Physician Competition and Quality of Care: Empirical Evidence from Medicare’s Physician Quality Reporting System

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Abstract

Using data on physician treatment quality from Medicare’s Physician Compare Quality Reporting System, this study explores the effects of physician practice competition on five distinct quality metrics directly tied to screening and follow-up care. Controlling for physician and practice attributes, it finds strong evidence that physicians in moderately and highly concentrated physician service markets have lower quality ratings than those in unconcentrated markets. Exploring differentiated effects across primary care and specialist providers, the results are predominately driven by primary care physicians.

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1 Introduction

In the national debate on how to effectively pay for healthcare, much of the focus has been placed on making care affordable and discussing how much patients should pay for the care they receive. These debates often assume that the quality of care is high and that there is little variation in quality across providers. However, with the creation of quality measures from administrative datasets it has become evident that not all providers are equal. Websites such as Hospital and Nursing Home Compare show that there is significant variation in quality across providers. Though our understanding of what drives quality in hospitals and nursing homes has improved, relatively little is known about the factors that determine quality of care in physician markets. Of particular importance is our understanding of how physicians respond to competition (Gaynor and Town, 2011), as health insurer market power has accelerated the consolidation of physician practices (Brunt and Bowblis, 2014).

Understanding how the consolidation of physician practices may impact the quality of care requires an examination of the market structure and level of competition among physician practices. Historically, physicians were perceived to operate in monopolistically competitive markets. However, recent empirical work has demonstrated that many physicians operate in more concentrated markets based on geographic proximity to other physicians and the uniqueness of services provided by specialists. For example, a study of Medicare, which is the government insurance program for older Americans (i.e. 65+) and the disabled, found evidence of highly concentrated physician markets despite conditions that are favorable for competition such as a national market and widespread physician acceptance (Kleiner et al., 2012).1 While researchers have found evidence suggesting that physicians in more concentrated markets use their market power to increase the price of medical care among the privately insured (Baker et al., 2014b; Dunn and Shapiro, 2014; Kleiner et al., 2015), it is not clear how this concentration can impact care for Medicare patients. Prices for physician office visits under Medicare are set annually using a national fee schedule with no room for negotiations on the part of physicians. Therefore physicians are unable to exercise the same influence over service prices found in private insurance. Thus in the absence of direct price competition, physicians may attempt to attract and retain Medicare patients based on other aspects of service provision such as the quality of treatment.

A number of studies have produced theoretical predictions for the relationship between quality of treatment and competition with regulated prices. While some notable theoretical models have found an ambiguous relationship (see for example Dranove and Satterthwaite 1992; Brekke et al. 2011), the consensus within the literature is that competition improves quality in the presence of price regulations (Gaynor and others,

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1Brunt and Jensen (2014) estimated that in 2008, 76% of survey physicians were accepting new Medicare patients. Recent analysis by the National Center for Health Statistics estimated 92% of physicians were accepting new Medicare patients.
Empirically, evidence on competition with regulated prices largely stems from the evaluation of hospitals and nursing homes under Medicare, and under the English National Health Service. Results from these studies remain mixed.\(^2\)

To our knowledge, no existing studies have empirically examined the effects of physician practice competition on quality under regulated prices. Using newly available quality reporting data on individual physicians from Medicare’s Physician Compare Reporting System coupled with data on service delivery and geocoded practice location coordinates, this study represents a significant contribution to the literature by exploring whether physician competition affects quality of care for Medicare patients. Controlling for a host of physician, practice, and area characteristics we explore physician scores for screening and follow-up care across 5-distinct primary care focused quality metrics constructed from data originating from physician interactions with Medicare patients. We find evidence that increased levels of competition improves the quality of screening and follow-up care. These results are found to be largely driven by primary care physicians instead of specialists.

The remainder of the paper is organized as follows. Section 2 provides the theoretical model examining the relation between competition and physician quality. Section 3 provides a description of the data and methods used to evaluate our generated hypotheses empirically. Sections 4, 5, and 6 provide a detailed discussion of results, sensitivity analysis, and concluding remarks.

### 2 Theoretical Model

The model consists of patients and physician practices. Patients cannot observe the quality of service of individual practices or the market as a whole. Rather, they have some initial belief about the quality of service in the market and they update this belief continuously over time. Each physician practice is endowed with some level of quality, \(q_{i}\), and practice profits are a function of both the number of competing practices and their quality relative to the average perceived quality in the market. The decision that physician practices ultimately face is whether to stay in the market or exit, given patients’ beliefs about quality.

#### 2.1 Patient Beliefs About Quality

Patients form beliefs about the quality of service in the market based on their experiences where they observe some initial level of quality in the market and construct beliefs about the overall quality of the market. Patients continuously update their beliefs through the observance of random observations of quality. Let \(q_{k,t}\) denote

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\(^2\)See for example, Gaynor and Town (2011) for a detailed discussion of studies on hospitals and English National Health Service and Bowblis (2012) for a discussion of the literature on U.S. nursing homes.
the perception of quality in the market at time $t$ by consumer $k$. We assume that the evolution of perceptions about quality are given by the following learning rule:

$$dq_{k,t} = \mu q_{k,t} dt + \sigma q_{k,t} \epsilon_k \sqrt{dt} \quad (1)$$

where $\mu q_{k,t}$ is the expected change in quality, $\sigma q_{k,t}$ is the standard deviation and is a function of the current perception of quality, and where $\epsilon_k \sqrt{dt}$ is an increment of a Wiener process where $\epsilon$ is drawn from a standard normal distribution, and where $q_{k,0}$ is the individual’s initial estimate of quality in the market.\(^3\)

### 2.2 Practice Profitability Beliefs About Quality

Each physician practice $i$ is endowed with a level of quality, $q_i$, and all physicians observe the average perception of quality in the market $q_A = E(q_{k,t})$.\(^4\) Furthermore, assume that the profit of physician practice $i$ is:

$$\text{Profit}_{i,t} = \frac{1}{n} \left( \frac{q_i}{q_{A,t}} \right)^\alpha \quad (2)$$

where $n$ is the number of practices that practice $i$ expects to be in the market and where $\alpha \in (0, 1)$ is a parameter. Since the physician practice is endowed with a given level of quality, the only source of variation in the practice’s profit are fluctuations in the average perception of quality. All else equal, as $q_A$ increases, a given practice will receive a lower profit. Suppose that each practice can be sold to a potential entrant for a salvage value, $S(n)$, where $S'(n) < 0$.\(^5\) It follows that if perceptions of average quality become sufficiently high, and hence profit becomes sufficiently low, practice $i$ will sell to a potential entrant and exit the market.

While all physicians observe the average perception of quality in the market, they also know that perceptions of quality will change over time. Thus, physicians have to form their own expectations about how average quality will evolve. We make the simplifying assumption that physicians assume that average perceived quality follows the same time series process as patient perceptions, i.e. physicians believe that $dq_A = \mu q_A dt + \sigma q_A dz$.

\(^3\)This is akin to an assumption that beliefs about average quality follow a random walk (with drift, if $\mu \neq 0$). It should also be noted that $q_A$ has a lower bound of 0. If we allow for positive drift, this would seem to imply that perceptions of quality could become infinitely high. Later we demonstrate that an upper bound exists and can be derived in conjunction with actual physician practice decisions.

\(^4\)We have defined $q_A$ in the physician practice’s profit equation as the mean of the distribution of perceptions of average quality across individuals. This presumes that there is a stationary distribution across individuals. We will show below that such a stationary distribution exists and that we can use the model to solve for this distribution.

\(^5\)We assume that the salvage value is a decreasing function of the number of practices in the market. This assumption can be understood as implying that potential entrants have a lower willingness to pay when they will face greater competition in the market. One could also assume that if $n$ is sufficiently high, no potential entrants exist. As a result, the only buyers for the practice would be practices in other industries who would also have a lower willingness to pay due to costs of repurposing.
Let $V_i(q_A)$ denote the value for physician practice $i$ of being in the market. Furthermore, recall that if $q_A$ gets sufficiently high, a physician practice might decide to exit the market by selling the practice to a potential entrant. Let $q_A^*$ denote the threshold for beliefs about average quality at which it is optimal for physician practice $i$ to exit. Given our assumptions, the value of being in the market is the expected value of the profit that the physician practice will receive plus the value of the option to exit the market. Thus, we can write $V_i(q_A)$ as

$$V_i(q_A) = \max_{q_A} \left[ \frac{V_{P,i}(q_A)}{\left( \frac{q_A}{q_A^*} \right)^\beta} \times \{ S(n) - V_{P,i}(q_A^*) \} \right]$$  \tag{3}$$

This equation demonstrates that the option value to the physician practice of exiting the market depends on both the current average perception of quality and the exit threshold chosen by the practice. Note that the choice of the exit threshold only affects the value of the option. In fact, equation (3) makes clear the trade-off that practice $i$ faces in choosing a threshold. For example, the option value of exit for the practice can be seen as the net benefit of exit multiplied by a stochastic discount factor. Note that the value of exit is the net benefit of exit. Upon exiting, the practice receives the salvage value $S(n)$. However, the opportunity cost of exit is the expected profits that the practice would have received, given the threshold. The value of exit is therefore the salvage value less the opportunity cost. The trade-off that the practice faces is as follows. A higher threshold means a higher value of exit. However, a practice will have to wait longer to hit a higher threshold than a lower threshold and therefore a higher threshold implies a reduction in the present value of exiting. The way that the practice can optimally balance this trade-off is to choose $q_A^*$ to maximize the option value of exit. Maximizing equation (3) with respect to $q_A^*$ yields

$$\beta V_{P,i}(q_A^*) - q_A^* \frac{\partial V_{P,i}(q_A^*)}{\partial q_A^*} = \beta S(n) \tag{4}$$

Recall that $V_{P,i}(\cdot)$ is the value of staying in the market in perpetuity. It follows that the present value of the perpetual profit is given as

$$V_{P,i}(q_A) = \frac{q_A^\alpha}{n \ r + \alpha \mu - \alpha (\alpha - 1)} \tag{5}$$

\footnote{A formal derivation can be found in the Appendix.}
Plugging this into the maximization condition and solving yields the equilibrium threshold for practice $i$:

$$
q^*_A = q_i \left[ \left( \frac{\beta + \alpha}{\beta} \right) \frac{1}{nS(n)[r + \alpha \mu - \alpha(1 - \alpha)]} \right]^{1/\alpha}
$$

(6)

### 2.3 Equilibrium

In this section, we use the physician practice exit decision in conjunction with the beliefs of patients to derive an equilibrium distribution for beliefs about quality. Given the equilibrium distribution, we can then solve for the mean of the distribution. Finally, we can see how average perceptions of quality when the number of physician practices in the market changes. We confine our analysis to a symmetric equilibrium in which the expected number of practices in the market by each physician practice, $n$, is the same for every physician practice and is correct in equilibrium.

What we are interested in is how competition affects the average belief about quality. In order to examine this, we need to have a stationary distribution of beliefs about quality across patients in equilibrium. To ensure that such a stationary distribution exists, we will assume that patients believe that there is some maximum possible quality that exists in the market. However, since patients cannot perfectly observe quality, they must form a belief about the maximum possible quality. We assume that they do this by observing exit behavior. For example, suppose that patients know that physician practices are solving an exit problem consistent with that described above. Let $\bar{q}$ denote the perceived quality of a benchmark practice that exited the market. This benchmark practice has a corresponding exit threshold of $q^*$. Patients can therefore get a noisy signal about the average quality of the market from their estimate of firm level quality. Furthermore, since $q^*$ is a noisy signal about the average quality in the market, patients will assume that the maximum level of quality in the market is some multiple of this noisy measure of the average, i.e., $q_{MAX} = \epsilon \bar{q}$. We can now characterize the stationary equilibrium distribution.

Let $h(q, t)$ be the probability density function for quality across patients at time $t$. Given equation (1), the Kolmogorov Forward Equation (KFE) can be written as

$$
\frac{\partial h}{\partial t} = -\frac{\partial}{\partial q} \left[ \mu q h(q, t) \right] + \frac{1}{2} \frac{\partial^2}{\partial (q)^2} \left[ \sigma^2(q)^2 h(q, t) \right]
$$

Since we are concerned with a stationary distribution, it follows that $\partial h/\partial t = 0$. A stationary distribution is therefore a solution to

$$
0 = -\frac{\partial}{\partial q_A} \left[ \mu q_A h(q) \right] + \frac{1}{2} \frac{\partial^2}{\partial (q)^2} \left[ \sigma^2(q)^2 h(q) \right]
$$

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6 We will assume that patients have the same quality benchmark. This doesn’t mean they are referred to the same practice.
Furthermore, given the assumption about a patient’s beliefs regarding the upper bound, it follows that

\[ \int_{0}^{q^*} h(q) dq = 1 \]

Suppose that we guess that \( h(q) = \chi q^\gamma \). Using the KFE and the boundary conditions for the distribution, it follows that

\[ q_A = \left( 1 - \frac{\sigma^2}{2\mu} \right) e_{\bar{q}} \left[ \left( \frac{\beta + \alpha}{\beta} \right) S(n) \left[ \frac{1}{nS(n)} + \alpha \mu - \alpha (1 - \alpha) \right] \right]^{1/\alpha} \tag{7} \]

### 2.4 Discussion and Implications

The main idea in the model is that, given some quality endowment for a physician practice, the average perception about quality affects the profitability of an individual physician practice. Since perceptions about quality vary over time, so do the profits of the practices. The decision facing practices is ultimately whether they should remain in the market in the face of fluctuations in the average perception of quality, given their expectation about the number of competitors and given their own quality endowment. We assume that there are potential entrants who are willing to purchase the practice at a salvage value, but that this value is a function of the expected level of competition in the market. Given the option to leave the market and obtain some salvage value, the practice must consider the level of profit it is earning relative to the outside offer from potential entrants. If the average perception of quality gets sufficiently high, a practice will decide to exit the market because the salvage value is sufficient to sacrifice expected future profits.

Our model shows how to derive this threshold. As shown in equation (6), the threshold is increasing in the practice’s quality endowment. This is fairly intuitive since practices that provide higher quality earn higher profits than those with lower quality. Thus, for a given average perception of quality, the practice with the higher quality endowment will have higher profits and more to lose from exiting the market. At the same time, the effect of competition on the threshold is ambiguous in the absence of a specified functional form for \( S(n) \). For example, the threshold implies that as the number of practices expected to be in the market increases, there are two countervailing forces at play. First, more practices implies that each individual practice will earn a lower profit. All else equal, this lowers the threshold since expected future profits decline and therefore there is a lower cost associated with exiting. Second, the addition of practices to the market implies that the willingness to pay of potential entrants declines. This implies that the expected benefit from exiting the market decreases. All else equal, this increases the threshold for exit because the benefit from exiting has declined. Whether or not the threshold increases or decreases depends on what happens to the net benefit of exit as the number of practices changes.
The ability to derive a threshold for exit also allows us to characterize the distribution of perceptions about quality. We are able to solve for the average perception of quality in the overall market in equilibrium. Since average quality is a function of the threshold for a benchmark physician practice, we can use the threshold to motivate intuition about the average perception of quality. Our primary motivation is to consider the effect of competition on the average perception of quality in the market. As one might expect from the discussion of the threshold, the effect of competition on the average perception of quality is complicated. In particular, we can state the following proposition:

**Proposition 1.** Suppose that $-S'(n) > \frac{S(n)}{n}$. An increase in the number of expected physician practices, $n$, leads to an increase in expected quality in equilibrium.

**Proof.** Considering the following comparative static implied by equation (7):

$$\frac{\partial q_A}{\partial n} = -\frac{1}{\alpha} \Gamma n^{-1/(\alpha-1)} S(n)^{-1/\alpha} - \frac{1}{\alpha} \Gamma n^{-1/\alpha} S(n)^{-(1/\alpha)-1} S'(n)$$

where

$$\Gamma = \left(1 - \frac{\sigma^2}{2\mu}\right) \epsilon q \left[\left(\frac{\beta + \alpha}{\beta}\right) \frac{1}{r + \alpha \mu - \alpha (1 - \alpha)}\right]^{1/\alpha}$$

It is straightforward to show that if $-S'(n) > \frac{S(n)}{n}$, then $\partial E(q_A)/\partial n > 0$. \qed

The intuition of this result is as follows. Recall that an increase in the number of practices, reduces both the benefit (salvage value) and the cost (foregone profits) of exiting. The reduction in the benefit from exiting implies that, all else equal, the threshold for exit for all practices increases. At the same time, the reduction in the cost implies that, all else equal, the threshold for exit for all practices declines. Whether or not the threshold of practices increases or decreases depends on what happens to the net benefit. So if the benefit declines by more than the cost, then the net benefit of exit declines, which implies that the threshold increases. When the threshold increases, practices of all quality levels are less likely to exit the market than they were before. Patients know that the lowest possible quality is zero. However, they get a noisy signal about the right tail of the distribution. When fewer physician practices exit, patients update their perception of the right tail. In this case, the update has the effect of increasing perceptions of average quality. Put differently, from the perspective of consumers, the reduction in exits sends a signal that quality is higher than they anticipated, which improves perceptions of quality.\footnote{Note that if the net benefit of exit to the physician practice is increases, then the reverse is true.}

When prices are determined outside of the market, it seems reasonable to think that physicians will compete along dimensions of quality. If so, one might conjecture that areas with greater competition would also
have higher quality of care. What our model suggests, however, is that if variations in quality are imperfectly observable, then it is not obvious that competition leads to higher perceptions of quality. In fact, the model suggests that perceptions of quality depend on both the patients’ own small sample observations as well as other actions that are associated with quality. Under reasonable assumptions about the salvage value, the model implies that perceptions of quality should rise, on average, when more physician practices enter the market. Nonetheless, it is possible that perceptions of quality could decline with increased competition. As a result, assessing whether increased competition leads to higher perceptions of quality requires careful empirical analysis. In the next section, we describe the data and methods used to evaluate physician practice competition on the quality of care.

3 Data and Methods

The primary data for the analysis comes from the 2014 and 2015 Physician Compare Individual Eligible Professional Public Reporting-Clinical Quality of Care Files (hereafter referred to as the Physician Compare Clinical Quality Files). Data from these years represent the first two years of compulsory reporting under the quality reporting system. Examining quality reporting data across this time period presents an ideal scenario to study physician competition, given that both years were used by CMS to establish quality benchmarks with physician reimbursement remaining unchanged based on an individual physician’s relative quality performance across these years.9

To report quality metrics to CMS, documentation of patient treatment and results used to construct each quality metric were reported primarily through the simultaneous submission of bundled quality documentation codes and the patient’s Medicare claims.10 To accurately document screening/follow-up for a condition via claims data, a physician was required to report specific quality-data codes simultaneous with their Medicare claims for all eligible visits. This process takes into account and removes data associated with pre-existing conditions, patient refusal, and emergencies where delaying treatment would reduce the patient’s health status. For qualifying visits, the physician’s quality score was then constructed as a percentage using the ratio of documented screening and follow-up to eligible visits.

Physician level quality variables are supplemented with other physician characteristics from the Physician Compare National Downloadable file, and practice level measures of competition constructed from service-billing data originating from the Medicare Fee-For-Service Provider Utilization and Payment Data-

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9Participation across 2014 and 2015 was compulsory in the sense that physicians who did not report metrics in these years received a negative 2% adjustment to all billed Medicare procedures in 2016 and 2017, respectively.
10CMS also permitted annual submission of data through a registry system, however an overwhelming majority of providers submitted directly through claims.
Physicians, and Other Supplier Public Use Files (hereafter referred to as the SPU files) for 2014 and 2015.

3.1 Dependent Variables

To construct measures of physician quality, we use Physician Compare quality metrics that were available in both the 2014 and 2015 reporting years. These include five quality metrics that assign a percentage score to each physician based whether the physician screened patients for specific conditions and developed a follow-up plan when the condition was present. Table 1 provides an overview and distribution of physician quality scores for each quality measure. These include screening patients for blood pressure, unhealthy body weight, depression, tobacco use, and their review of medications for patients within 30 days of discharge from an inpatient facility. Examining the distribution of each of these variables, it is apparent that many of these quality metrics are highly skewed. For example, ‘tobacco cessation’ and ‘medication check’ indicates that the 10th percentile of physicians had a 89% and 88% screening and follow-up score on these quality metrics, respectively.

Given the skew of the data, we use the physician’s percentage quality score to construct more stringent quality criteria for the analysis. Specifically, we construct binary variables for whether the physician scored 95% or above on each quality metric. Summary statistics for each of these constructed quality variables are reported in Table 2. Within our sample, we observe that 48% of physicians achieved a screening/follow-up success rate of 95% for high blood pressure, and 44% achieved this quality level for body weight management. Depression represents the lowest average rating for quality with only 33% of physicians achieving 95% screening/follow-up with their patients. Medication and tobacco cessation represent the highest overall quality observed within our sample, with 82% and 80% success rates, respectively.

3.2 Measuring Physician Competition

The analysis uses a measure of competition commonly employed as a tool in the evaluation of mergers and antitrust cases, namely, the market Herfindahl-Hirschman Index (HHI). In constructing an HHI, each participant (e.g., firm) must be identified given the relevant product and geographic markets. What makes defining physician markets difficult is that an individual physician may practice in multiple settings and locations. For example, a physician may have an independent practice, be part of a multi-physician organization, or be a member of a multi-specialty practice. Additionally, some physicians may treat patients in multiple locations, under multiple practices, which can be in different geographic markets.

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11 Alternative measures constructed using 50% and 75% thresholds for the binary produced results that support the findings of the primary reported models. These results are in the Appendix.

12 HHI is defined as the sum of squared market shares for each participant in the relevant geographic and product market.
Given this complexity, we follow previous researchers (Frech et al., 2015; Hausman and Lavetti, 2015) by defining the physician’s firm as all physicians practicing at the same geographic location, regardless of ownership. To identify physician locations, we geocoded the physician’s address (associated with their National Provider Identifier account) to precise latitude and longitude coordinates and defined each location based on unique 4-digit (land parcel level) coordinates.

In this paper, each practice specialty is treated as a separate product market. To assign the practice’s specialty into one of 60 different specializations, we examine the provider composition at the practice. After eliminating physician extenders (e.g., nurses and physician’s assistants), and while treating primary care physician (PCP) specialties (i.e., Family Practice, General Practice, Internal Medicine, Geriatric Medicine, and Pediatric Medicine) as one specialty, we assign the practice to the specialty with the highest prevalence. For practices with less than one third of the total number of physicians at the practice in any given specialty, we define the specialty as a multi-specialty/group practice.\footnote{The classification of a practice as multi-specialty/group practice appears robust to alternative thresholds. Using 10%, 50%, and 70% threshold rules to classify physicians as multi-specialty/group practices, we observe no change in the specialty assignment among 97.5%, 95.7%, 83.4% of the practices, respectively.}

Once each practice and its corresponding practice specialty is identified, we need to define the relevant geographic market. Existing studies find competition within specialties to occur in relatively small geographic areas (McCarthy, 1985; Wong, 1996; Brasure et al., 1999; Kleiner et al., 2012) with many defining the relevant geographic market based on zip-code clusters or counties. However, studies examining the willingness to travel and distance to the nearest physician indicate substantial variation across both the rural-urban continuum and specialty. Probst et al. (2006) examined willingness to travel for physician services and approximates the average distance travelled for care at 10.2 miles, with those in urban and rural areas traveling an average of 8 and 17 miles, respectively. Other work examining the overall average distance to the nearest physician (regardless of specialty) finds an estimated distance of 4.7 miles, even in the most rural settings (Rosenthal et al., 2005). However, this same work also finds that the average distance varies substantially across both the rural-urban continuum and physician specialty with some patients (in rural areas) averaging as much as 63 miles from the nearest physician in certain specialties.

Given these empirical estimates for travel distance, we assign the relevant geographic markets differently for each practice based on: (1) whether the practice’s specialization is PCP or non-PCP specialty, and (2) based on the practice’s rural/urban continuum code. For PCP practices, relevant competitors are defined as all other PCP practices within a certain distance of the practice (e.g., radius with the PCP as the center of a circle). For each of the other 59 specialties, relevant competitors are those within a certain distance of the practice in the same specialty. This implies we calculate an HHI specific to each specialty. The size of the
geographic market is based on the distance to the nearest physician reported by rural/urban continuum of the practice found in Rosenthal et al. (2005). For PCPs, the size of the market is a radius of 5 miles for PCPs practicing in a county with rural/urban continuum code indicating a metro or urban county, 10 miles if in a county adjacent to metro area, and 15 miles in a rural county not adjacent to a metro area. For each of the 59 other specialties, we assume a much larger geographic area. Using Rosenthal et al. (2005), we compute the average distance to the nearest specialist (regardless of specialty) by rural/urban continuum code. For non-PCP specialties the corresponding radiiuses are: 5 miles for those practicing in metro counties, 10 miles for those in urban counties with a population of 20,000 or more, 20 miles for those with an urban population of 2,500 to 19,999 who are adjacent to a metro area, 25 miles for those in a county with an urban population of 2,500 to 19,999 who are not adjacent to a metro area and those in rural counties that are adjacent to a metro area, and 40 miles for those in completely rural counties not adjacent to a metro area.

To construct HHIs we use the SPU files that provide annual procedure frequency data for Medicare patients for each physician. Using the practice’s concentric circle as the relevant geographic market and specialty as the relevant product market, we construct HHIs for each year using each practice’s market share based on the observed total Relative Value Units (RVUs) delivered to Medicare patients in the year of observation. RVUs are a commonly used unit of account in medical care designed to adjust physician compensation for provided services based on their complexity, time, and level of effort of billed services. However, as noted by previous researchers (Kessler and McClellan, 2000), using observed patient volume can result in potential endogeneity. For example, patients seeking high quality care may gravitate towards high quality providers, resulting in reverse causality and confounded empirical estimates. Therefore, we also compute HHIs using the practice’s market share assuming equal distribution of RVUs across all relevant providers in the relevant market. To account for potential nonlinear effects of HHI, both measures of HHI (i.e. observed and equal RVU HHI) are classified into three categories (unconcentrated [HHI<1500], moderately concentrated [1500≤HHI ≤ 2500], and highly concentrated [HHI >2500] based on the Department of Justice, Horizontal Merger Guidelines).

Examining summary statistics for both HHI measures used in the analysis (Table 3), we observe that the average physician within our sample (including primary care, multi-specialty, and speciality physicians) practices in a highly concentrated market with an overall average observed HHI of 5,118. However, breaking the sample for physicians into primary care and specialist subsamples, we see that primary care physician markets are much more competitive (average HHI=3,063) than specialists (average HHI=6,458). Imputing equal RVUs across the practice’s market lowers the constructed HHI across all samples. For all providers (including primary care, multi-specialty, and speciality physicians) and specialists, this drops the HHI to 4,766
and 5932, respectively. For Primary care physicians, this alternative HHI places the average physicians close to the moderately concentrated market range with an HHI of 2,658.

3.3 Control Variables

Each model includes a number of controls for physician, practice, and area characteristics. Physician controls include the physician’s gender, a categorical control for the number of years the physician has been in practice, and whether the physician graduated from an unnamed medical school.\textsuperscript{14} Practice level controls include the practice specialty, categorical controls for practice size, and whether the practice has meaningful use of an electronic medical records system. County level controls come from the Centers for Medicare and Medicaid Services Geographic Variation Public Use Files (GVPUS) for 2014 and 2015 as well as the Area Health Resource File. County controls include the average age of the serviced Medicare population, Medicare Advantage participation rates, percentage of the county population that is enrolled in Medicare Part B, the percentage of Medicare beneficiaries that are Medicaid eligible, health status as measured through the average Hierarchical Condition Category (HCC) score for the Medicare population,\textsuperscript{15} and the percentage of Medicare beneficiaries that are male, white, black, and Hispanic. The GVPUS files mask demographic information for counties with less than 11 beneficiaries. For these counties we use a generated regressor model using 2014 Census estimates for the percentage of the county population that is male, white, black, and Hispanic to predict Medicare beneficiary demographics. To control for state level differences in the practice of medicine, including relative differences in tort reform that may influence the practice of defensive medicine, each model also includes state fixed effects.

3.4 Regression Specification

For each quality outcome measure, we estimate the following probit model for physician \( i \), in county \( k \), in year \( t \):

\[
P(Quality_{it}) = \Phi(\beta_0 + CM_i \beta_1 + \theta_1 \beta_2 + \gamma_k \beta_3 + \beta_4 2015 + S \beta_5)
\]

where \( CM \) represent the categorical market concentration measure which is measured at a practice level, \( \theta \) represents a vector of physician and practice characteristics, \( \gamma \) represents a vector of county characteristics,

\textsuperscript{14}This variable is defined as 0 if a medical school is associated with the physicians National Provider Identifier and 1 if their is no medical school associated with their NPI account.

\textsuperscript{15}HCC scores use patient demographics and disease categories generated from claims data to calculate and adjust payment under Medicare advantage programs (Medicare Part C) for beneficiaries. In the context of our model, they can be thought of as a measure of the average health of the county Medicare population.
2015 is binary indicating whether the physician observation is observed in 2015 (vs. 2014), and where $S$ represents state fixed effects.

We hypothesize that all physicians may respond to competition if a quality metric corresponds to their area of medicine, such as PCPs and cardiologists focusing on screening for blood pressure and tobacco use. However, it is not clear that all the metrics used in this study apply to all physician specialties. For example, one would not anticipate that an urologist would focus much attention on depression or tobacco usage and cessation. Since most the quality metrics examined in this study correspond to preventative care and general health screening, we anticipate that PCPs may respond differently than specialists to increased levels of competition in their market. Specifically, PCPs are expected to respond to increased competition through improvement in these quality metrics but we anticipate no improvement in these metrics for specialists, who may disregard them entirely (resulting in statistically insignificant effects). Given these anticipated differences, we estimated Equation 9 for all providers and with providers dichotomized between PCP and specialist practice types.\footnote{For these models, we include multi-specialty group practices in the all providers regressions, but not in the PCP or specialist samples. Alternative models which assuming direct competition between PCP and group practices find results that are even stronger than reported models.} For results to be consistent with a direct relationship between higher competition and quality, we should expect coefficient estimates for HHI 1500 to 2500 (moderately concentrated) and HHI 2500+ to be negative and statistically significant, implying reduced quality relative to the omitted category (HHI < 1500, unconcentrated).

4 Results

4.1 Results for Competition on Quality

Average partial effects for key physician concentration measures as well as physician and practice characteristic are reported in Tables 4-8. Examining our measures of physician competition for the all providers sample (Columns 1 and 2 of Tables 4-8), we find negative and statistically significant average partial effects for practices in a market with an HHI in the 1500-2500 (moderately concentrated) and 2500+ (highly concentrated) categories relative to the omitted (HHI < 1500, unconcentrated) category for blood pressure (Table 4), body weight (Table 5), depression (Table 6), and medication management (Table 7). These results imply that reduced levels of competition are associated with reductions in screening and follow-up quality. For tobacco cessation management (Table 8), we find positive and statistically significant average partial effects implying that reduced competition is associated with higher overall provider quality.

Examining the response by estimating separate models for only PCPs and only specialists we observe
starkly contrasting results. We find that PCPs exhibit much stronger improvements in quality with higher levels of competition whereas specialists often exhibiting a negative quality response. For example, examining the blood pressure quality results in Table 4 across all providers, we observe that relative to those in unconcentrated markets (i.e. those where $\text{HHI} < 1500$), individuals in moderately concentrated ($\text{HHI} \text{ 1500 to 2500}$) and highly concentrated markets ($\text{HHI} > 2500$) were 2.8-3.9% and 2.2-2.9% less likely to meet the 95% threshold. However, isolating the samples by specialty we observe that these effects are much stronger for PCPs (columns 3 and 4) with those in moderate and highly concentrated markets exhibiting 3.1-3.4% and 6.2-7.1%, respective declines in the probability of meeting the metric. For specialists (columns 5 and 6), we observe no statistically significant effect for moderate concentration, and in fact positive and statistically significant 6% increase in the probability of meeting the blood pressure management quality metric.

For body weight management, the pattern of differentiated results by specialty persists with those in PCPs in moderate and highly concentrated markets exhibiting 3-3.5% and 3.9-4.7% reductions in meeting the metric relative to those in unconcentrated markets. For specialists, results are insignificant with the exception of highly concentrated markets under an equal RVU HHI assumption where we observe a 2.6% increase in meeting the metric relative to those in competitive markets.

These results carry through to medication management and tobacco cessation management. For medication management, we observe that PCPs and specialists in moderately concentrated markets are respectively 7.5% less likely and 53% more likely than those in unconcentrated markets to meet the quality standard. For highly concentrated markets PCPs are approximately 7% less likely whereas specialists are 53-71% more likely to meet the metric. For tobacco cessation, PCPs in moderate and highly concentrated markets are found to be 1.7-1.9 and 2.2-2.8% less likely to meet the metric. For specialists, those in moderate and highly concentrated markets are found to be 2.7-7.9% and 4.8 to 8% more likely to meet the cessation quality metric.

4.2 Results for Physician and Practice Attributes Controls on Quality

Results for control variables indicate that male physicians are less likely to meet the 95% quality threshold used to define high quality for blood pressure management, depression management, and tobacco cessation by approximately 8%, 3%, and 4%, respectively. While we find some evidence for higher quality related to body weight management among PCPs, we find no overall evidence of higher quality in the all provider or specialist samples.

Years in practice is consistently associated with higher quality across all regressions. For the all providers sample (Columns 1 and 2), 11-19, 20-29, and 30+ years of experience is associated with an approximate
increase of 6%, 10%, and 13% in providing high quality blood pressure care, an increase of 4%, 7%, and 9% in successfully providing high quality body weight management, and an increase of 4%, 6%, and 8% in providing high quality depression management, relative to those with 10 or less years of experience. For the tobacco cessation metric, 11-19, 20-29, and 30+ years of experience is associated with a 4%, 7%, and 8% increases in meeting the quality criteria relative to those with 10 or less years of experience.

Relative to solo practitioners, larger practices appear to provide lower quality care. For all providers (Columns 1 and 2), those in practices of 4 to 9 physicians are approximately 5% less likely to meet the 95% patient quality metric for blood pressure, and among PCPs (Columns 3 to 4) they are 11% less likely when compared to solo practitioners. These effects for the blood pressure quality measures is found to be even larger for practices of 10 or more physicians. The trend that physicians in larger practices are associated with lower quality also holds for body weight management, depression management, and weakly for medication management.

Results also indicate higher quality among physicians from unnamed medical schools. These individual physicians were found to be approximately 3%, 4%, 5%, and 4% more likely to provide high quality treatment for blood pressure, body weight, depression, and medication management, respectively. Results for meaningful electronic health record use are largely mixed across measures with two measures indicating improvements in quality (blood pressure and tobacco cessation), two indicating reductions in quality (body weight and depression management).

5 Sensitivity Analysis

To assess the validity of our primary analysis a number of alternative specification and robustness tests were performed. Our first concern was the assignment of quality as a binary variable based on the observed 95% thresholds and the potential for mismeasurement of quality. To determine if the threshold was driving the results, we estimated alternative models using 50% and 75% thresholds. Results from these alternatives are reported in Appendix Tables A-6 and A-7. These results confirm two things. First, using alternative specifications of the dependent variable reveals a consistent overall positive relationship between increased competition and quality. Second, for many of our metrics, the higher threshold of 95% represents a better measure of quality given that lower thresholds present less variation resulting in more perfect predictions and data loss. For example, the all providers sample for Tobacco cessation management had 61,157 providers under the 95% threshold. Dropping our criteria for meeting the quality standard to 50%, we lose 2,410 (4%) observations due to perfect prediction. Of notable exception, in our analysis is the 50% criteria for
depression management. Among our quality metrics, depression management had the lowest success rate using the 95% quality threshold at only 33% of physicians (Table 2). Lowering this threshold to 50% we observe a reduction in the all providers sample (which includes multi-speciality physicians, primary care, and specialists), we lose a net 8 physicians relative to the 95% quality threshold sample due to perfect prediction. However, examining the primary care and specialist samples, the 50% threshold criteria actually improves the results by better balancing the dependent variable resulting in fewer perfect predictions.\textsuperscript{17}

We had two other major concerns that are addressed simultaneously. One concern was the potential for reverse causality based on a potential relationship between quality and physician practice location. For example, lower quality physicians may be less attractive to larger non-rural practices. As a result, low quality physicians may be more likely to practice in more rural areas where they face less competition on quality dimensions. To address this concern, we estimate results restricting the sample to only non-rural primary care physicians in Appendix Table A-8 and find results that directly conform to our primary analysis.

Finally, we were concerned with size of areas used to define a geographic market across different specialties. We use a common size for all specialities even though these could be different by specialty. This could lead to measurement error by either over or underestimating the degree of competition faced by the practice. So long as this measurement error is not systematic, it should create only attenuation bias reducing the likelihood of finding statistically significant effects for competition on quality. Nevertheless, to determine whether systematic bias in the HHI construction is driving the results, we estimated models using alternative radial bands for a specific specialty (primary care) restricted to urban markets with alternative competition bands (from 5 miles up to 25 miles) are reported in Appendix Table A-8. These results confirm the primary conclusions of the analysis.

6 Conclusions

In a market where prices are regulated it makes intuitive sense that firms will compete on other dimensions, such as quality in order to attract customers. This is especially true among healthcare providers paid by Medicare because providers have no ability to negotiate prices. In this study, we use newly available quality metrics on physician practices to examine whether competition fosters quality. Our main finding is that competition is associated with higher quality in physician markets overall, but there is an important caveat: the results do not apply to all physician specialties. When we restrict the sample to PCPs, we find strong effects, suggesting that PCPs respond to competition by improving the quality of care they provide to Medicare

\textsuperscript{17}For PCPs and specialists under the 95% quality criteria, 27% and 33.6% of physicians meet the criteria. Under the 50% threshold criteria for meeting the metric, these groups had 45% and 51% meeting the criteria, respectively.
patients. However, when the sample is restricted to specialists, competition is found be associated with no distinction in quality or even reductions in quality.

There are a few reason for this result. The quality metrics reported often focus on preventative care and screening, areas of quality important for PCPs and some specialists but not to all physicians. Since PCPs may compete for patients based on these aspects of care, it makes sense for PCPs to focus on these aspects of patient care in order to attract new patients and retain existing ones. In contrast, specialists are chosen by patients for their surgical skill or expertise in a narrow area of medicine, not their ability to provide preventative and screening services. One concern about publicly reporting these quality metrics for specialists is that there may be spillover effects as specialists divert energy away from aspects of care that matter more to the practice of medicine in that specialty.18

While there is a need to better expand available metrics of quality that are specific to each specialty, our results suggest that competition is an important factor in providing high quality to Medicare patients. With the accelerated consolidation of health insurers and healthcare providers since the passage of the Affordable Care Act, healthcare markets across the United States are becoming more concentrated. In the last decade, healthcare providers have merged to become larger and physician practices have become vertically integrated with hospitals. Though supporters of these mergers will argue that operational efficiencies lead to lower costs, vertical integration of hospitals and physician practices has led physicians to bill at higher prices (Baker et al., 2014a; Capps et al., 2015; Neprash et al., 2015). Coupled with our results, it appears that this consolidation has not only led to increased prices, but also potentially lower quality.

18This result was observed by Propper et al. (2008) under the British NHS where public reporting of hospital wait times, improved patient wait time times at the expense of increased hospital mortality rates.
<table>
<thead>
<tr>
<th>Quality Measure</th>
<th>Description</th>
<th>Percentile (of Percentage Patients)</th>
<th>10th</th>
<th>25th</th>
<th>50th</th>
<th>75th</th>
<th>90th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood Pressure</td>
<td>Percentage of this health care professional’s patients who had their blood pressure checked. If the patient had high blood pressure, they received a plan of recommended next steps</td>
<td></td>
<td>30</td>
<td>53</td>
<td>93</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Body Weight</td>
<td>Percentage of this health care professional’s patients who were screened at least once in the last six months. If the patient’s weight was higher or lower than normal for his or her body type and height, they received a plan of recommended next steps.</td>
<td></td>
<td>33</td>
<td>46</td>
<td>88</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Depression</td>
<td>Percentage of this health care professional’s patients who were screened for depression and if they have depression, got a plan outlining next steps</td>
<td></td>
<td>0</td>
<td>1</td>
<td>50</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Medication Check</td>
<td>Percentage of this health care professional’s patients that had their medications compared within 30 days after coming home from an inpatient facility.</td>
<td></td>
<td>88</td>
<td>97</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Tobacco Cessation</td>
<td>Percentage of this health care professional’s patients that were asked at least once in the last two years if they use tobacco. If patients use tobacco, this health care professional spoke with them about ways to help them quit using tobacco.</td>
<td></td>
<td>89</td>
<td>96</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Variable</td>
<td>Description</td>
<td>All Providers</td>
<td>Primary Care</td>
<td>Specialists</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>-------------</td>
<td>---------------</td>
<td>--------------</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Prop. (se.)</td>
<td>Prop. (se.)</td>
<td>Prop. (se.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BP</td>
<td>0.479 (0.004)</td>
<td>0.551 (0.007)</td>
<td>0.443 (0.005)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>BMI</td>
<td>0.442 (0.002)</td>
<td>0.383 (0.004)</td>
<td>0.515 (0.003)</td>
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<td></td>
</tr>
<tr>
<td>Depression</td>
<td>0.334 (0.007)</td>
<td>0.275 (0.011)</td>
<td>0.336 (0.013)</td>
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</tr>
<tr>
<td>Medication</td>
<td>0.819 (0.008)</td>
<td>0.852 (0.011)</td>
<td>0.782 (0.015)</td>
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<td></td>
<td></td>
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<tr>
<td>Tobacco</td>
<td>0.803 (0.002)</td>
<td>0.771 (0.003)</td>
<td>0.843 (0.002)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
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<td>5,579</td>
<td>9,179</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>52,359</td>
<td>16,120</td>
<td>25,872</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>4,172</td>
<td>1,628</td>
<td>1,315</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2,365</td>
<td>991</td>
<td>774</td>
<td></td>
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</tr>
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<td>61,157</td>
<td>17,904</td>
<td>28,249</td>
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Table 3: Description and Summary Statistics for Physician and Practice Characteristics

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<tr>
<th>Variable</th>
<th>Description</th>
<th>All Providers</th>
<th>Primary Care</th>
<th>Specialists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed (O)HHI</td>
<td>Observed Medicare RVU HHI</td>
<td>5118.147</td>
<td>3063.489</td>
<td>6458.568</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10.297)</td>
<td>(14.144)</td>
<td>(13.921)</td>
</tr>
<tr>
<td>OHHI &lt;1500 (ref. category)</td>
<td>1 if observed Medicare RVU HHI &lt; 1500</td>
<td>0.126</td>
<td>0.262</td>
<td>0.048</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>OHHI 1500 to 2500</td>
<td>1 if 2500 &gt; observed Medicare RVU HHI ≥ 1500</td>
<td>0.145</td>
<td>0.266</td>
<td>0.082</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>OHHI 2500+</td>
<td>1 if observed Medicare RVU HHI ≥ 2500</td>
<td>0.729</td>
<td>0.472</td>
<td>0.870</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Equal (E)HHI</td>
<td>Medicare HHI Imputing Equal RVUs to each physician in the market</td>
<td>4766.221</td>
<td>2658.060</td>
<td>5931.882</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(10.422)</td>
<td>(13.363)</td>
<td>(14.593)</td>
</tr>
<tr>
<td>EHHI &lt;1500 (ref. category)</td>
<td>1 if Equal Medicare RVU HHI &lt; 1500</td>
<td>0.165</td>
<td>0.354</td>
<td>0.080</td>
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<tr>
<td></td>
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<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>EHHI 1500 to 2500</td>
<td>1 if 2500 &gt; observed Medicare RVU HHI ≥ 1500</td>
<td>0.159</td>
<td>0.264</td>
<td>0.108</td>
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<td></td>
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<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.001)</td>
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<tr>
<td>EHHI 2500+</td>
<td>1 if observed Medicare RVU HHI ≥ 2500</td>
<td>0.676</td>
<td>0.382</td>
<td>0.812</td>
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<tr>
<td></td>
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<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
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<tr>
<td>female (ref. category)</td>
<td>1 if physician is female</td>
<td>0.362</td>
<td>0.397</td>
<td>0.354</td>
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<td></td>
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<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
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<tr>
<td>male</td>
<td>1 if physician is male</td>
<td>0.638</td>
<td>0.603</td>
<td>0.646</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Medical Experience</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 10 years (ref. category)</td>
<td>1 if 10 or less years practicing medicine</td>
<td>0.254</td>
<td>0.224</td>
<td>0.279</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>11-19 yr</td>
<td>1 if 11-19 years practicing medicine</td>
<td>0.261</td>
<td>0.262</td>
<td>0.256</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>20-29 yrs</td>
<td>1 if 20-29 year practicing medicine</td>
<td>0.246</td>
<td>0.257</td>
<td>0.239</td>
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<tr>
<td></td>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>30+ yrs</td>
<td>1 if 30+ years practicing medicine</td>
<td>0.239</td>
<td>0.258</td>
<td>0.226</td>
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<tr>
<td></td>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Practice Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>solo (ref. category)</td>
<td>1 if solo practitioner</td>
<td>0.133</td>
<td>0.134</td>
<td>0.176</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>2 to 3 phys</td>
<td>1 if practice has 2 to 3 physicians</td>
<td>0.179</td>
<td>0.209</td>
<td>0.229</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>4 to 9 physicians</td>
<td>1 if practice has 4 to 9 physicians</td>
<td>0.243</td>
<td>0.272</td>
<td>0.294</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>10+ physicians</td>
<td>1 if practice has 10+ physicians</td>
<td>0.445</td>
<td>0.384</td>
<td>0.301</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>unnamed</td>
<td>1 if NPI record has no medical school name for the physician</td>
<td>0.433</td>
<td>0.433</td>
<td>0.443</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>EHR</td>
<td>1 if use certified EHR technology</td>
<td>0.416</td>
<td>0.478</td>
<td>0.364</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>96,478</td>
<td>26,677</td>
<td>49,480</td>
</tr>
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</table>
Table 4: Average Marginal and Partial Effects for High Quality Blood Pressure Management

<table>
<thead>
<tr>
<th></th>
<th>All Providers</th>
<th>Primary Care</th>
<th>Specialists</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>-0.028**</td>
<td>-0.039***</td>
<td>-0.034**</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.012)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.022*</td>
<td>-0.029**</td>
<td>-0.062***</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.011)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>male</td>
<td>-0.078****</td>
<td>-0.077****</td>
<td>-0.075***</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.007)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>11-19 yr</td>
<td>0.061***</td>
<td>0.061***</td>
<td>0.066***</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>20-29 yr</td>
<td>0.100***</td>
<td>0.100***</td>
<td>0.089***</td>
</tr>
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<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.018)</td>
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<tr>
<td>2 to 3 physicians</td>
<td>-0.016</td>
<td>-0.016</td>
<td>-0.058***</td>
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<td>(0.012)</td>
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<td>(0.020)</td>
</tr>
<tr>
<td>4 to 9 physicians</td>
<td>-0.046***</td>
<td>-0.047***</td>
<td>-0.107***</td>
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<td>(0.012)</td>
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<td>(0.019)</td>
</tr>
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<td>10+ physicians</td>
<td>-0.142***</td>
<td>-0.141***</td>
<td>-0.217***</td>
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<td>0.028***</td>
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<td>(0.012)</td>
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<td>0.161***</td>
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Distribution of RVUs for HHI

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</tr>
<tr>
<td>11-19 yr</td>
<td></td>
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</tr>
<tr>
<td>20-29 yr</td>
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<tr>
<td>4 to 9 physicians</td>
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Notes: *** P < 0.01, ** P < 0.05, * P < 0.1. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects, state fixed effects, and the following control variables: Medicare average age, Medicare Advantage penetration rate, percentage of the Medicare population male, percentage of the Medicare population White, percentage of the Medicare population Black, percentage of the Medicare population Hispanic, percentage of the county population covered by Medicare Part B, percentage of Medicare population that is Medicare/Medicaid dual eligible, Average Medicare HCC Score, lag of the natural log of county income per capita, and an indicator for whether the county is rural.
Table 5: Average Marginal and Partial Effects for High Quality Body Weight Management

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<td>(2) AMFX (SE.)</td>
<td>(3) AMFX (SE.)</td>
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<tr>
<td>HHI 1500 to 2500</td>
<td>-0.016**</td>
<td>-0.018**</td>
<td>-0.030***</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.007)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.014***</td>
<td>-0.017***</td>
<td>-0.039***</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.007)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>male</td>
<td>0.006</td>
<td>0.006</td>
<td>0.025***</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>11-19 yr</td>
<td>0.043***</td>
<td>0.043***</td>
<td>0.047***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>20-29 yr</td>
<td>0.074***</td>
<td>0.074***</td>
<td>0.093***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>30+ yr</td>
<td>0.087***</td>
<td>0.087***</td>
<td>0.103***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>2 to 3 physicians</td>
<td>-0.035***</td>
<td>-0.036***</td>
<td>-0.065***</td>
</tr>
<tr>
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<td>(0.007)</td>
<td>(0.007)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>4 to 9 physicians</td>
<td>-0.059***</td>
<td>-0.059***</td>
<td>-0.097***</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.007)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>10+ physicians</td>
<td>-0.106***</td>
<td>-0.105***</td>
<td>-0.149***</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.007)</td>
<td>(0.011)</td>
</tr>
<tr>
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<td>0.043***</td>
<td>0.043***</td>
<td>0.043***</td>
</tr>
<tr>
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<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>EHR</td>
<td>-0.067***</td>
<td>-0.067***</td>
<td>-0.042***</td>
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<td>(0.005)</td>
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<tr>
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<td>52359</td>
<td>16120</td>
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Distribution of RVUs for HHI

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<th>Equal</th>
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</tbody>
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Notes: ** P < 0.01, * P < 0.05, ** P < 0.1. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects, state fixed effects, and the following control variables: Medicare average age, Medicare Advantage penetration rate, percentage of the Medicare population male, percentage of the Medicare population White, percentage of the Medicare population Black, percentage of the Medicare population Hispanic, percentage of the county population covered by Medicare Part B, percentage of Medicare population that is Medicare/Medicaid dual eligible, Average Medicare HCC Score, lag of the natural log of county income per capita, and an indicator for whether the county is rural.
Table 6: Average Marginal and Partial Effects for High Quality Depression Management

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<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>0.010</td>
<td>-0.012</td>
<td>-0.028</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.021)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.039*</td>
<td>-0.050***</td>
<td>-0.026</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.020)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>male</td>
<td>-0.030**</td>
<td>-0.030**</td>
<td>-0.025</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>11-19 yr</td>
<td>0.037***</td>
<td>0.037**</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>20-29 yr</td>
<td>0.061****</td>
<td>0.060***</td>
<td>0.035</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.017)</td>
<td>(0.025)</td>
</tr>
<tr>
<td>30+ yr</td>
<td>0.084****</td>
<td>0.084****</td>
<td>0.052**</td>
</tr>
<tr>
<td></td>
<td>(0.018)</td>
<td>(0.018)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>2 to 3 physicians</td>
<td>-0.042*</td>
<td>-0.040*</td>
<td>-0.038</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.022)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>4 to 9 physicians</td>
<td>-0.067***</td>
<td>-0.065***</td>
<td>-0.060**</td>
</tr>
<tr>
<td></td>
<td>(0.021)</td>
<td>(0.021)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>10+ physicians</td>
<td>-0.065***</td>
<td>-0.062***</td>
<td>-0.034</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.022)</td>
<td>(0.027)</td>
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<tr>
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<td>0.052***</td>
<td>0.052***</td>
<td>0.041**</td>
</tr>
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<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>EHR</td>
<td>-0.110***</td>
<td>-0.110***</td>
<td>-0.071***</td>
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<td>(0.014)</td>
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Observations 4172 4172 1628 1628 1315 1315

Distribution of RVUs for HHI

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Notes: *** P < 0.01, ** P < 0.05, * P < 0.1. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects, state fixed effects, and the following control variables: Medicare average age, Medicare Advantage penetration rate, percentage of the Medicare population male, percentage of the Medicare population White, percentage of the Medicare population Black, percentage of the Medicare population Hispanic, percentage of the county population covered by Medicare Part B, percentage of Medicare population that is Medicare/Medicaid dual eligible, Average Medicare HCC Score, lag of the natural log of county income per capita, and an indicator for whether the county is rural.
Table 7: Average Marginal and Partial Effects for High Quality Medication Management

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<td>(1) AMFX (SE.)</td>
<td>(2) AMFX (SE.)</td>
<td>(3) AMFX (SE.)</td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>0.005 (0.031)</td>
<td>-0.052* (0.030)</td>
<td>-0.029 (0.029)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.001 (0.029)</td>
<td>0.004 (0.029)</td>
<td>-0.069** (0.031)</td>
</tr>
<tr>
<td>Male</td>
<td>-0.010 (0.019)</td>
<td>-0.008 (0.027)</td>
<td>0.002 (0.027)</td>
</tr>
<tr>
<td>11-19 yr</td>
<td>-0.032 (0.028)</td>
<td>-0.032 (0.028)</td>
<td>-0.049 (0.037)</td>
</tr>
<tr>
<td>20-29 yr</td>
<td>0.006 (0.027)</td>
<td>0.008 (0.027)</td>
<td>-0.034 (0.037)</td>
</tr>
<tr>
<td>30+ yr</td>
<td>0.003 (0.027)</td>
<td>0.005 (0.027)</td>
<td>-0.056 (0.037)</td>
</tr>
<tr>
<td>2 to 3 physicians</td>
<td>-0.038 (0.030)</td>
<td>-0.036 (0.030)</td>
<td>-0.019 (0.035)</td>
</tr>
<tr>
<td>4 to 9 physicians</td>
<td>-0.038 (0.026)</td>
<td>-0.036 (0.027)</td>
<td>-0.060* (0.033)</td>
</tr>
<tr>
<td>10+ physicians</td>
<td>-0.056** (0.028)</td>
<td>-0.052* (0.028)</td>
<td>-0.034 (0.035)</td>
</tr>
<tr>
<td>unnamed</td>
<td>0.036*** (0.016)</td>
<td>0.035** (0.016)</td>
<td>0.039 (0.024)</td>
</tr>
<tr>
<td>EHR</td>
<td>0.006 (0.017)</td>
<td>0.005 (0.017)</td>
<td>0.015 (0.026)</td>
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</table>

Observations
2365 2365 991 991 774 774

Distribution of RVUs for HHI

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<td>(2365)</td>
<td>(2365)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>(991)</td>
<td>(991)</td>
</tr>
<tr>
<td>Male</td>
<td>(774)</td>
<td>(774)</td>
</tr>
</tbody>
</table>

Notes: *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects, state fixed effects, and the following control variables: Medicare average age, Medicare Advantage penetration rate, percentage of the Medicare population male, percentage of the Medicare population White, percentage of the Medicare population Black, percentage of the Medicare population Hispanic, percentage of the county population covered by Medicare Part B, percentage of Medicare population that is Medicare/Medicaid dual eligible, Average Medicare HCC Score, and the lag of the natural log of county income per capita.
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<td>(1) AMFX (SE.)</td>
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<td>(3) AMFX (SE.)</td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>0.024***</td>
<td>0.012**</td>
<td>-0.017*</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>0.021***</td>
<td>0.017***</td>
<td>-0.022**</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.005)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>male</td>
<td>-0.037***</td>
<td>-0.037***</td>
<td>-0.047***</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>11-19 yr</td>
<td>0.040***</td>
<td>0.040***</td>
<td>0.070***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>20-29 yr</td>
<td>0.068***</td>
<td>0.068***</td>
<td>0.091***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>30+ yr</td>
<td>0.077***</td>
<td>0.078***</td>
<td>0.107***</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.005)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>2 to 3 physicians</td>
<td>0.007</td>
<td>0.007</td>
<td>-0.020**</td>
</tr>
<tr>
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<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>4 to 9 physicians</td>
<td>-0.000</td>
<td>-0.000</td>
<td>-0.011</td>
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<td>-0.017***</td>
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<td>(0.006)</td>
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<tr>
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<td>0.013***</td>
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<td>17904</td>
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Notes: *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects, state fixed effects, and the following control variables: Medicare average age, Medicare Advantage penetration rate, percentage of the Medicare population male, percentage of the Medicare population White, percentage of the Medicare population Black, percentage of the Medicare population Hispanic, percentage of the county population covered by Medicare Part B, percentage of Medicare population that is Medicare/Medicaid dual eligible, Average Medicare HCC Score, lag of the natural log of county income per capita, and an indicator for whether the county is rural.
References


Appendix

The Derivation of the $V_i(q_A)$

In the paper, we presented equation (3) as the value of physician practice $i$. We motivated this equation with economic intuition. In this section, we formally derive this condition.

The Bellman equation for physician practice $i$ can be written as

$$r V_i(q_A) = \frac{1}{n} \left( \frac{q_i}{q_{A,t}} \right)^\alpha + \frac{1}{dt} E_d V_i$$

where $r$ is the discount rate and $E$ is the expectations operator. Note that each individual’s beliefs about average quality in the market are given by equation (1). In the text, we made the simplifying assumption that $f(q_{A,k,t}) = q_{A,k}$, $\forall t$ and $g(q_{A,k,t}) = \sigma q_{A,k}$, $\forall t$. Furthermore, note that $q_A = E(q_{A,k})$. Thus, we assume that physician practices believe that average of individual perceptions of quality, $q_A$, exhibits the same time series properties as the individual perceptions, $q_{A,k}$. It follows that physician practices believe that

$$\frac{d q_A}{q_A} = \mu dt + \sigma dz \tag{10}$$

Thus, using Ito’s Lemma, we can re-write the Bellman equation as

$$r V_i(q_A) = \frac{1}{n} \left( \frac{q_i}{q_{A,t}} \right)^\alpha + \mu q_A V_i' + \frac{1}{2} \sigma^2 (q_A)^2 V_{ii}' \tag{11}$$

This second-order differential equation has a known solution of the form:

$$V_i(q_A) = V_i^P(q_A) + C_1 q_A^{\beta_1} + C_2 q_A^{\beta_2} \tag{12}$$

where $V_i^P(\cdot)$ is a particular solution and $C_i q_A^{\beta_i}$, $i = 1, 2$, are homogeneous solutions to equation (11) in which $C_1$ and $C_2$ are non-negative constants and $\beta_1$ and $\beta_2$ are solutions to the quadratic equation:

$$\frac{\sigma^2}{2} \beta^2 + \left( \mu - \frac{\sigma^2}{2} \right) \beta - r = 0 \tag{13}$$

We give equation (12) the following economic interpretation:

$$V_i(q_A) = \underbrace{V_i^P(q_A)}_{\text{Value of staying in the market in perpetuity}} + \underbrace{C_1 q_A^{\beta_1} + C_2 q_A^{\beta_2}}_{\text{Option value of exiting the market}}$$

This interpretation of the solution for $V_i$ allows us to simplify the solution even further and the derive a threshold for exit using economic intuition.

First, from equation (2), if $q_A$ gets arbitrarily low, all else equal, a practice’s profit becomes arbitrarily large and the value of the option to exit the market becomes worthless. Formally, given our interpretation of the solution, this condition can be written as

$$\lim_{q_A \rightarrow 0} [V_i(q_A) - V_i^P(q_A)] = 0$$

Note from equation (13) that there is one positive solution and one negative solution. Let $\beta_1$ denote the positive solution. In order for this condition to hold, it must be true that $C_2 = 0$. 

29
Second, as long as the value of practice is greater than the salvage value, the practice will remain in the market. However, if the value of the practice is less than or equal to the salvage value, then the practice should exit. Let \((q_A)^*\) denote the threshold at which the practice is indifferent between remaining open and exiting the market. It follows that \(q_A^*\) satisfies:

\[
V_i[q_A^*] = S(n) \tag{15}
\]

Or, using the homogeneous solution:

\[
C = [q_A^*] - \beta \{S(n) - V_i^P[q_A^*] \}
\tag{16}
\]

where the subscripts have been dropped for expositional convenience. Setting \(C_2 = 0\) and plugging this condition in for \(C_1\) in equation (12) yields equation (3).

### The Distribution of Beliefs about Quality

Let \(h(q,t)\) denote the probability density functions of beliefs about quality across individuals at time \(t\). The Kolmogorov Forward Equation (KFE) for a generalized Itô process of the form of equation (1) is

\[
\frac{\partial h}{\partial t} = -\frac{\partial}{\partial q} \{f(q)h(q,t)\} + \frac{1}{2} \frac{\partial^2}{\partial q^2} \{g(q)^2h(q,t)\}
\]

Using the assumptions regarding \(f(\cdot)\) and \(g(\cdot)\), this can be re-written as

\[
\frac{\partial h}{\partial t} = -\frac{\partial}{\partial q} \{\mu q h(q,t)\} + \frac{1}{2} \frac{\partial^2}{\partial q^2} \{\sigma^2 q^2 h(q,t)\}
\]

Note that we are interested in a stationary equilibrium distribution. Thus, by definition, it must be true that \(\frac{\partial h}{\partial t} = 0\). It follows that the KFE can be written as:

\[
0 = -\frac{\partial}{\partial q} \{\mu q h(q)\} + \frac{1}{2} \frac{\partial^2}{\partial q^2} \{\sigma^2 q^2 h(q)\} \tag{17}
\]

Furthermore, note that we have

\[
\int_0^{q^*} h(q) dq = 1 \tag{18}
\]

Now, guess that the distribution is \(h(q) = \chi q^\gamma\). Plugging this into the KFE implies that

\[
\gamma = \frac{2\mu}{\sigma^2} - 2
\tag{19}
\]

Also, integrating equation (18) by parts and simplifying implies that

\[
\chi = (\gamma + 1)(\epsilon q^*)^{-1(\gamma+1)}
\tag{20}
\]

Thus, the stationary equilibrium distribution for perceptions of quality is

\[
h(q) = \left(\frac{2\mu}{\sigma^2} - 1\right)(\epsilon q^*)^{1-\frac{2\mu}{\sigma^2} q^{2\mu-2}}
\tag{21}
\]

The expected quality in the market is therefore given as

\[
q_A = E(q) = \int_0^{q^*} q \left[\left(\frac{2\mu}{\sigma^2} - 1\right)(\epsilon q^*)^{1-\frac{2\mu}{\sigma^2} q^{2\mu-2}}\right] dq 
\tag{22}
\]
Integrating by parts and substituting using equation (6) yields the expected value of the perception of average quality in the market in equilibrium:

\[
E(q_A) = \left(1 - \frac{\sigma^2}{2\mu}\right) e^q \left[\left(\frac{\beta + \alpha}{\beta}\right) \frac{1}{nS(n)|r + \alpha \mu - \alpha(1 - \alpha)|}\right]^{1/\alpha}
\]  

(23)
### Table A-1: Average Marginal and Partial Effects for High Quality Blood Pressure Management

<table>
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<tr>
<th>(1)</th>
<th>All Providers AMFX (SE.)</th>
<th>(2)</th>
<th>Primary Care AMFX (SE.)</th>
<th>(3)</th>
<th>Specialists AMFX (SE.)</th>
<th>(4)</th>
<th>Specialists AMFX (SE.)</th>
<th>(5)</th>
<th>Specialists AMFX (SE.)</th>
<th>(6)</th>
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<td>-0.028**</td>
<td>-0.039***</td>
<td>-0.034**</td>
<td>-0.031*</td>
<td>0.023</td>
<td>0.028</td>
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<td>(0.012)</td>
<td>(0.017)</td>
<td>(0.016)</td>
<td>(0.026)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.022*</td>
<td>-0.021***</td>
<td>-0.062***</td>
<td>-0.071***</td>
<td>0.061***</td>
<td>0.029</td>
<td>(0.012)</td>
<td>(0.011)</td>
<td>(0.017)</td>
<td>(0.016)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>Male</td>
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<td>-0.071***</td>
<td>-0.075***</td>
<td>-0.075***</td>
<td>-0.050***</td>
<td>-0.059***</td>
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<td>(0.007)</td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>11-19 yr</td>
<td>0.061***</td>
<td>0.061***</td>
<td>0.066***</td>
<td>0.066***</td>
<td>0.022***</td>
<td>0.021</td>
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<td>(0.009)</td>
<td>(0.017)</td>
<td>(0.017)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>20-29 yr</td>
<td>0.100***</td>
<td>0.100***</td>
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<td>0.087***</td>
<td>0.062***</td>
<td>0.062***</td>
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<td>(0.010)</td>
<td>(0.018)</td>
<td>(0.018)</td>
<td>(0.013)</td>
</tr>
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<td>30+ yr</td>
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<td>0.131***</td>
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<td>0.057***</td>
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<td>(0.010)</td>
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<td>(0.018)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>2 to 3 physicians</td>
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<td>(0.019)</td>
<td>(0.019)</td>
<td>(0.015)</td>
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<tr>
<td>10+ physicians</td>
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<td>-0.215***</td>
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<td>(0.015)</td>
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<td>(0.007)</td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>EHR</td>
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<td>0.027***</td>
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<td>(0.008)</td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Year 2015</td>
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<td>-0.124***</td>
<td>-0.226***</td>
<td>-0.227***</td>
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<td>0.044***</td>
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<td>(0.014)</td>
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<td>-0.007</td>
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<td>-0.019***</td>
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<td>(0.004)</td>
<td>(0.008)</td>
<td>(0.008)</td>
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<td>Medicare Adv. part. rate</td>
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<td>0.001</td>
<td>0.001</td>
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<td>(0.000)</td>
<td>(0.001)</td>
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<tr>
<td>% Medicare pop. male</td>
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<td>-0.006</td>
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<td>0.010*</td>
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<td>-0.004</td>
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<td>(0.004)</td>
<td>(0.006)</td>
<td>(0.006)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>% Medicare pop. White</td>
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<td>-0.004***</td>
<td>0.007***</td>
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<td>(0.001)</td>
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<td>(0.002)</td>
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<tr>
<td>% Medicare pop. Black</td>
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<td>0.000</td>
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<td>-0.001**</td>
<td>-0.003**</td>
<td>-0.007**</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
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<tr>
<td>% Medicare pop. Hispanic</td>
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<td>0.001</td>
<td>-0.004***</td>
<td>-0.004***</td>
<td>0.000***</td>
<td>0.009***</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
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<tr>
<td>% County pop. covered by Medicare Part B</td>
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<td>-0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.003</td>
<td>0.003</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.002)</td>
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<tr>
<td>% Medicare/Medicaid dual eligible</td>
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<td>-0.001</td>
<td>-0.006***</td>
<td>-0.006***</td>
<td>0.003***</td>
<td>0.003***</td>
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<td>(0.001)</td>
<td>(0.001)</td>
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<tr>
<td>Average Medicare HCC Score</td>
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<td>-0.001</td>
<td>0.253*</td>
<td>0.243*</td>
<td>-0.058</td>
<td>-0.063</td>
<td>(0.037)</td>
<td>(0.037)</td>
<td>(0.142)</td>
<td>(0.141)</td>
<td>(0.105)</td>
</tr>
<tr>
<td>ln(lagged income per capita)</td>
<td>0.038*</td>
<td>0.035*</td>
<td>0.072*</td>
<td>0.062*</td>
<td>0.087***</td>
<td>0.086***</td>
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<td>(0.021)</td>
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<td>(0.037)</td>
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<td>-0.091**</td>
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<td>-0.131**</td>
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<td>(0.041)</td>
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<td>(0.066)</td>
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**Notes:** ***P < 0.01, **P < 0.05, *P < 0.1. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects and state fixed effects which are not reported.
Table A-2: Average Marginal and Partial Effects for High Quality Body Weight Management

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<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
</tr>
<tr>
<td>HH1 1500 to 2500</td>
<td>-0.010**</td>
<td>-0.013**</td>
<td>-0.030***</td>
<td>-0.035***</td>
<td>0.012</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.007)</td>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.015)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>HH1 2500+</td>
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<td>-0.017***</td>
<td>-0.039***</td>
<td>-0.047***</td>
<td>0.023</td>
<td>0.026**</td>
</tr>
<tr>
<td></td>
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<td>(0.007)</td>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.014)</td>
<td>(0.012)</td>
</tr>
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<tr>
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<td>(0.007)</td>
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<td>(0.006)</td>
</tr>
<tr>
<td>11-19 yr</td>
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<td>0.043***</td>
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<td>(0.010)</td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>20-29 yr</td>
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<td>0.074***</td>
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<td>0.092***</td>
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<tr>
<td></td>
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<td>(0.006)</td>
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<td>(0.010)</td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>30p yr</td>
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<td>0.087***</td>
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<td>0.102***</td>
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<td>0.060***</td>
</tr>
<tr>
<td></td>
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<td>(0.006)</td>
<td>(0.011)</td>
<td>(0.011)</td>
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<td>(0.009)</td>
</tr>
<tr>
<td>2 to 3 physicians</td>
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<td>-0.036***</td>
<td>-0.065***</td>
<td>-0.066***</td>
<td>-0.017*</td>
<td>-0.017*</td>
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<td>(0.007)</td>
<td>(0.007)</td>
<td>(0.012)</td>
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<td>(0.010)</td>
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<td>4 to 9 physicians</td>
<td>-0.039***</td>
<td>-0.035***</td>
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<td>-0.034***</td>
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<td></td>
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<td>(0.007)</td>
<td>(0.011)</td>
<td>(0.011)</td>
<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>10+ physicians</td>
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<td>-0.149***</td>
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<td>0.043***</td>
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<tr>
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<td>(0.007)</td>
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<td>(0.007)</td>
</tr>
<tr>
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<td>-0.042***</td>
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<td>-0.074***</td>
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<td>(0.007)</td>
<td>(0.007)</td>
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<td>% Medicare pop. Black</td>
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<td>% Medicare pop. Hispanic</td>
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<tr>
<td>% County pop. covered by Medicare Part B</td>
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<td>% Medicare/Medicaid dual eligible</td>
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<td>Average Medicare HCC Score</td>
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<tr>
<td>ln(lagged income per capita)</td>
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<td>0.026</td>
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Notes: *** P < 0.01, ** P < 0.05, * P < 0.1. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects and state fixed effects which are not reported.
### Table A-3: Average Marginal and Partial Effects for High Quality Depression Management

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<th>All Providers (1)</th>
<th>All Providers (2)</th>
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<th>Primary Care (4)</th>
<th>Specialists (5)</th>
<th>Specialists (6)</th>
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<td>AMFX (SE.)</td>
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<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
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<td>HHI 1500 to 2500</td>
<td>0.010</td>
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<td>HHI 2500+</td>
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<td>11-19 yr</td>
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<td>20-29 yr</td>
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<td>0.060***</td>
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<td>30p yr</td>
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<td>2 to 3 physicians</td>
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<td>4 to 9 physicians</td>
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<td>Medicare average age</td>
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<td>% Medicare pop. male</td>
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<td>0.017*</td>
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<td>% Medicare pop. White</td>
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<td>-0.005*</td>
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<tr>
<td>% Medicare pop. Black</td>
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<td>-0.001***</td>
<td>-0.007*</td>
<td>-0.007*</td>
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<td>% Medicare pop. Hispanic</td>
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<td>-0.007</td>
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<tr>
<td>% County pop. covered by Medicare Part B</td>
<td>-0.002</td>
<td>-0.002</td>
<td>-0.005**</td>
<td>-0.009**</td>
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<td>% Medicare/Medicaid dual eligible</td>
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<td>Average Medicare HCC Score</td>
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<td>ln(lagged income per capita)</td>
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<td>0.097</td>
<td>0.023</td>
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<td>(0.062)</td>
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<td>(0.077)</td>
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Notes: ** * * P < 0.01, ** * P < 0.05, * P < 0.1. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects and state fixed effects which are not reported.
Table A-4: Average Marginal and Partial Effects for High Quality Medication Management

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<th>Primary Care</th>
<th>Specialists</th>
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<td>(2) AMFX (SE.)</td>
<td>(3) AMFX (SE.)</td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>0.005 (0.031)</td>
<td>-0.032* (0.030)</td>
<td>-0.029 (0.029)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.001 (0.029)</td>
<td>0.004 (0.027)</td>
<td>-0.060** (0.032)</td>
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<tr>
<td>male</td>
<td>-0.010 (0.019)</td>
<td>-0.008 (0.019)</td>
<td>0.002 (0.027)</td>
</tr>
<tr>
<td>11-19 yr</td>
<td>-0.032 (0.028)</td>
<td>-0.032 (0.028)</td>
<td>-0.049 (0.037)</td>
</tr>
<tr>
<td>20-29 yr</td>
<td>0.006 (0.027)</td>
<td>0.008 (0.027)</td>
<td>-0.034 (0.037)</td>
</tr>
<tr>
<td>30p yr</td>
<td>0.003 (0.027)</td>
<td>0.005 (0.027)</td>
<td>-0.056 (0.037)</td>
</tr>
<tr>
<td>2 to 3 physicians</td>
<td>-0.038 (0.030)</td>
<td>-0.036 (0.030)</td>
<td>-0.019 (0.035)</td>
</tr>
<tr>
<td>4 to 9 physicians</td>
<td>-0.038 (0.026)</td>
<td>-0.036 (0.027)</td>
<td>-0.060* (0.035)</td>
</tr>
<tr>
<td>10+ physicians</td>
<td>-0.056** (0.028)</td>
<td>-0.052* (0.028)</td>
<td>-0.034 (0.035)</td>
</tr>
<tr>
<td>unnamed</td>
<td>0.036** (0.016)</td>
<td>0.035** (0.016)</td>
<td>0.039 (0.024)</td>
</tr>
<tr>
<td>EHR</td>
<td>0.006 (0.017)</td>
<td>0.005 (0.017)</td>
<td>0.015 (0.026)</td>
</tr>
<tr>
<td>Year 2015</td>
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<td>0.005 (0.020)</td>
<td>-0.019 (0.028)</td>
</tr>
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<td>Medicare average age</td>
<td>0.013 (0.012)</td>
<td>0.011 (0.012)</td>
<td>0.019 (0.016)</td>
</tr>
<tr>
<td>Medicare Adv. part. rate</td>
<td>0.001 (0.001)</td>
<td>0.001 (0.001)</td>
<td>0.001 (0.002)</td>
</tr>
<tr>
<td>% Medicare pop. male</td>
<td>0.021*** (0.010)</td>
<td>0.015* (0.010)</td>
<td>0.028* (0.014)</td>
</tr>
<tr>
<td>% Medicare pop. White</td>
<td>0.015*** (0.005)</td>
<td>0.015*** (0.005)</td>
<td>0.001 (0.009)</td>
</tr>
<tr>
<td>% Medicare pop. Black</td>
<td>0.015*** (0.005)</td>
<td>0.019*** (0.005)</td>
<td>0.002 (0.009)</td>
</tr>
<tr>
<td>% Medicare pop. Hispanic</td>
<td>0.015*** (0.005)</td>
<td>0.014*** (0.005)</td>
<td>0.004 (0.009)</td>
</tr>
<tr>
<td>% County pop. covered by Medicare Part B</td>
<td>-0.006 (0.004)</td>
<td>-0.006 (0.004)</td>
<td>-0.006 (0.003)</td>
</tr>
<tr>
<td>% Medicare/Medicaid dual eligible</td>
<td>0.006** (0.003)</td>
<td>0.005** (0.003)</td>
<td>0.007* (0.004)</td>
</tr>
<tr>
<td>Average Medicare HCC Score</td>
<td>-0.323 (0.215)</td>
<td>-0.311 (0.215)</td>
<td>-0.501 (0.349)</td>
</tr>
<tr>
<td>ln(lagged income per capita)</td>
<td>0.130*** (0.057)</td>
<td>0.135*** (0.056)</td>
<td>0.024 (0.094)</td>
</tr>
<tr>
<td>Observations</td>
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</tr>
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</table>

Notes: ** * P < 0.01, ** P < 0.05, * P < 0.1. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects and state fixed effects which are not reported.
Table A-5: Average Marginal and Partial Effects for High Quality Tobacco Cessation Management

<table>
<thead>
<tr>
<th></th>
<th>All Providers</th>
<th>Primary Care</th>
<th>Specialists</th>
</tr>
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<tbody>
<tr>
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<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
</tr>
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<td></td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>0.024***</td>
<td>-0.017*</td>
<td>0.019**</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.009)</td>
<td>(0.008)</td>
</tr>
<tr>
<td></td>
<td>0.012**</td>
<td>-0.020***</td>
<td>0.005***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.009)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.037***</td>
<td>-0.047***</td>
<td>-0.047***</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>male</td>
<td>0.021***</td>
<td>0.012**</td>
<td>-0.017*</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.009)</td>
<td>(0.008)</td>
</tr>
<tr>
<td></td>
<td>-0.022***</td>
<td>-0.028***</td>
<td>0.005***</td>
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<tr>
<td></td>
<td>(0.005)</td>
<td>(0.009)</td>
<td>(0.008)</td>
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<tr>
<td>11-19 yr</td>
<td>0.040***</td>
<td>0.070***</td>
<td>0.025***</td>
</tr>
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<td></td>
<td>(0.005)</td>
<td>(0.010)</td>
<td>(0.009)</td>
</tr>
<tr>
<td></td>
<td>0.060***</td>
<td>0.090***</td>
<td>0.041***</td>
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<td>(0.009)</td>
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<td>20-29 yr</td>
<td>-0.000</td>
<td>-0.011</td>
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<td>(0.010)</td>
</tr>
<tr>
<td>30p yr</td>
<td>0.013***</td>
<td>0.026***</td>
<td>0.022***</td>
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<td>(0.006)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>2 to 3 physicians</td>
<td>0.007</td>
<td>-0.020**</td>
<td>-0.021**</td>
</tr>
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<td>(0.010)</td>
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<td>4 to 9 physicians</td>
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<td>-0.011</td>
<td>-0.012</td>
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<td>(0.010)</td>
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<tr>
<td>10+ physicians</td>
<td>-0.017***</td>
<td>-0.056***</td>
<td>-0.055***</td>
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<td>(0.010)</td>
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<tr>
<td>unnamed</td>
<td>-0.005</td>
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<td>(0.006)</td>
<td>(0.006)</td>
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<td>0.022***</td>
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<td>Year 2015</td>
<td>0.015***</td>
<td>0.010</td>
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<td></td>
<td>(0.003)</td>
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<td>(0.007)</td>
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<td>Medicare average age</td>
<td>0.005**</td>
<td>0.006</td>
<td>0.006</td>
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<tr>
<td></td>
<td>(0.002)</td>
<td>(0.004)</td>
<td>(0.004)</td>
</tr>
<tr>
<td>Medicare Adv. part. rate</td>
<td>-0.002***</td>
<td>-0.004***</td>
<td>-0.004***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>% Medicare pop. male</td>
<td>0.000**</td>
<td>0.007*</td>
<td>0.007*</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>% Medicare pop. White</td>
<td>-0.000</td>
<td>0.004***</td>
<td>0.004***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>% Medicare pop. Black</td>
<td>-0.002***</td>
<td>0.004***</td>
<td>0.004***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>% Medicare pop. Hispanic</td>
<td>-0.002***</td>
<td>0.003***</td>
<td>0.003***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>% County pop. covered by Medicare Part B</td>
<td>-0.003***</td>
<td>-0.005***</td>
<td>-0.005***</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>% Medicare/Medicaid dual eligible</td>
<td>-0.001***</td>
<td>-0.002***</td>
<td>-0.002***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Average Medicare HCC Score</td>
<td>0.283***</td>
<td>0.438***</td>
<td>0.425***</td>
</tr>
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<td>(0.040)</td>
<td>(0.079)</td>
<td>(0.079)</td>
</tr>
<tr>
<td>ln(lagged income per capita)</td>
<td>0.037***</td>
<td>0.101***</td>
<td>0.097***</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.019)</td>
<td>(0.019)</td>
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<tr>
<td>rural</td>
<td>-0.071***</td>
<td>-0.095**</td>
<td>-0.092**</td>
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<tr>
<td></td>
<td>(0.026)</td>
<td>(0.042)</td>
<td>(0.042)</td>
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<td>17904</td>
<td>28249</td>
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Distribution of RVUs for HHI

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<tr>
<th></th>
<th>Observed</th>
<th>Equal</th>
<th>Observed</th>
<th>Equal</th>
<th>Observed</th>
<th>Equal</th>
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</table>

Notes: *** P < 0.01, ** P < 0.05, * P < 0.1. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects and state fixed effects which are not reported.
Table A-6: Average Marginal Effects for Probit Regressions Using 50% Threshold for Defining High Quality

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<td>All Providers</td>
<td>Primary Care</td>
<td>Specialists</td>
<td>All Providers</td>
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<tr>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>-0.019</td>
<td>-0.037***</td>
<td>-0.023</td>
<td>-0.040***</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.011)</td>
<td>(0.015)</td>
<td>(0.014)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.025**</td>
<td>-0.033***</td>
<td>-0.060***</td>
<td>-0.071***</td>
</tr>
<tr>
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<td>(0.011)</td>
<td>(0.010)</td>
<td>(0.015)</td>
<td>(0.014)</td>
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<td>Observations</td>
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<td>18378</td>
<td>5543</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>0.003</td>
<td>-0.020***</td>
<td>-0.027***</td>
<td>-0.050***</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.006)</td>
<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.012*</td>
<td>-0.019***</td>
<td>-0.041***</td>
<td>-0.042***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
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<td>(0.009)</td>
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<td>Observations</td>
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<td>32359</td>
<td>16101</td>
<td>16101</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>-0.013</td>
<td>-0.005</td>
<td>-0.048*</td>
<td>-0.050*</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.022)</td>
<td>(0.029)</td>
<td>(0.027)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.080***</td>
<td>-0.080***</td>
<td>-0.053**</td>
<td>-0.058**</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.021)</td>
<td>(0.027)</td>
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</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>0.018</td>
<td>0.012</td>
<td>-0.040</td>
<td>-0.017</td>
</tr>
<tr>
<td></td>
<td>(0.024)</td>
<td>(0.022)</td>
<td>(0.036)</td>
<td>(0.033)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>0.004*</td>
<td>0.002</td>
<td>0.002</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.003)</td>
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<td>Observations</td>
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<td>408</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>-0.004*</td>
<td>0.001</td>
<td>-0.004</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.000</td>
<td>0.002</td>
<td>0.002</td>
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</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.003)</td>
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<tr>
<td>Observations</td>
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<td>14050</td>
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<td>Distribution of RVUs for HHI</td>
<td>Observed</td>
<td>Equal</td>
<td>Observed</td>
<td>Equal</td>
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<td>スーパーセレクト</td>
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Notes: ** * P < 0.01, ** P < 0.05, * P < 0.1. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included Specialty fixed effects and state fixed effects which are not reported. Sample sizes differ from primary models due to differences in dropped observations from perfect predictions.
Table A-7: Average Marginal Effects for Probit Regressions Using 75% Threshold for Defining High Quality

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<th>All Providers</th>
<th>Primary Care</th>
<th>Specialists</th>
</tr>
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<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td></td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
</tr>
<tr>
<td>Panel A: High Quality Blood Pressure Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>-0.007 (-0.013)</td>
<td>-0.018 (-0.017)</td>
<td>0.064** (-0.029)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.008 (-0.012)</td>
<td>-0.061*** (-0.017)</td>
<td>0.061*** (-0.016)</td>
</tr>
<tr>
<td>Observations</td>
<td>18418</td>
<td>18418</td>
<td>5558</td>
</tr>
<tr>
<td>Panel B: Body Weight Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>-0.011 (-0.007)</td>
<td>-0.024*** (-0.010)</td>
<td>0.025* (-0.009)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.022*** (-0.007)</td>
<td>-0.035*** (-0.009)</td>
<td>-0.042*** (-0.014)</td>
</tr>
<tr>
<td>Observations</td>
<td>52359</td>
<td>52359</td>
<td>16120</td>
</tr>
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<td>Panel C: High Quality Depression Management</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>0.005 (0.024)</td>
<td>-0.024 (-0.027)</td>
<td>-0.120 (-0.025)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.060*** (0.022)</td>
<td>-0.033 (0.026)</td>
<td>-0.139* (0.084)</td>
</tr>
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<td>4172</td>
<td>1628</td>
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<td>Panel D: High Quality Medication Management</td>
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<tr>
<td>HHI 1500 to 2500</td>
<td>-0.003 (-0.024)</td>
<td>0.010 (0.020)</td>
<td>-0.031 (0.019)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>0.003 (0.022)</td>
<td>0.004 (0.022)</td>
<td>-0.000 (0.016)</td>
</tr>
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<td>876</td>
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<td>Panel E: High Quality Tobacco Cessation Management</td>
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</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>0.004 (0.005)</td>
<td>0.003 (0.004)</td>
<td>0.016* (0.004)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>0.005** (0.003)</td>
<td>0.006 (0.004)</td>
<td>0.023*** (0.008)</td>
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<td>Observations</td>
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<td>16904</td>
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Notes: * * * \( P < 0.01 \), ** \( P < 0.05 \), * \( P < 0.1 \). Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects and state fixed effects which are not reported. Sample sizes differ from primary models due to differences in dropped observations from perfect predictions.
Table A-8: Average Marginal Effects for Probit Regressions Using Alternative Bands for Urban Primary Care Physicians

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<th>Competition Measure includes all PCPs up to:</th>
<th>5 miles</th>
<th>10 miles</th>
<th>15 miles</th>
<th>20 miles</th>
<th>25 miles</th>
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<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
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<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
<td>AMFX (SE.)</td>
</tr>
<tr>
<td>Panel A: High Quality Blood Pressure Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>-0.033*</td>
<td>-0.034***</td>
<td>-0.040**</td>
<td>-0.021*</td>
<td>-0.050***</td>
</tr>
<tr>
<td>(0.018)</td>
<td>(0.012)</td>
<td>(0.018)</td>
<td>(0.011)</td>
<td>(0.020)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.054***</td>
<td>-0.023**</td>
<td>-0.098***</td>
<td>-0.034***</td>
<td>-0.120***</td>
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<tr>
<td>(0.017)</td>
<td>(0.011)</td>
<td>(0.020)</td>
<td>(0.010)</td>
<td>(0.025)</td>
<td>(0.010)</td>
</tr>
<tr>
<td>Panel B: Body Weight Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HHI 1500 to 2500</td>
<td>-0.023**</td>
<td>-0.035***</td>
<td>0.005</td>
<td>-0.034***</td>
<td>-0.010</td>
</tr>
<tr>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.010)</td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>HHI 2500+</td>
<td>-0.037***</td>
<td>-0.057***</td>
<td>-0.020*</td>
<td>-0.052***</td>
<td>-0.033**</td>
</tr>
<tr>
<td>(0.010)</td>
<td>(0.009)</td>
<td>(0.011)</td>
<td>(0.012)</td>
<td>(0.015)</td>
<td>(0.017)</td>
</tr>
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<td>Panel C: High Quality Depression Management</td>
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<tr>
<td>HHI 1500 to 2500</td>
<td>-0.013</td>
<td>-0.016</td>
<td>0.009</td>
<td>-0.021</td>
<td>-0.063**</td>
</tr>
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<td>(0.026)</td>
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<td>(0.029)</td>
<td>(0.028)</td>
<td>(0.032)</td>
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<tr>
<td>HHI 2500+</td>
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<tr>
<td>(0.025)</td>
<td>(0.025)</td>
<td>(0.032)</td>
<td>(0.037)</td>
<td>(0.037)</td>
<td>(0.044)</td>
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<td>Panel D: High Quality Medication Management</td>
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<tr>
<td>HHI 1500 to 2500</td>
<td>-0.022</td>
<td>-0.057*</td>
<td>0.007</td>
<td>0.012</td>
<td>0.014</td>
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<td>(0.030)</td>
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<td>(0.033)</td>
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<tr>
<td>HHI 2500+</td>
<td>-0.066**</td>
<td>0.007</td>
<td>-0.001</td>
<td>0.047*</td>
<td>0.007</td>
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<tr>
<td>(0.033)</td>
<td>(0.025)</td>
<td>(0.040)</td>
<td>(0.025)</td>
<td>(0.044)</td>
<td>(0.023)</td>
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<tr>
<td>Panel E: High Quality Tobacco Cessation Management</td>
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<tr>
<td>HHI 1500 to 2500</td>
<td>-0.013</td>
<td>-0.012</td>
<td>0.035***</td>
<td>-0.013</td>
<td>0.018*</td>
</tr>
<tr>
<td>(0.009)</td>
<td>(0.008)</td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.010)</td>
<td>(0.011)</td>
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<tr>
<td>HHI 2500+</td>
<td>-0.022**</td>
<td>-0.024***</td>
<td>-0.015</td>
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<td>(0.010)</td>
<td>(0.011)</td>
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Distribution of RVUs for HHI: Observed Equal Observed Equal Observed Equal Observed Equal

Notes: ** ** P < 0.01, ** P < 0.05, * P < 0.1. Average Marginal/Partial Effects are estimated for probit regressions using Stata 15. Each model also included specialty fixed effects and state fixed effects which are not reported.