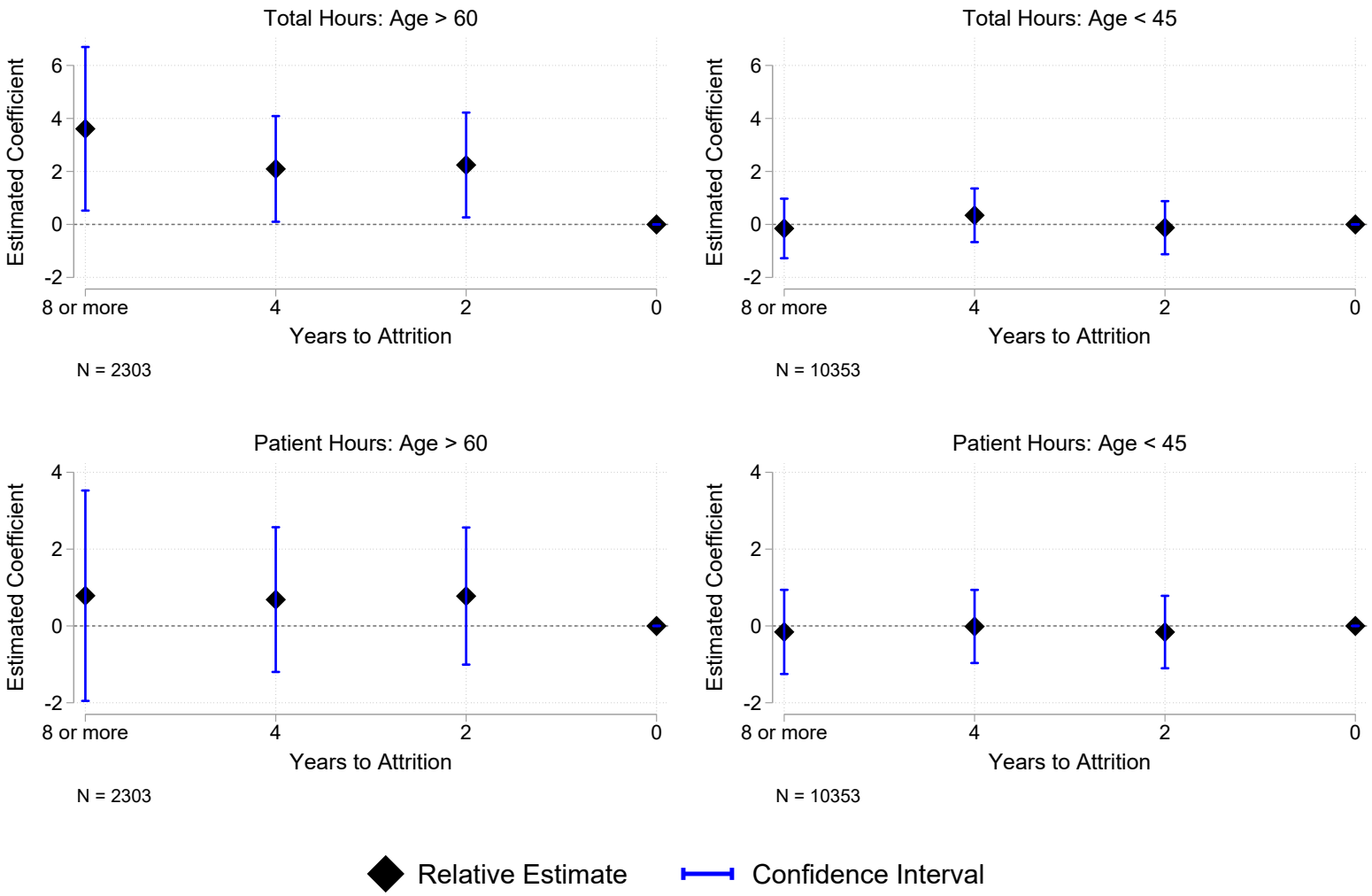
Note: This figure is adapted from Clemens and Gottlieb (2017). It plots the evolution of the Conversion Factors for surgical and non-surgical procedures in the Medicare payment schedule. The dotted circles show the survey waves of the Community Tracking Study. Original source: *Federal Register*, various issues

Appendix Figure A.4: Weeks Worked by Age



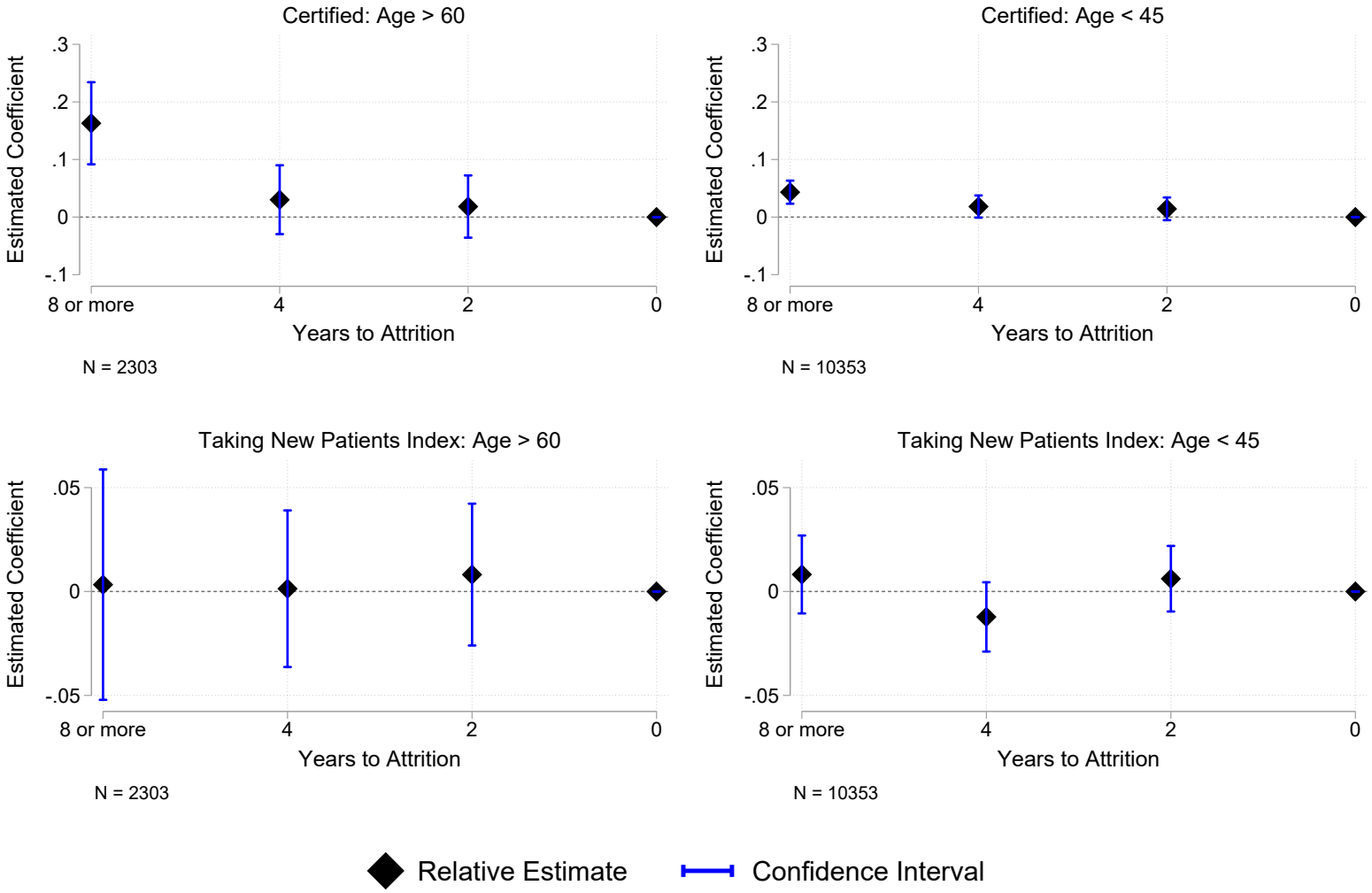
Note:

Appendix Figure A.5: Labor Supply Before Retirement



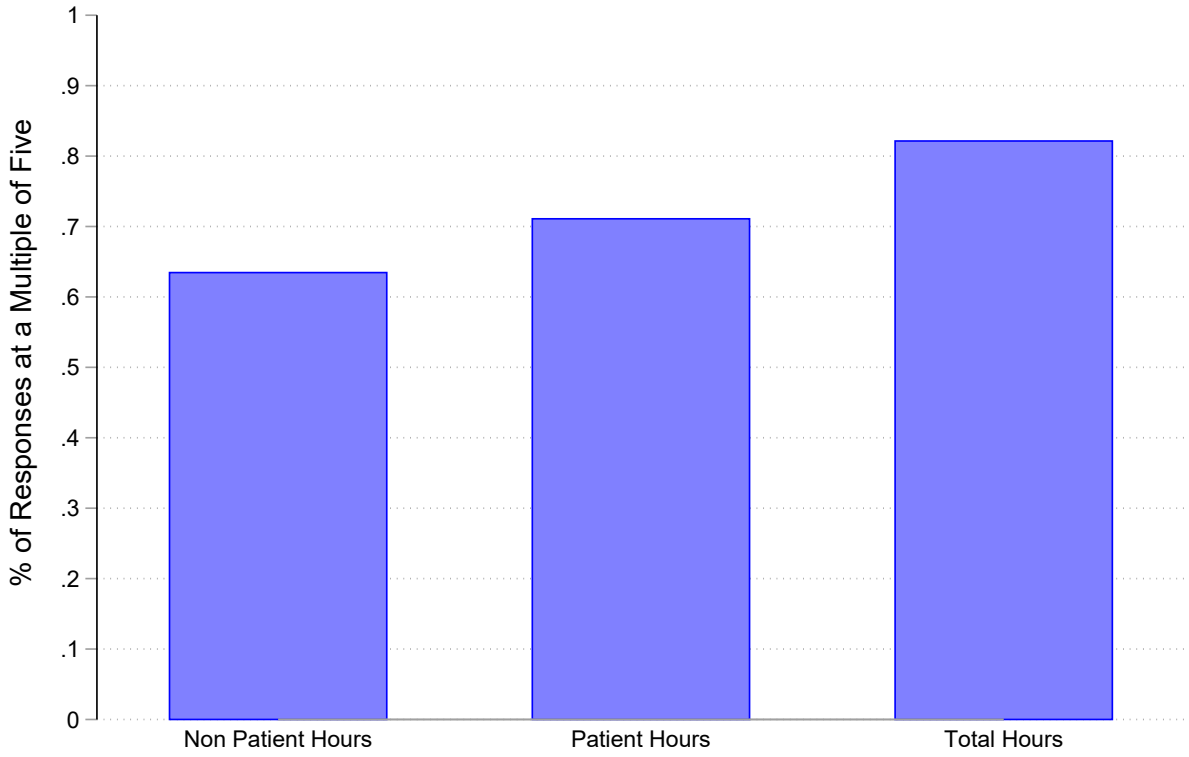
Note: The estimated coefficients from equation (1) are shown above for total hours and patient care hours as the outcome variables. Each dot represents the difference in the outcome variable relative to the base group that attrits immediately. For physicians age 60 or older, non-patient hours decline as they approach their final year in the Community Tracking Study panel. For young physicians, the number of years until attrition from the panel does not predict non-patient hours. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

Appendix Figure A.6: Other Investments Before Retirement



Note: The estimated coefficients from equation (1) are shown above for board certification and taking new patients as the outcome variables. Each dot represents the difference in the outcome variable relative to the base group that attrits immediately. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

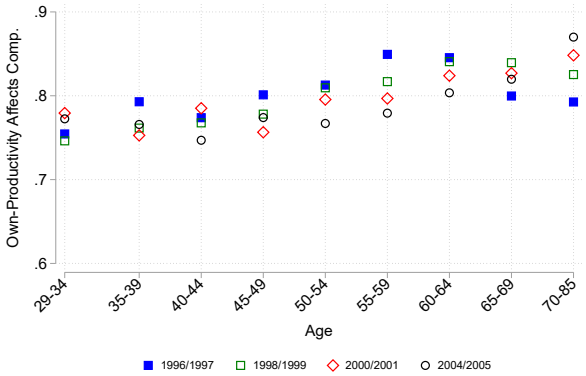
Appendix Figure A.7: The Magnitude of Round Number Reporting



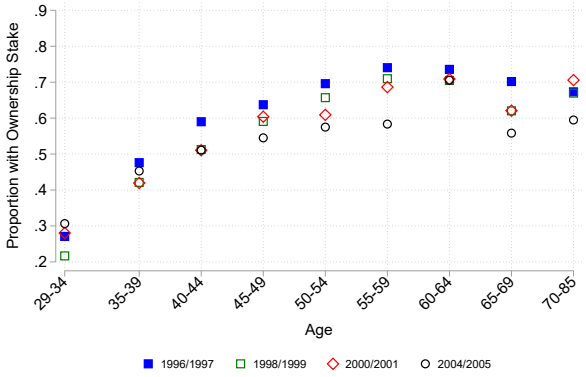
Note: This figure plots the percent of responses that are a multiple of five for each of the three hours variables. Responses with reported hours of zero are excluded from both the numerator and denominator. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

Appendix Figure A.8: Cross-Sectional Age Profile of Ownership and Salary Structure

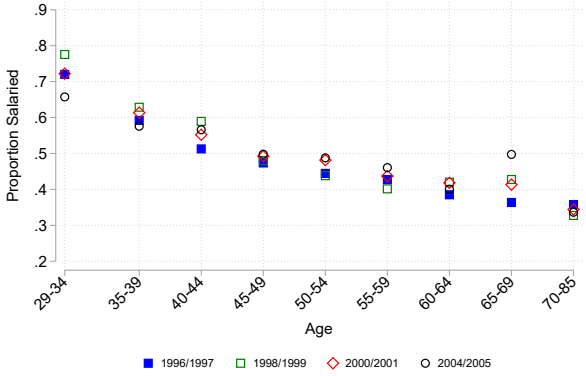
Panel A: Own-Productivity Affects Compensation



Panel B: Ownership Stake in Primary Practice

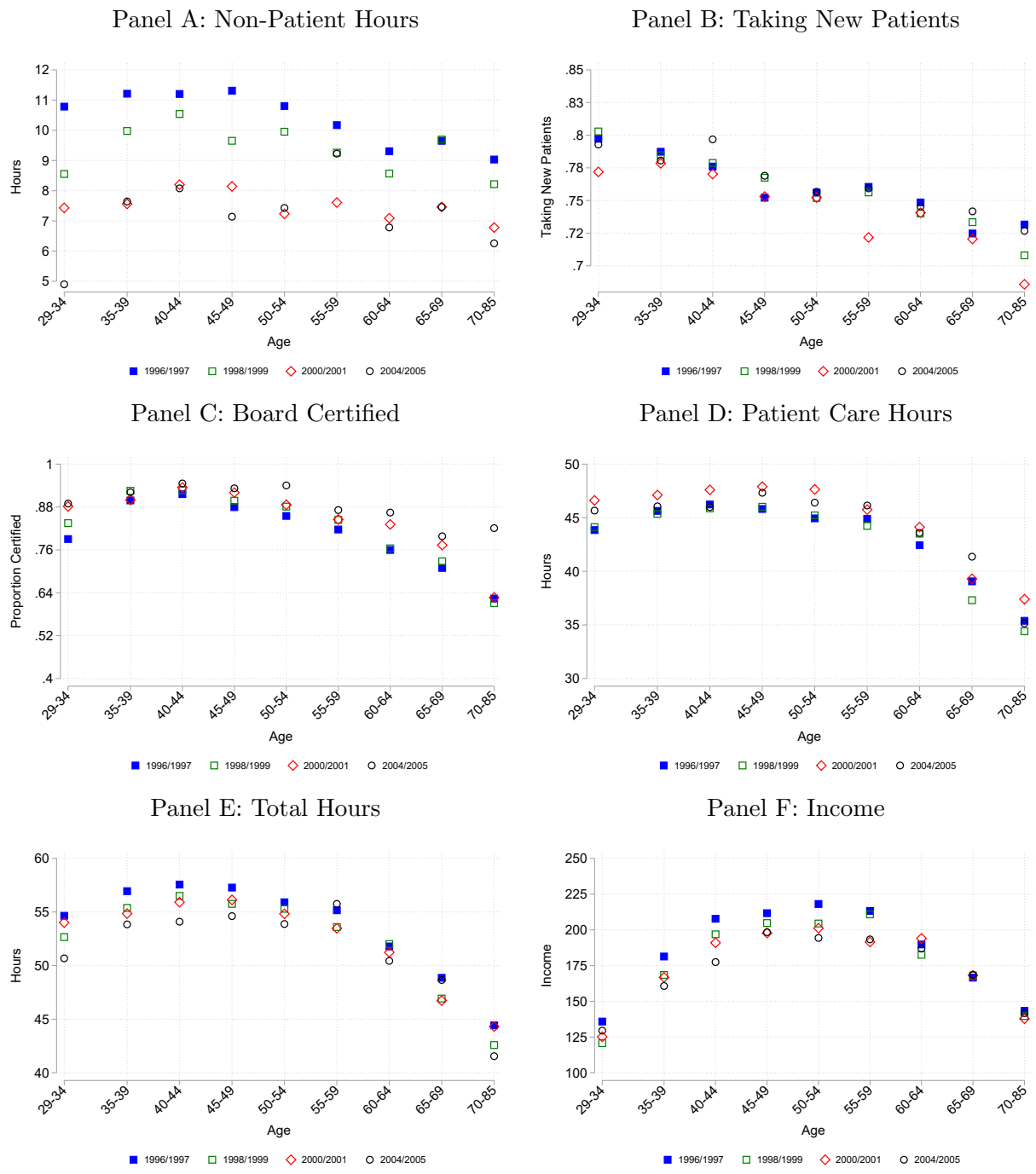


Panel C: Remunerated on a Salary Basis



Note: Panel A plots the percent of physicians reporting that their own-productivity affects their compensation. Panel B plots the percent that are full or partial owners of their practice. Panel C shows the proportion of physicians that report being remunerated on a salary basis, each by age group. These variables may affect a physician's incentive and ability to adjust on-the-job investments in response to price changes. Given the strong correlations with age, these factors could influence the age gradient of how on-the-job investments respond to Medicare payment changes. Source: Authors' calculations based on data from the Community Tracking Study, 1997–98 wave only (Center for Studying Health System Change, 1999).

Appendix Figure A.9: Age Patterns by Survey Wave



Note: This figure plots average weekly patient care hours, and total weekly hours worked, by age group. Source: Authors' calculations based on data from the Community Tracking Study, 1996/97 wave only (Center for Studying Health System Change, 1999).

Appendix Table A.1: Practice Type

	Count
Solo Practice	12577
Group Practice	12093
Privately-Owned Hospital	5021
Medical School/Univ	3429
Two Physician Practice	3008
Group Model HMO	1258
Free-Standing Clinic	1150
Staff Model HMO	1134
State/local Government Hospital	621
State/local Government Clinic	531
Other	510
Integrated Health System	466
PPM	455
Community Health Center	367
Independent Contractor	321
State/local Government Other	211
PHO	185
Foundation	99
MSO	89
Locum Tenens	89
Other Insurance	79
Employer-based Clinic	74
Total	43767

This table displays the frequency of different practice types as reported by respondents. Solo practice, two-physician, and group practice make up the large majority of respondents. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

Appendix Table A.2: **Descriptive Statistics by Panel Length**

	Number of Times Observed in Panel			
	1	2	3	4
Patient Hours	44.26	44.16	44.22	45.04
Non-Patient Hours	9.16	8.80	9.06	8.91
Total Hours	53.50	53.06	53.35	54.02
Weeks Worked	46.81	47.28	47.50	47.50
Certified	0.83	0.86	0.86	0.91
Taking New Patients	0.75	0.74	0.73	0.74
Income	167	169	173	187
Age	46.78	47.66	49.39	49.96
Gender (Male 0 Female 1)	0.27	0.26	0.23	0.20
Full/Partial Owner	0.50	0.51	0.56	0.61
Salaried	0.56	0.55	0.52	0.48
Own-Productivity Affects Compensation	0.78	0.78	0.79	0.81
N	11984	5522	4345	1926

This table reports means by the number of survey waves in which the physician appeared. The maximum is four, corresponding to being observed in all four survey waves. Source: Authors' calculations based on data from the Community Tracking Study (Center for Studying Health System Change, 1999).

A.1 Extensions and Robustness Checks

This section discusses additional extensions and robustness checks.

A.1.1 Cohorts

First, we investigate whether cohort trends confound the interpretation of the age profiles from section 2 by plotting the profile of labor supply and investment within each survey wave in Figure A.9. Encouragingly, the age profiles for patient hours, total hours, taking new patients, and income are invariant over time. In contrast, the profile for non-patient hours shifts downwards for all age groups. The late-career decline diminishes slightly, but remains visible in later waves. The percent decline from age 45-49 to age 60-85 in 1996/97 was 18 percent; in 2000/01, it was 12 percent. Finally, board certification propensity increased among older age groups, but remained constant among the young. This indicates higher certification rates among younger cohorts, which would overstate the old-age decline apparent in 1996/97.

B Data Appendix

B.1 Questionnaire Wording

Total Labor Supply

The CTS uses the following wording to elicit total hours of work:

> Thinking of your last complete week of work, approximately how many hours did you spend in all medically related activities? Please include all time spent in administrative tasks, professional activities and direct patient care. Exclude time on call when not actually working.

Patient Care Hours

Immediately after asking about total hours, the following question is asked to measure patient care hours:

> Thinking of your last complete week of work, about how many hours did you spend in direct patient care activities? (If necessary, read:) INCLUDE time spent on patient record-keeping, patient-related office work, and travel time connected with seeing patients. EXCLUDE time spent in training, teaching, or research, any hours on-call when not actually working, and travel between home and work at the beginning and end of the work day.

Income

In each survey wave, respondents are ask to report their income net of expenses for the calendar year preceding the survey wave:

> During 1995 [**authors' note: or 1997, 1999, 2003**], what was your own net income from the practice of medicine to the nearest $1,000, after expenses but before taxes? Please include contributions to retirement plans made for you by the practice and any bonuses as well as fees, salaries and retainers. Exclude investment income. (If code "2" in # A4, read:) Also, please include earnings from ALL practices, not just your main practice. (If necessary, read:) We define investment income as income from investments in medically related enterprises independent of a physician's medical practice(s), such as medical labs or imaging centers.

Weeks Worked

Similarly, respondents report their number of weeks worked in the year prior to the survey wave:

> Considering all of your practices, approximately how many weeks did you practice medicine during 1995 [**authors' note: or 1997, 1999, 2003**]? Exclude time missed due to vacation, illness and other absences. (If necessary, read:) Exclude family leave, military service, and professional conferences. If your office is closed for several weeks of the year, those weeks should NOT be counted as weeks worked.

B.2 Variable Construction

We winsorize each of the hours variables at 105 hours per week. This is equivalent to 15 hour work days seven days a week. This is a fairly extreme upper bound on what a "usual" work week can feasibly look like.

Willingness to Accept New Patients

The original survey asks:

Medicare:

> Is the practice accepting all, most, some, or no new patients who are insured through Medicare, including Medicare managed care patients?

Medicaid:

> Is the practice accepting all, most, some, or no new patients who are insured through Medicaid, including Medicare managed care patients?

Private:

> Is the practice accepting all, most, some, or no new patients who are insured through private or commercial insurance plans including managed care plans and HMOs with whom the practice has contracts? This includes both fee for service patients and patients enrolled in managed care plans with whom the practice has a contract. It excludes Medicaid or Medicare managed care.

All, most, some, and none correspond respectively to 4, 3, 2, and 1 in the survey coding. We sum the responses to each of the three questions, subtract 3, and divide by 9 so that the resulting index ranges from 0 to 1.

Board Certification

In the 1996/97, 1998/99, and 2000/01 waves, we use the derived variable BDCERT. Physicians are classified into one of four mutually-exclusive categories: (i) Board certified in any specialty, (ii) Board eligible in any specialty, (iii) Neither, (iv) Not Ascertained. If the physician fell in group (ii), (iii), or (iv) we classified them as not certified.

In the 2004/05 wave, the BDCERT variable was replaced by BDCTANY, which simply classifies respondents into two mutually-exclusive categories: (i) Board certified in any specialty, (ii) Not board certified in any specialty.

Does Productivity Determine Compensation

The survey specifically asks physicians if their own productivity influences compensation. We capture this use a binary variable derived from the answer to the following question:

> I am now going to read you a short list of factors that are sometimes taken into account by medical practices when they determine the compensation paid to physicians in the practice. For each factor, please tell me whether or not it is EXPLICITLY considered when your compensation is determined:
>
> YOUR OWN productivity
>
> (If necessary, read:) Examples include the amount of revenue you generate for the practice, the number of relative value units you produce, the number of patient visits you provide, or the size of your enrollee panel.