For Online Publication
Appendix for:
What Does A Provider Network Do? Evidence From Random Assignment in Medicaid managed care

A. Data and Outcomes

To estimate the impact of limited provider networks on Medicaid enrollees, I merge administrative health records from the New York State Department of Health (NYSDOH), managed care provider network directory information, and hospital characteristics from the American Hospital Association. I briefly describe each data source and my outcomes here.

A.1. Administrative enrollment and claims data

I obtained de-identified administrative data on enrollment, plan choice, and insurance claims for the entire New York Medicaid population from 2008 to 2012.[1] The state requires all full risk managed care plans which enroll Medicaid beneficiaries to collect and submit standardized encounter data for all contracted services through the Medicaid Encounter Data System (MEDS). Data submissions are validated by a system of electronic edits and reviewed by Medicaid staff.

There are, and continue to be, concerns about the completeness of plan encounter data which includes both paid claims by plans and "encounters" reported to plans by capitated providers. The data provided by the state includes an indicator that separately identifies claims paid directly by the plan from encounters reported by providers. A recent evaluation of encounter data completeness by the Lewin Group identified New York encounter data as usable for research (The Lewin Group, 2012).

For each enrollee, I observe limited demographic data, monthly enrollment data, and claims for medical services covered by Medicaid. The data cover the months in which enrollees are in Medicaid fee-for-service (FFS) and managed care. The enrollment data include an indicator that I use to identify enrollees that are randomly-assigned to their health plans by the "auto assignment" algorithm.

The medical claims include detailed patient diagnoses, procedures, provider identifiers, and the amount paid by the insurer (MMC or FFS). New York State Department of Health staff have standardized the fee-for-service and managed care data. For the outpatient data, I use the Berenson-Eggers Type of Service (BETOS) codes to assign each HCPCS code to one of seven categories: evaluation and management, procedures, imaging, tests, durable medical equipment, other, or unclassified. For the inpatient data, I use the Clinical Classifications Software (CCS) developed by the Healthcare Cost and Utilization Project

[1] The data was obtained pursuant to a Data Exchange Application & Agreement (DEAA) with New York Medicaid. The data was de-identified to protect the privacy of Medicaid enrollees.

(HCUP) to assign each inpatient admission to a clinically meaningful category based on the primary diagnosis.

A.2. Outcome measures

Healthcare use and spending outcomes. When measuring healthcare use and spending, I include services paid for by the Medicaid managed care plans as well as any additional "carved out" services paid for by fee-for-service Medicaid. I use service categories provided by the NYSDOH to measure spending separately by broad category of service. Prior to assignment or plan choice, enrollees are covered by the publicly-operated, Medicaid fee-for-service program which allows me to observe their baseline healthcare use and spending. This enables powerful balance tests and allows me to construct a measure of enrollee health status (uncontaminated by provider network or plan effects) using a cross-validated, LASSO regression that takes as inputs enrollee demographics, diagnoses, and baseline spending to predict spending post-assignment. Appendix Section A.7 describes this model in more detail.

Potentially high- and low-value services. Following Brot-Goldberg et al. (2017), I use my administrative health records to examine enrollees' use of a wide range of medical services, including those that are potentially wasteful and those considered to be of high value.

I examined three sets of potentially high-value services that policymakers worry are underused: (1) high-value medical care (e.g., primary care); (2) recommended preventive care; and (3) high-value prescription drugs (e.g., statins). Each set of services is intended to improve population health and reduce the incidence of costly disease (Chernew, Schwartz and Fendrick, 2015) and it is common for policymakers to provide financial rewards to managed care plans if the utilization of these services is high. The high-value medical care category includes primary care, mental health services, physical therapy, and prenatal/postpartum care. To measure the receipt of recommended preventive care, I use a set of measures developed by the Secretary of Health and Human Services (HHS) for adult Medicaid enrolles. These include the frequency of flu vaccination for adults ages 18 to 64, breast cancer screening, cervical cancer screening, smoking cessation counseling, HbA1c testing, and chlamydia screening in women. I also examined a set of low-value services either cited for potential overuse or believed to reflect underuse of primary or preventive care: (1) imaging and lab, services often cited as wasteful (e.g., Sorenson et al., 2020); (2) emergency department use; (3) avoidable hospitalizations; and (4) services designated as low-value care by clinicians (see Schwartz et al., 2014). The avoidable hospitalization measure I uses includes hospitalizations for: diabetes short-term complications, chronic obstructive pulmonary disease or asthma in adults, heart failure, and asthma in younger adults. For each service, I construct an indicator for whether an enrollee received that service in a month. I also construct indicators for "any potentially high-value care" and "any potentially low-value care" that measure whether enrollees received any of the potentially high- or low-value services, respectively, in a month.

Consumer satisfaction. The final outcome I study is enrollee utility or satisfaction

as measured by whether or not an enrollee stays in their randomly assigned plan. I assume that enrollees' preferences are revealed through their subsequent plan choices since auto-assigned enrollees may switch plans after assignment. Specifically, for the first three months after assignment enrollees may switch for any reason, after which a nine-month lock-in period begins during which they may only switch for "good cause." While this differs from a traditional willingness-to-pay measure, in a world of consumer choice frictions (e.g., Handel and Kolstad, 2015; Handel, Kolstad and Spinnewijn, 2019), an advantage of this measure is that it reflects the utility an enrollee experiences in their assigned plan (Israel, 2005), which is revealed in their subsequent plan switches.

A.3. Alternative sample: extended sample of auto-assignees

The construction of my primary sample of auto-assignees is described in Section I. I construct two alternative samples of auto-assignees. First, I construct balanced samples of enrollees that remain in Medicaid for at least 12, 18, and 24 months post-assignment. Second, I construct an imbalanced sample of enrollees that are in Medicaid for at least the 6 months post-assignment, but begin to attrit from the sample after 6 months. I impose the sample restrictions used to construct my primary sample (Section I), with the exception that I require additional months of enrollment in Medicaid for the extended balanced samples. In addition, the enrollees differ slightly from my primary specification, even for the imbalanced sample, due to the imposition of small additional restrictions—for example, enrollees had to remain in New York City for at least 12 months following assignment (rather than 6 as in my primary sample).

A.4. Alternative sample: enrollees that made active plan choices

The construction of my primary sample of auto-assignees is described in Section I. I construct an alternative sample using data on adult Medicaid enrollees in New York City that made active plan choices during the period April 2008 to July 2012. I restrict this sample in four ways to ensure comparability to my primary estimation sample. First, I drop enrollees that live outside the five boroughs of New York City. Second, I restrict the sample to enrollees aged 18 to 65. Third, I remove individuals who qualify for Medicaid because they receive Supplemental Security income (SSI) due to differences in their auto-assignment policy. Fourth, to keep the sample balanced, I restrict the primary sample to enrollees that are in Medicaid for at least three months prior, and six months after, their active plan choice. I make these restrictions because I'm interested in identifying a set of enrollees in the same market, age band, and eligibility category as the auto-assignee population. These sample restrictions leave me with 95,888 enrollees in five counties and ten plans. Appendix Table 7 for how the baseline characteristics of this sample compare to the auto-assignees—the two sets of enrollees have similar characteristics and healthcare utilization patterns at baseline.

A.5. Provider Network Data

I assemble a unique dataset on the physician and hospital managed care networks using New York's Provider Network Data System (PNDS). Recent research has highlighted inaccuracies in managed care provider networks (Resneck Jr et al., 2014). Reassuringly, New York has a long history of collecting and verifying managed care network data. New York began collecting data on managed care networks in 1996 to determine compliance with network adequacy requirements and create provider directories for consumers. HHS (2014) examined state standards for access to care in Medicaid and reported that New York, unlike most states, had several policies in place to ensure timely and accurate submission of provider network data. Federal law requires that states contract with external quality review organizations (EQRO) to evaluate access to care for Medicaid managed care enrollees.[2] In New York, the state's EQRO uses secret-shopper calls to determine the accuracy of managed care provider directories.

The PNDS is standardized, allowing us to construct comparable network measures for each plan. The managed care plans all report several provider identifiers, including the state license number and the national provider identifier (NPI) for both physicians and hospitals. The plans also report Medicaid provider identification numbers which allow us to merge the network data with fee-for-service claims and managed care encounter data. While the PNDS data is reported quarterly, I construct an indicator for whether a provider is in-network at the annual level. The indicator is set to one if the provider is in network in any quarter. The PNDS also includes an indicator for each provider-insurer pair that identifies which insurance products the provider is in network for. Since many of the managed care plans serve both the Medicaid and commercial markets this indicator allows me to isolate providers in their Medicaid network.

The PNDS also includes basic data on provider characteristics, including gender, type, specialty, and address. With provider and patient zip code data, I construct travel time for each patient-provider pairing in New York City using the ArcGIS Network Analyst.[3] For hospitals I follow Ericson and Starc (2015) and use the 2007 to 2012 American Hospital Association (AHA) data to identify the set of general medical and surgical hospitals, excluding long-term care, rehabilitation and Veterans Affairs hospitals. This data was hand-merged to the New York Medicaid operating certificates for hospitals to identify the set of hospitals serving New York Medicaid enrollees. The AHA data was then used to construct variables (such as services provided or location) for each Medicaid hospital in New York City. As in Ho (2006), I fill in missing data using surrounding years wherever possible. The final dataset comprises 63 hospitals.

[2] 42 CFR §§ 438.310-370.

[3] I thank Fei Carnes at the Center for Geographic Analysis at Harvard University for assistance with this.

A.6. Restrictions on payment to Medicaid providers for out-of-network services

Only a small share of physician and hospital visits are to out-of-network providers in New York Medicaid. This section discusses the rules related to out-of-network service use and billing for out-of-network services by Medicaid providers in New York State.

Guidance[4] from New York Medicaid states that unless a provider and Medicaid enrollee agree in advance of the provision of services that the enrollee is being seen as a private pay patient, the provider is prohibited from billing the enrollee for services, or otherwise requesting compensation for services other than any applicable copayments. This applies whether the enrollee is enrolled in the Medicaid fee-for-service program or Medicaid managed care. The guidance suggests that wherever a provider and enrollee reach such an agreement, best practice is for the provider to obtain and keep a signed written consent memorializing the agreement. Although the guidance linked to above dates from 2014, the prohibition on billing Medicaid enrollees absent a private pay arrangement is a longstanding rule based in federal statute.

New York's Medicaid managed care model contract ("model contract") also suggests that providers that furnish Medicaid-covered services to a Medicaid managed care enrollee are not entitled to payment from the enrollee's plan unless: (1) the provider is in-network with the plan; (2) the plan authorized the enrollee to receive the services before they were rendered (because, for example, there were no in-network providers available to render the service to the enrollee); or (3) the plan is legally required to grant a limited period of service continuity (ranging from 60 to 90 days, or up to 60 days after delivery for pregnant women) to preserve an ongoing treatment relationship. See Section 15.6 of the model contract.[5]

According to the Model Contract, a limited period of service continuity is required only in the case of:

1) New plan enrollees with a life-threatening or degenerative and disabling condition for up to 60 days following enrollment;

2) New plan enrollees who enroll in the second trimester of pregnancy, for up to 60 days after delivery; or

3) Existing plan enrollees whose provider leaves the network for reasons other than imminent harm to patients, fraud, or a final disciplinary action, for up to 90 days from the provider's departure from the network or 60 days after delivery.

For a provider to receive payments under circumstances 1, 2, or 3, the provider must agree to accept the plan's rates as payment in full (which may not exceed those provided to in-network providers), adhere to the plan's quality assurance requirements and provide

[4]See New York State Medicaid Update - February 2014, Volume 30 - Number 2: https://www.health.ny.gov/health_care/medicaid/program/update/2014/201402.htm#bill accessed on February 16, 2021.

[5]The latest version of the MMC model contract can be accessed here: https://www.health.ny.gov/health_care/managed_care/docs/medicaid_managed_care_fhp_hiv-snp_model_contract.pdf

the plan with all necessary medical information related to the care, and otherwise adhere to the plan's policies and procedures. *See* Section 15.6 of the Model Contract.[6]

Hence, out-of-network providers that furnish services to Medicaid enrollees without those enrollees receiving prior approval have limited means to collect payment from either the plan (who is not required to pay) or the enrollee (who cannot be charged). As a result, prior authorization for out-of-network care is a powerful tool to steer patients to in-network providers in Medicaid managed care in New York.

A.7. Predicting enrollee health status using baseline characteristics

To predict enrollee health status I estimate a cross-validated Lasso regression with post-assignment healthcare spending (in the 6 months after assignment) as the outcome and use a set of demographic and baseline utilization measures as predictors. For demographics, I use enrollees' Medicaid eligibility category, zip code, race, five year age by gender bins, and an indicator for whether they were an "auto assignee" or "active chooser." In addition to these predictors, I use indicators for the 700 most common baseline diagnosis codes (those obtained by enrollees at anytime in the 12 months prior to assignment), baseline medical spending, and baseline pharmacy spending. The baseline spending variables are z-score normalized because they are continuous and on a different scale than the binary indicators which can lead to problems in Lasso estimation.

A.8. Approach to defining high-prevalence chronic conditions

To document chronic conditions among the enrollees, I assigned Hierarchical Condition Codes (HCCs) using up to 12 months of pre-assignment data for each enrollee. To avoid post-treatment bias, I do not use diagnoses or procedures obtained post-assignment. I categorized enrollees into three chronic conditions based on the following lists of HCCs:

Chronic condition	Hierarchical Condition Codes (HCCs)
Behavioral health	54, 55, 56, 58
Diabetes	17, 18, 19
Cardiovascular disease	84, 85, 86, 87, 88, 96, 99, 100, 103, 104, 106, 107, 108

I examine heterogeneous treatment effects using these categories in Appendix Table 15.

[6]There are two caveats to the answer provided above. First, in the case of family planning services, enrollees are entitled to see any Medicaid-enrolled provider, whether in-network or not, and the plan must pay for the services provided. Second, in practice an out-of-network provider could bill a plan for services rendered to a plan enrollee, no matter the circumstances. However, Section 22.3 of the Model Contract states that all covered services, with limited exceptions such as emergency services and family planning services, must be provided through provider agreements with network providers.

B. Network measure construction

In this section, I provide some additional details on the estimation of the physician demand model and discuss how I construct two alternative measures of network breadth—the "covered share of visits" measure and the "network utility" measures.

B.1. Model of Physician Demand

I begin by providing additional details on the physician demand model. The method and specification for estimating physician demand differ from the hospital model in two ways. First, due to the large physician choice set (n=22,983), and the small volume of Medicaid claims for many physicians, it is not possible to estimate a fixed effect for each physician (as was done for each hospital). Instead, I estimate separate physician demand models in each of the forty-two neighborhoods (defined by zip) in NYC. For each neighborhood, I estimate fixed effects for the largest five percent of practices serving the enrollees of that neighborhood. Including neighborhood-specific fixed effects for these physicians is critical to fit since the distribution of claims across physicians is highly-skewed.[7] The remaining physicians are undifferentiated in the model beyond their observed characteristics. To minimize scaling differences across the models for each neighborhood, I normalize the fixed effect for the "small practices" to equal zero in each neighborhood.

The large choice set also makes it infeasible to estimate the conditional logit model using the full set of alternatives for each observation. Instead, I follow McFadden (1978) and for each choice instance select four random alternatives (in addition to the chosen physician) and proceed with the estimation using these subsets. McFadden (1978) demonstrates that the likelihood function for multinomial logit with a subset of alternatives reduces to the standard likelihood if the choice of the subset satisfies a "uniform conditioning property," a requirement that each alternative has an equal probability of being selected. The use of random subsets satisfies this property.

To estimate the physician demand model I assume that with some probability consumer i in neighborhood n enrolled in plan j seeks out a physician for services s. Their utility from visiting physician p at time t is given by:

$$(1) \quad u_{i,j,s,t,p,n} = \underbrace{\delta_n(\text{Dist}_{i,p} \times Z_{i,s,t})}_{\text{Distance}} + \underbrace{\lambda_n(X_p \times Z_{i,s,t}) + \xi_{p,n}}_{\text{Physician Characteristics}} + \underbrace{\psi_n \cdot 1\{p \notin N_{j,t}\}}_{\text{Out-of-Network Cost}} + \epsilon_{i,j,s,t,p,n}$$

where $\text{Dist}_{i,p}$ is patient travel distance and distance-squared (in minutes), X_p are observed physician characteristics, $\xi_{p,n}$ are unobserved physician characteristics (represented by physician fixed effects for large practices),[8] and $1\{p \notin N_{j,t}\}$ is an indicator that physician p is out-of-network for plan j in time t (with ψ_n the hassle cost), and $\epsilon_{i,j,s,t,p,n}$ is an

[7] One limitation of this approach is that the designation of large practice is based on the data. Unfortunately, the available data on physicians do not include exogenous measures of practice size.

[8] Physicians may be identified as a large practice in some neighborhoods and not in others.

i.i.d. Type 1 extreme value error. Patient observables $Z_{i,s,t}$ are interacted with distance and physician characteristics to allow for preference heterogeneity. Since patients often receive multiple services in a single physician visit, s is a vector of indicator variables that identifies whether a visit contained the following services classified by BETOS codes: evaluation and management, procedures, imaging, tests, durable medical equipment, other, or unclassified. The physician demand estimates are presented in Appendix Table 4 and discussed in Section II.

B.2. Construction of "covered share of visits" measure

To assess the robustness of my results to alternative measures of network breadth, I use methods from Ericson and Starc (2015) to a construct a "visit shares" measure at the plan-by-year-by-zip code level as the fraction of visits (hospital admissions or physician visits) for enrollees living in a given zip code covered by each managed care network. I pool healthcare claims for the sample period (April 2008 to December 2012) to construct this measure. Intuitively, the measure varies across plans and zip codes based on systematic differences in where enrollees in different zip codes seek physician and hospital care and which providers are in network for each plan. One limitation of this approach is that the provider choices of managed care enrollees are shaped by their networks, which is not accounted for in the visit share measure. This could be a problem, for example, in a zip code where one plan has a dominant market share. In that case the measure of network breadth may be artificially inflated for that plan because enrollees in that plan disproportionately seek care from in-network providers and these comprise a large share of the visits for all enrollees residing in that zip code.

B.3. Construction of "network utility" measure

In addition to my primary covered shared of simulated visits measure, and the covered share of visits measure described in the prior section, I also calculate the expected utility provided by each plan's network at the plan-by-year-by-zip code level. In the hospital case, for example, I follow Ho (2006, 2009) and Shepard (2016) and define the expected utility of the network for an individual i in plan j in year t:

$$\text{HospitalEU}_{i,j,t} \equiv E[\max_{h}(V_{i,j,t,h}(N_{j,t}) + \epsilon_{i,j,t,h})] = \log\left(\sum_{h} \exp(V_{i,j,t,h}(N_{j,t}))\right) \tag{2}$$

where representative utility $V_{i,j,t,h}(N_{j,t})$ is defined as $u_{i,j,t,h} - \epsilon_{i,j,t,h}$. In constructing this measure, I use the coefficients from column 2 in Appendix Table 3. The measure accounts for unobservable hospital quality, distance (and distance squared) between patient zip code and each hospital, and whether or not the hospital is in network for each plan. Because the scale of network utility is arbitrary I normalize the measure to have mean zero and standard deviation one. The physician network utility measure is constructed in a similar

fashion, with the major difference being that the coefficients in the physician model vary by neighborhood (due to the infeasibility of estimating a single physician choice model). Following Ericson and Starc (2015), the network utility measures are z-score normalized within each zip code. Consistent with prior work, the three different methods of measuring network breadth are highly-correlated (Appendix Figure 5).

C. Additional Details on Research Design

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C.1. Alternative specification with plan fixed effects

This section describes the alternative specification introduced in Section III. In this specification I include plan fixed effects (in addition to zip code fixed effects) to address the potential correlation between the γ_j (i.e., the plan effects) and enrollee's network breadth, Γ_{zj}, in Equation 2. In other words, there is a concern that the outcomes of enrollees assigned to narrower (or broader) networks may be impacted by the unobservable non-network characteristics of the plans they plans they are assigned to, such as how aggressively those plans use supply-side tools to ration care. Each plan may adopt a different bundle of managed care (i.e., supply-side) tools to manage their enrollees and this decision is made jointly with the formation and management of their provider networks. For example, one of the largest Medicaid Managed Care plans in New York City is owned by the local safety net hospital chain and operates a narrow hospital network, including only a handful of additional facilities. Appendix Figure 6 demonstrates that the enrollees assigned to this plan generated a lot of health care spending and utility, despite its narrow network, potentially biasing naive comparisons between plans.

To motivate the alternative specification, we return to our model of the data generating process for health care spending where log spending (Y_{izjct}) for enrollee i living in zip code z enrolled in plan j is determined by a location component (ω_z), plan component (γ_j), provider network component (Γ_{zj}), enrollee-level fixed effect (ζ_i), time-varying observables (X_{it}), and a mean zero shock (ϵ_{izjct}):

$$Y_{izjct} = \omega_z + \gamma_j + \beta\Gamma_{zj} + \zeta_i + \delta X_{it} + \epsilon_{izjct} \tag{3}$$

In my primary specification, I recover the effect of network breadth on healthcare spending by estimating Equation 3 at the enrollee-level, combining γ_j, ζ_i, and ϵ_{izjct} into a compound error term η_{izjct} and remove enrollees assigned to the outlier plan. However, our estimates of β may be biased if plans have independent effects on enrollee outcomes (i.e., the differences in the γ_js are economically significant) and those "plan effects" are correlated with enrollees' assigned network breadths. To address this, the alternative specification recovers the effect of network breadth on healthcare spending by estimating Equation 3 at the enrollee-level with controls for both zip code and plan of assignment, combining ζ_i, and

ϵ_{izjct} into a compound error term υ_{izjct}:

$$Y_{izjct} = \alpha + \gamma_j + \beta\Gamma_{zj} + \phi_{ct} + \omega_z + \delta X_{it} + \upsilon_{izjct} \tag{4}$$

where β is the coefficient of interest, α is a constant, γ_j are plan of assignment fixed effects, ϕ_{ct} are county $c \times$ month t of assignment fixed effects (the unit of randomization), ω_z are zip code fixed effects, and X_{it} is a vector of individual controls.

To address the endogeneity of enrollees sorting into plans, I restrict to auto-assigned enrollees and instrument for an enrollee's plan (γ_j) and provider network breadth (Γ_{zj}) with their assigned plan and the breadth of their assigned network. The resulting second stage estimating equation is:

$$Y_{izjct} = \alpha + \widehat{\gamma_j} + \beta\widehat{\Gamma_{zj}} + \phi_{ct} + \omega_z + \delta X_{it} + \epsilon_{izjct} \tag{5}$$

where $\widehat{\gamma_j}$ and $\widehat{\Gamma_{zj}}$ are predicted plan of enrollment and provider network breadth, respectively, based on first stage regressions that use assigned plan and assigned provider network breadth to instrument for actual plan and network.

The key source of identification in this model is the variation in network breadth that remains at the plan-by-zip level after controlling for enrollees' assigned plan and, separately, zip code. By virtue of including zip code fixed effects, our identification relies on within-zip code variation (as in our primary specification) and, hence, removes any potential bias due to a correlation between provider network breadth and location effects (i.e., provider networks may be broader in zip codes where enrollees tend to use more care for other reasons). However, within-zip code differences in provider network breadth may also be correlated with the plan effects (γ_j) if some plans are broader or narrower, on average. I address this, by also including controls for assigned plan (or instrumenting for plan with assigned plan). In this specification, we are comparing the outcomes for enrollees who are assigned broader provider networks because they are assigned to a plan in a zip code where that plan's network is relatively broad (both relative to its network elsewhere and to the networks of other plans in that zip code). To estimate β in Equation 5 requires that there exists variation at the plan $\times$ zip-level after residualizing on plan and, separately, zip code. Fortunately, in Panel D of Appendix Figure 7, we see that considerable variation in provider network breadth exists to estimate Equation 5.

Since auto assignment is not binding, I estimate the causal impact of network breadth with two-stage least squares using enrollee's assigned plan and provider network breadth to instrument for their actual plan and provider network breadth. Given 10 plans, there are 9 first stage estimating equations to predict actual plan enrollment (with 1 plan omitted) and an additional first stage equation that uses assigned provider network breadth to predict actual provider network breadth 5. The regressors in each of the first-stage equations are identical. To account for any serial correlation within randomization cohorts, I cluster standard errors at the county $\times$ month of assignment level in both the first and second stage regressions.

C.2. Event study specification

This section describes the regression specification for our event study. Let i index enrollees. Let t indicate event-time, defined as months relative to auto assignment. The data is at the enrollee-month level.

For a given outcome, Y_{it}, our event study regression specification takes the form:

$$Y_{it} = \alpha_i + \alpha_t + \left[\sum_{t \neq -1} \beta_t \times \widetilde{\Gamma}_i \right] + \epsilon_{it}, \tag{6}$$

where α_i are enrollee fixed effects, α_t are event-time fixed effects, $\widetilde{\Gamma}$ is the enrollee's assigned network breadth, and β_t are coefficients on network breadth that vary by event time. I omit the month prior to assignment, $\beta_{t=-1}$, so that the point estimates for the other event times can be interpreted relative to the pre-assignment baseline period. Because the strength of the instrument (i.e., assigned network breadth) weakens over time as enrollees switch out of their assigned plans, I also estimate an IV version of the event study where assigned network breadth, $\widetilde{\Gamma}$, is used to instrument for actual network breadth Γ, which may differ by period.

C.3. Specification Checks Related to Analyses of Heterogeneity by Network Characteristics

This section presents specification checks for the models used to explore heterogeneity in the effects of network breadth by network characteristics, and discusses the differences in estimates with and without plan fixed effects.

Column 1 of Appendix Table 18 reproduces the results from the randomization test presented in Column 3 of Table 2, a regression of the full set of baseline and predicted outcomes on the simulated visit shares measure of network breadth. Columns 2 and 3 report results for the same regression, but with measures of physician and hospital network breadth. None of the regressors were significant at the five percent level in either regression. In Columns 4 and 5 I include hospital network breadth as a control in the regression with physician network breadth as the outcome and physician network breadth as a control in the regression with hospital network breadth as the outcome. A similar story emerges, with none of the regressors significant at the five percent level. Reassuringly, none of the F-tests of the joint significance of the coefficients for each of the five regressions are significant at the five (or ten) percent level.

As in my primary specification, I examine the sensitive of the estimated effects of physician and hospital network breadth to the inclusion of plan controls. To do so, I add controls for plan of assignment to my specification as follows:

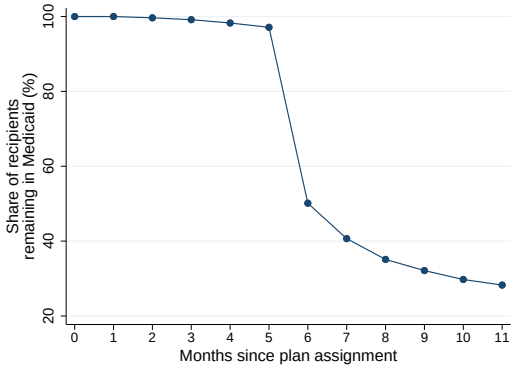
$$Y_{izjct} = \alpha + \omega_z + \widehat{\gamma_j} + \beta_1 \widehat{Phys_{zj}} + \beta_2 \widehat{Hosp_{zj}} + \phi_{ct} + \delta X_{it} + \eta_{izjct} \tag{7}$$

where $\widehat{\gamma_j}$ is the predicted plan of enrollment for each enrollee. In this specification, I control for plan and zip and use the rich variation that remains at the plan-by-zip level.

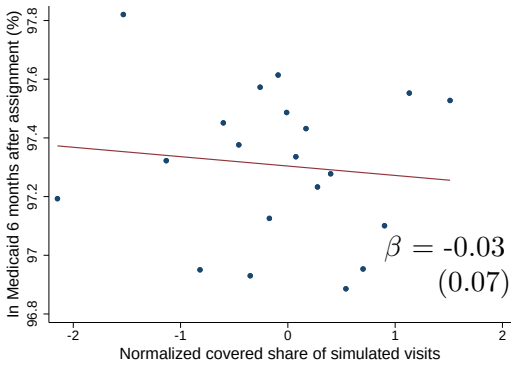
Unlike the primary results I present in Section IV, my estimates of the effects of physician and hospital network breadth are somewhat sensitive to the inclusion of plan controls, particularly estimates of the effect of network breadth on the use of potentially high-value and low-value services. Panels A and B of Appendix Figure 19 document that two of the Medicaid managed care plans with the broadest physician networks (once I residualize on hospital network breadth and my controls) generate low rates of high-value and low-value service use among randomly assigned enrollees. However, when I condition on plan (i.e., include plan fixed effects) in Panels E and F, I find strong associations between assigned physician network breadth and utilization. Because non-network dimensions of these plans (e.g., utilization management, prior authorization, etc.) may be correlated with physician network breadth—in this case the plans with the broadest physician networks appear to ration care more aggressively—my preferred specification in this section includes plan fixed effects. Comparisons of Table 5 (with plan controls) and Appendix Table 17 (without plan controls) reveal that the main differences relate to estimates of the effects of physician and hospital network breadth on the use of potentially high-value and low-value services. Results related to health care spending and consumer satisfaction are qualitatively similar between the two models.

Appendix Figure 1. : Testing for Differential Attrition

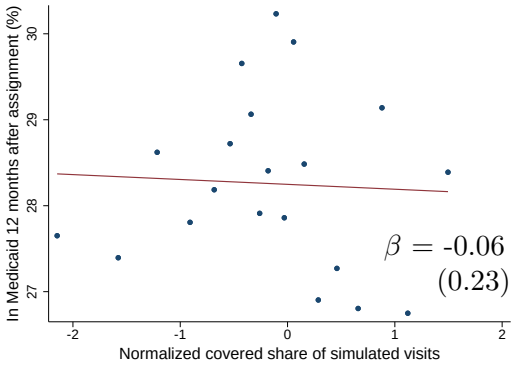
Panel A. Share of enrollees in Medicaid in 12 months after assignment



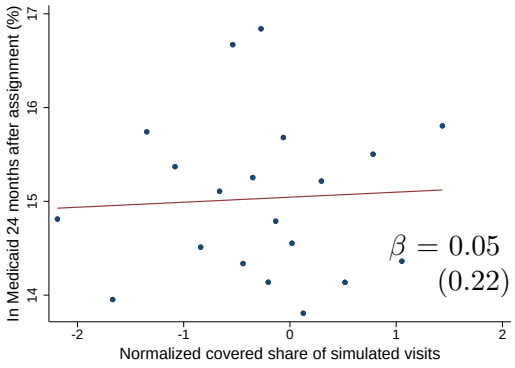
Panel B. Assigned network breadth and attrition 6 months post-assignment



Panel C. Assigned network breadth and attrition 12 months post-assignment

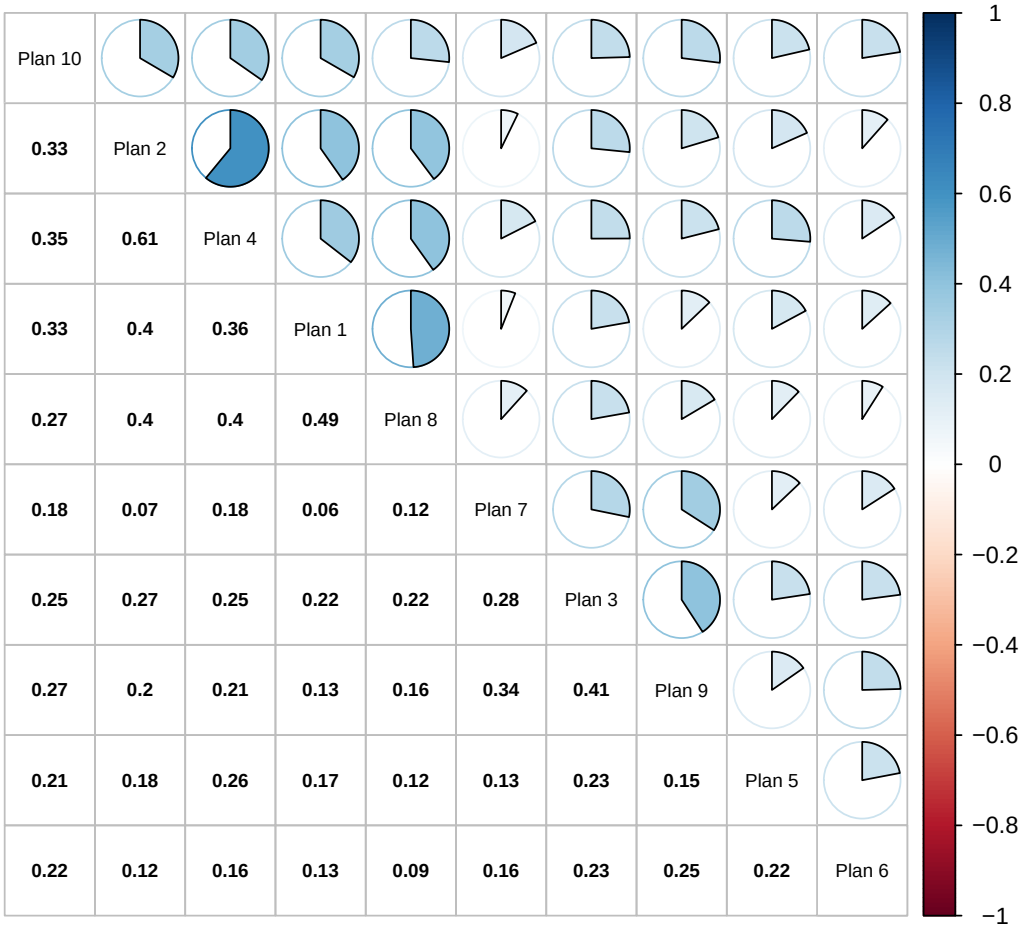


Panel D. Assigned network breadth and attrition 24 months post-assignment



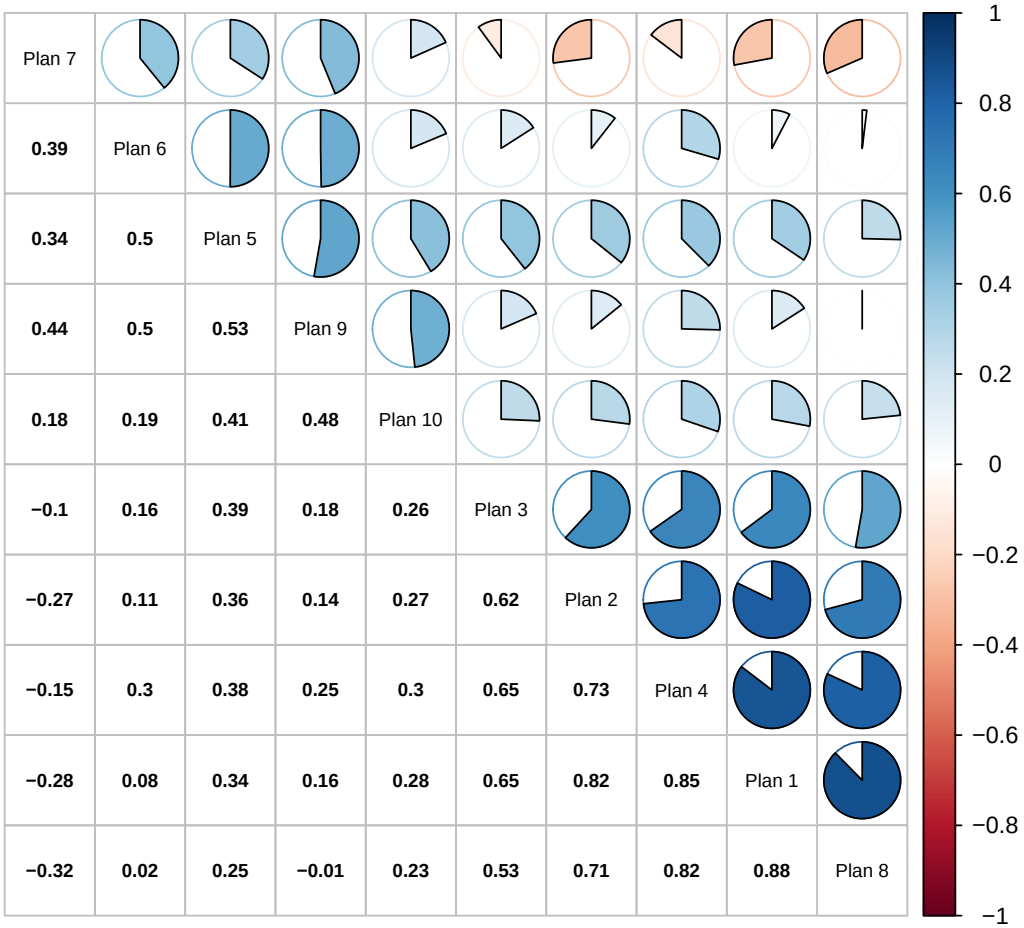
Notes: These figures examine the prevalence of differential attrition in my primary sample. Panel A plots the raw share of enrollees in Medicaid managed care separately for each month following auto assignment. I restrict the sample to enrollees that were auto assigned with at least 12 months remaining in the sample (an auto assignment date of January 2012 or earlier). The large drop in enrollment at six months is due to loss of eligibility that occurs for enrollees following a guaranteed six months of eligibility that starts at the beginning of their MCO enrollment (see New York State Socal Services Law 364-j (11)). Panels B-D contain residualized binned scatterplots of the reduced form impact of normalized covered share of simulated visits (network breadth) on enrollment in Medicaid in the six, twelve, and twenty-four months post-assignment. The binned scatterplots are constructed by first regressing assigned network breadth and the outcome variable on the set of control variables (i.e. age, gender, race, tenure, baseline outcomes, county × month of assignment), calculating residuals, and grouping the residualized network breadth measure into 20 equal-sized bins. The mean for each outcome is added back in to ease interpretation. The solid line and corresponding coefficient are based on an OLS regression of the residualized outcome on the residual network breadth measure, with standard errors clustered at the county × month of assignment level (Chetty, Friedman and Rockoff, 2014).

Appendix Figure 2. : Correlation of Physician Provider Networks Across Medicaid Managed Care Plans, 2010



Notes: This figure reports the correlation of physician network participation (at the individual physician level) across the ten Medicaid managed care plans in my sample. For the year 2010, I construct a vector of all physicians practicing in New York City and, based on the provider network data, an indicator for whether they are "in-network" for each plan. The figure reports the pairwise Pearson correlation coefficients between the vectors that measure physician network participation in each plan. Plan 7 is the provider-owned plan.

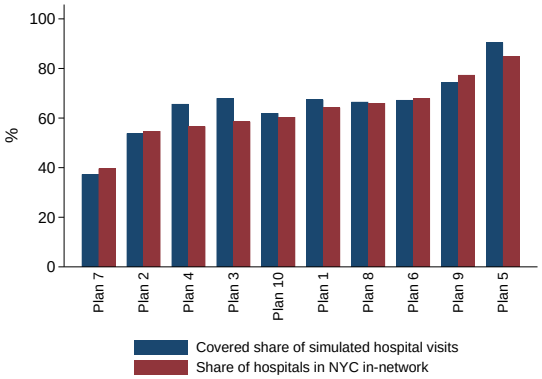
Appendix Figure 3. : Correlation of Hospital Provider Networks Across Medicaid Managed Care Plans, 2010



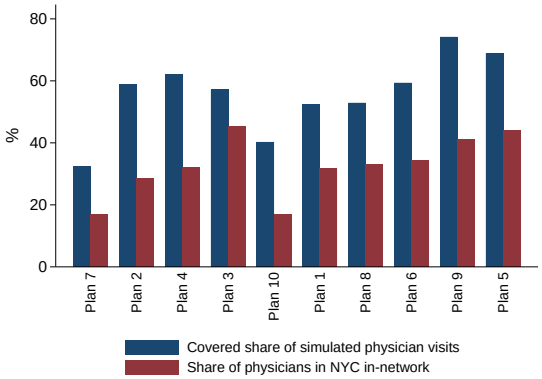
Notes: Notes: This figure reports the correlation of hospital network participation (at the hospital level) across the ten Medicaid managed care plans in my sample. For the year 2010, I construct a vector of all hospitals in New York City and, based on the provider network data, an indicator for whether they are "in-network" for each plan. The figure reports the pairwise Pearson correlation coefficients between the vectors that measure hospital network participation in each plan. Plan 7 is the provider-owned plan.

Appendix Figure 4. : Plan-Level Network Breadth and Contracted Physician and Hospitals

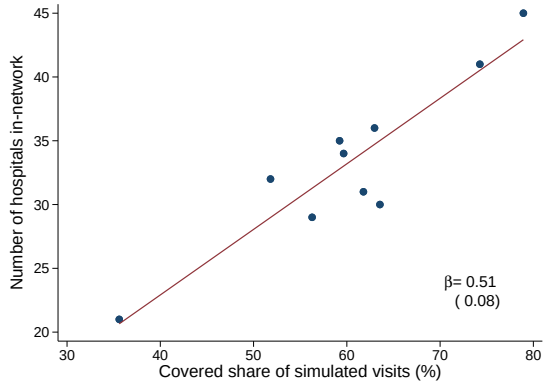
Panel A. Hospital network breadth and share of NYC hospitals in-network



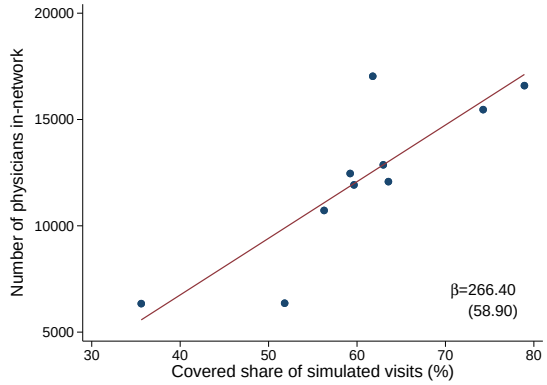
Panel B. Physician network breadth and share of NYC physicians in-network



Panel C. Overall breadth and number of contracted hospitals

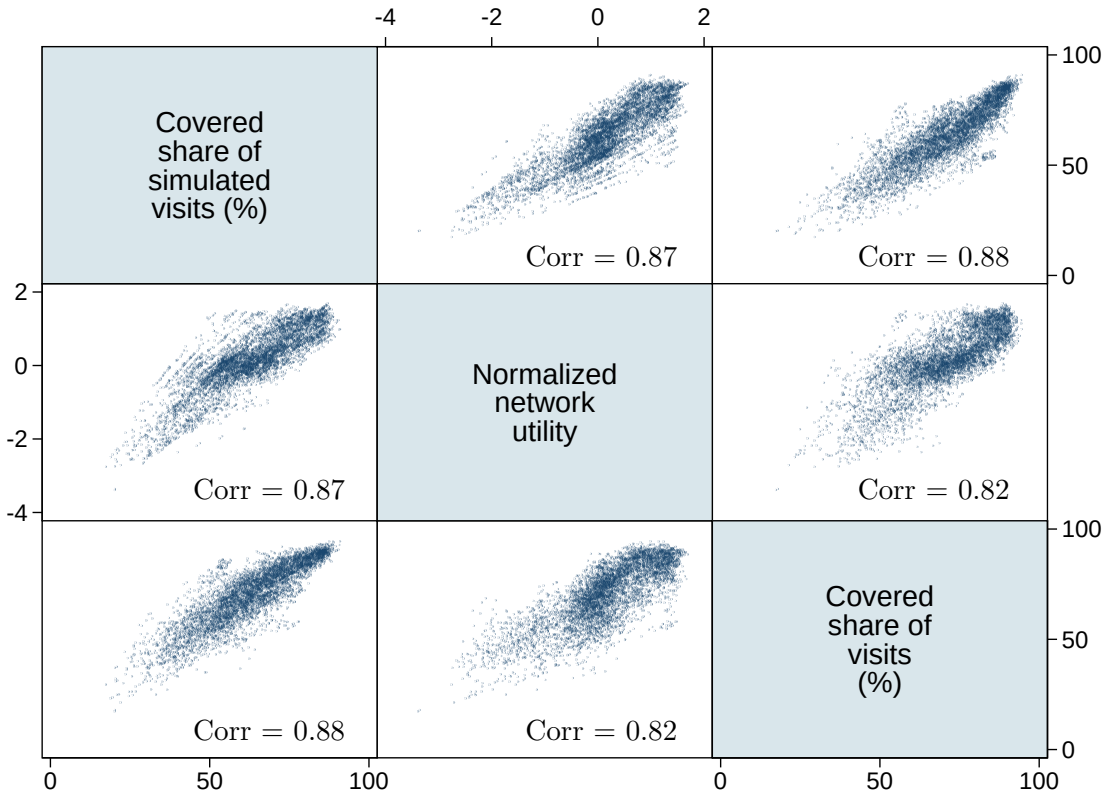


Panel D. Overall breadth and number of contracted physicians



Notes: Panels A and B of this figure plot the covered share of simulated hospital and physicians visits at the plan-level against the fraction of hospitals and physicians in New York City covered by each plan. Panels C and D plot the relationship between the overall share of simulated visits covered by each plan on the x-axis against the number of hospitals and physicians in New York City that participate in each plan on the y-axis. The data on physician and hospital network participation with each plan is drawn from the Provider Network Data System (PNDS) plan directories for 2010. The hospital and physician counts for each New York City county are drawn from the Area Health Resources File for 2010. Plan names are masked at the request of the New York State Department of Health.

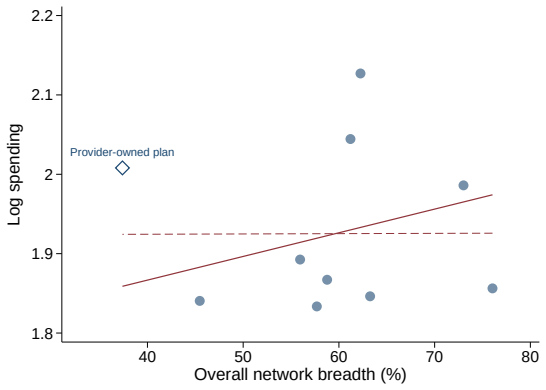
Appendix Figure 5. : Pairwise Correlations of Measures of Network Breadth Based on Different Measurement Methods



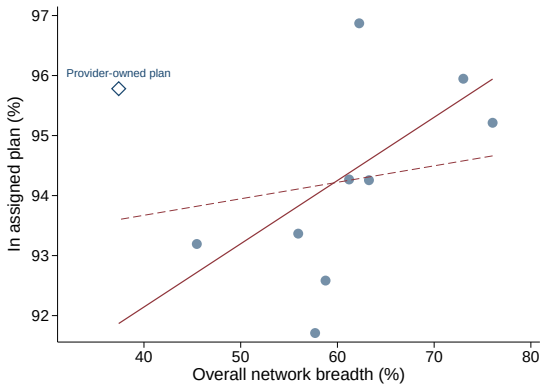
Notes: This figures plots pairwise correlations for different measures of overall network breadth. The covered share of simulated visits measure is my primary measure of network breadth. It is constructed at the plan-by-zip-by-year level (see Section II for a detailed description of how I construct this measure). The network utility measure captures the expected utility of each plan's physician and hospital network at the plan-by-zip-by-year level (e.g. Shepard, 2016). The covered share of visits measure is the share of observed visits for enrollees at the zip-by-year level that were covered by each of the managed care plan networks. Further details on the construction of each of the alternative measures is detailed in Appendix Section B.

Appendix Figure 6. : Assigned Network Breadth, Health Care Spending, and Consumer Satisfaction at the Plan Level

Panel A. Healthcare spending



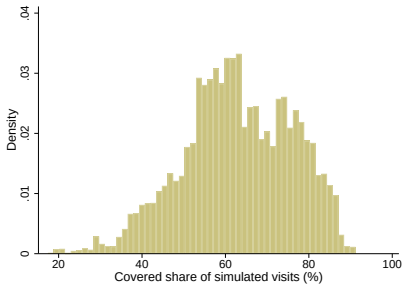
Panel B. Consumer satisfaction



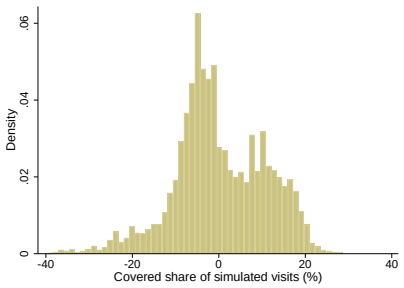
Notes: These figures plot residualized binned scatterplots of the reduced form impact of normalized covered share of simulated visits (network breadth) on healthcare spending and consumer satisfaction. Each binned scatterplot is constructed by first regressing assigned network breadth and the outcome variable on the set of control variables (i.e. age, gender, race, tenure, baseline outcomes, county × month of assignment), calculating residuals, and grouping the residualized network breadth measure into bins based on plan of assignment. The mean for each outcome is added back in to ease interpretation. The hollow diamond marks the provider-owned plan and the solid circles correspond to the other nine plans in the data. The provider-owned plan is a clear outlier. It has a narrower network than the other plans, but enrollees randomly-assigned to it generate higher levels of healthcare spending and consumer satisfaction as compared to enrollees randomly-assigned to other plans. The solid line and corresponding coefficients omit the provider-owned plan. For each panel, the inclusion of the provider-owned plan biases the effect of provider network breadth towards the null (the dashed line).

Appendix Figure 7. : Variation in Network Breadth Across and Within Zip and Plan

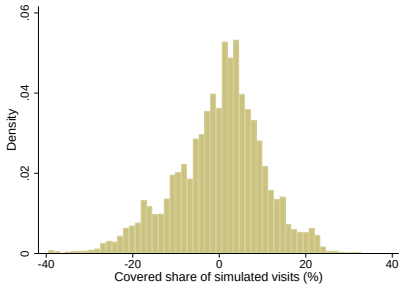
Panel A. Overall variation



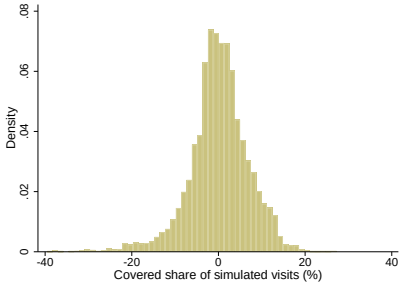
Panel B. Demeaned by zip



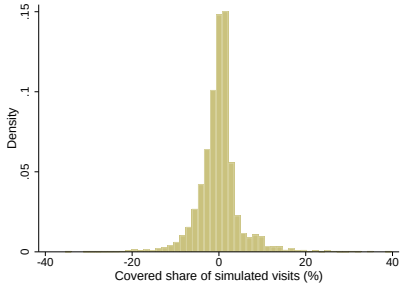
Panel C. Demeaned by plan



Panel D. Demeaned by plan and zip

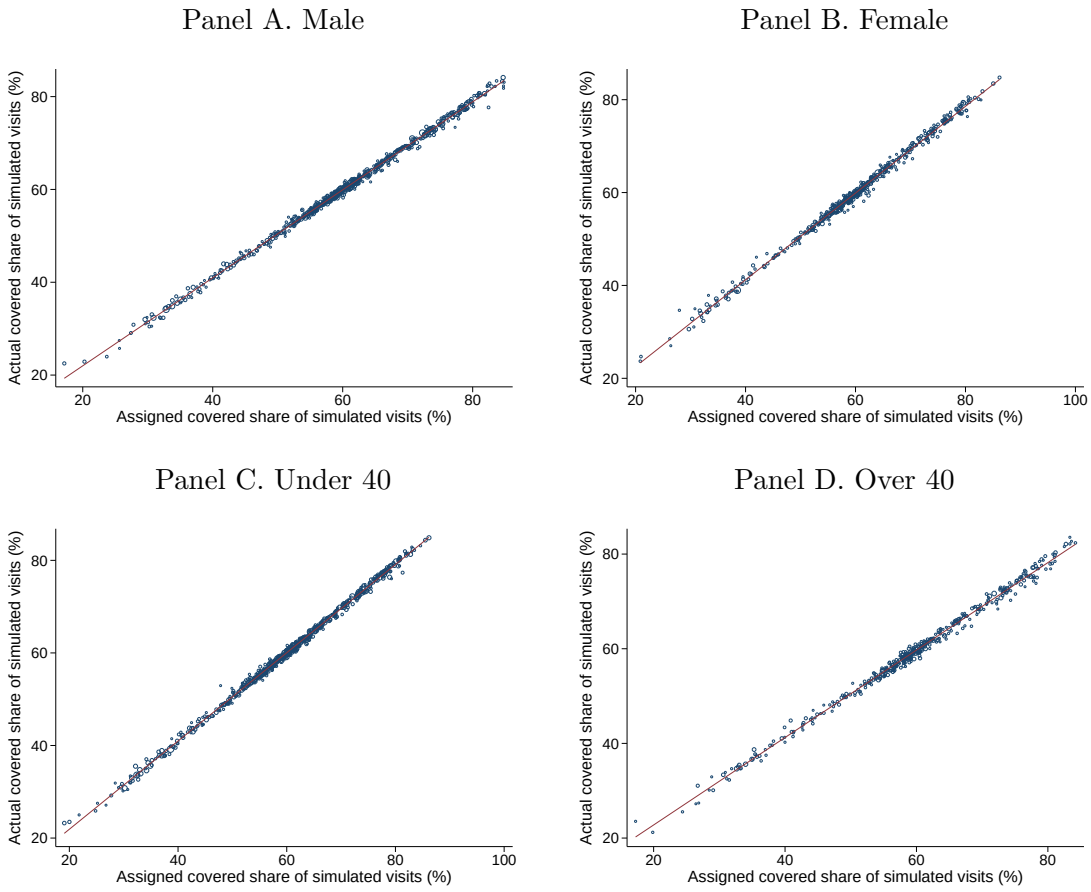


Panel E. Demeaned by plan-by-zip



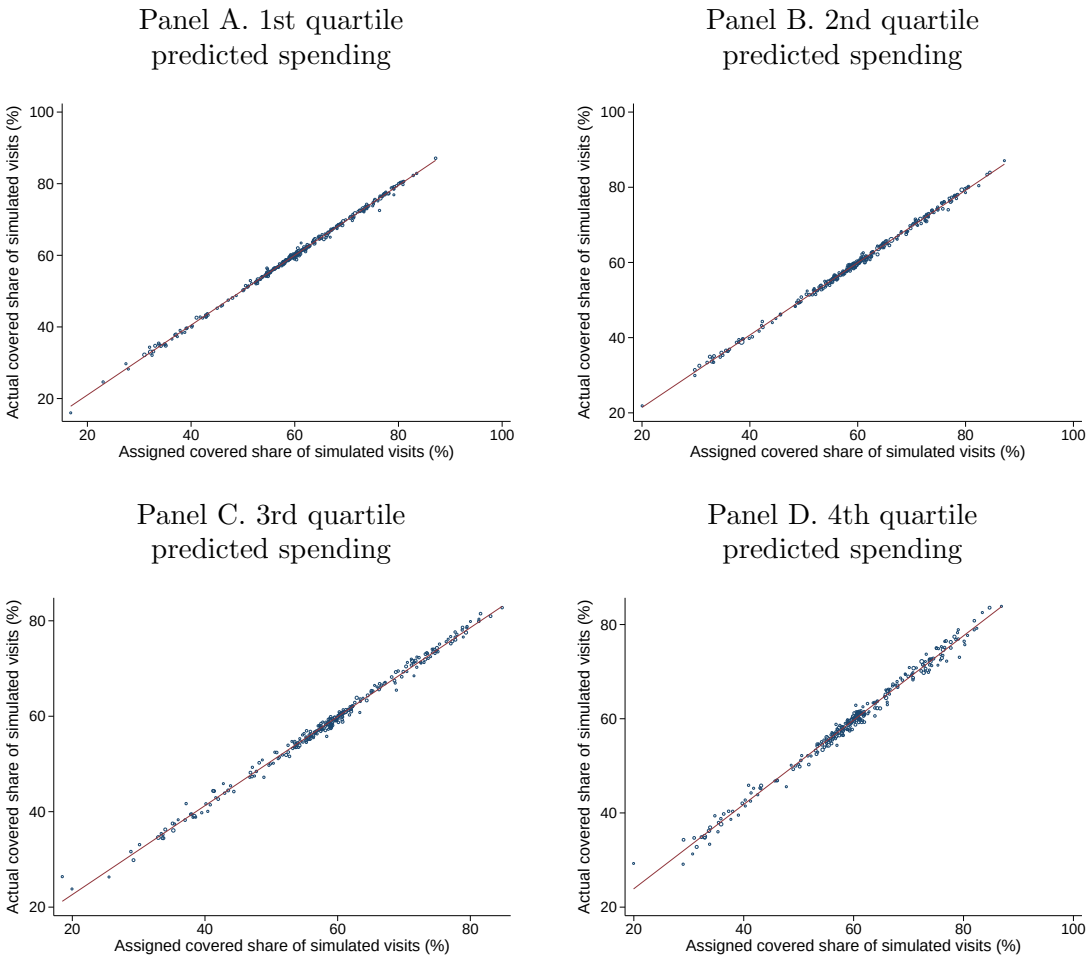
Notes: These figures plot the distribution of overall network breadth when residualizing on combinations of enrollee zip and randomly-assigned plan. Results are based on my primary sample (see Section I for details on primary sample construction). The network breadth measure is the z-score normalized covered share of simulated visits. Panel A plots the raw distribution of network breadth. Panel B presents the distribution of network breadth residualized on enrollee zip. Panel C presents the distribution of network breadth residualized on assigned plan. Panel D presents the distribution of network breadth when residualizing on assigned plan and, separately, enrollee zip. The remaining variation in this panel is what I exploit to estimate the affect of network breadth on consumers. Panel E presents the distribution of network breadth when residualizing on assigned plan-by-enrollee zip. Network breadth is relatively stable over time so little variation remains once I demean at the assigned plan-by-enrollee zip level.

Appendix Figure 8. : Variation by Subgroup in Relationship Between Assigned and Actual Network Breadth



Notes: Results are based on my primary sample (see Section I for details on primary sample construction). The panels plot residualized binned scatterplots of the reduced form impact of the normalized covered share of simulated visits (network breadth) on actual network breadth for different subgroups. The binned scatterplots are constructed by first regressing assigned network breadth and actual network breadth on the set of control variables (i.e. age, gender, race, tenure, baseline outcomes, county × month of assignment), calculating residuals, and grouping the residualized network breadth measure into bins at the plan-zip level. The mean is added back in to ease interpretation (Chetty, Friedman and Rockoff, 2014).

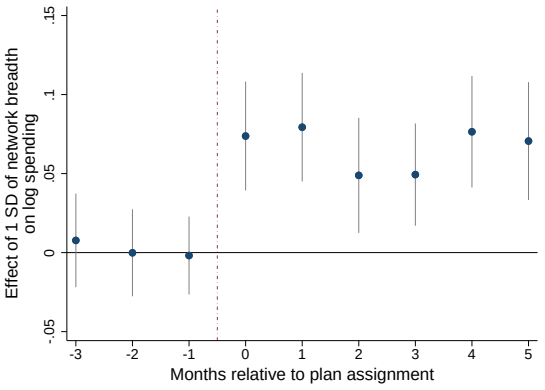
Appendix Figure 9. : Variation by Subgroup in Relationship Between Assigned and Actual Network Breadth



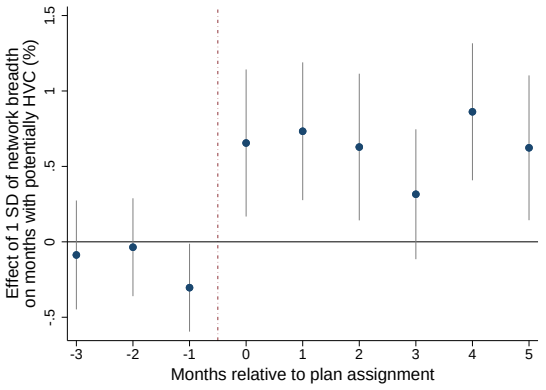
Notes: Results are based on my primary sample (see Section I for details on primary sample construction). The panels plot residualized binned scatterplots of the reduced form impact of the normalized covered share of simulated visits (network breadth) on actual network breadth for different subgroups. The binned scatterplots are constructed by first regressing assigned network breadth and actual network breadth on the set of control variables (i.e. age, gender, race, tenure, baseline outcomes, county × month of assignment), calculating residuals, and grouping the residualized network breadth measure into bins at the plan-zip level. The mean is added back in to ease interpretation (Chetty, Friedman and Rockoff, 2014).

Appendix Figure 10. : Reduced Form Estimates of the Impact of Assigned Network Breadth on Health Care Spending, Health Care Quality, and Consumer Satisfaction by Month

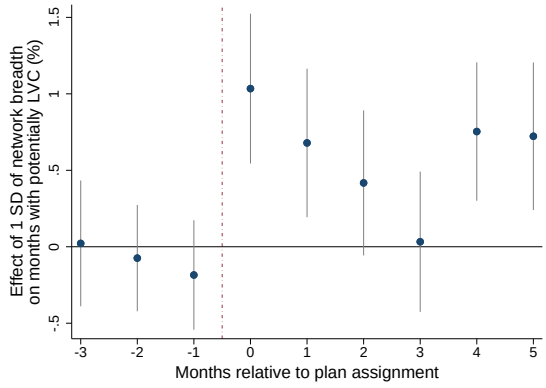
Panel A. Healthcare spending



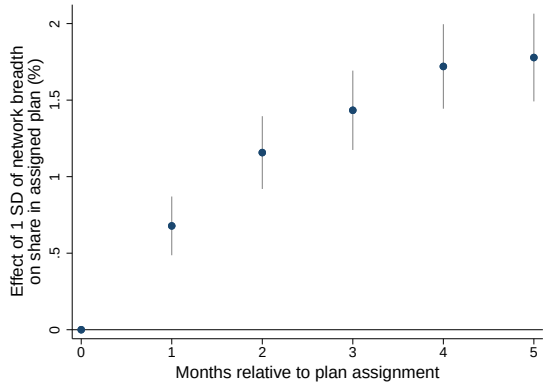
Panel B. Potentially high-value care



Panel C. Potentially low-value care

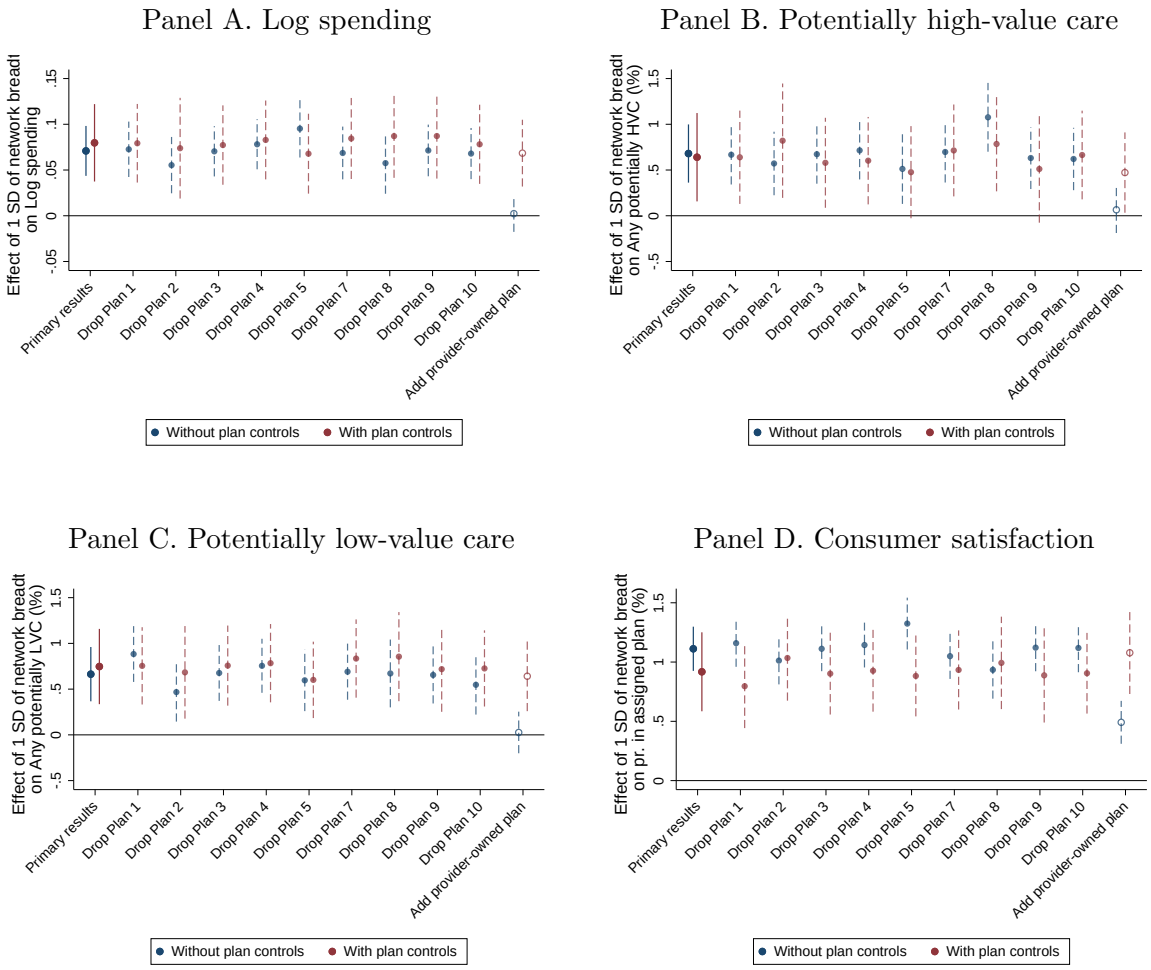


Panel D. Consumer satisfaction



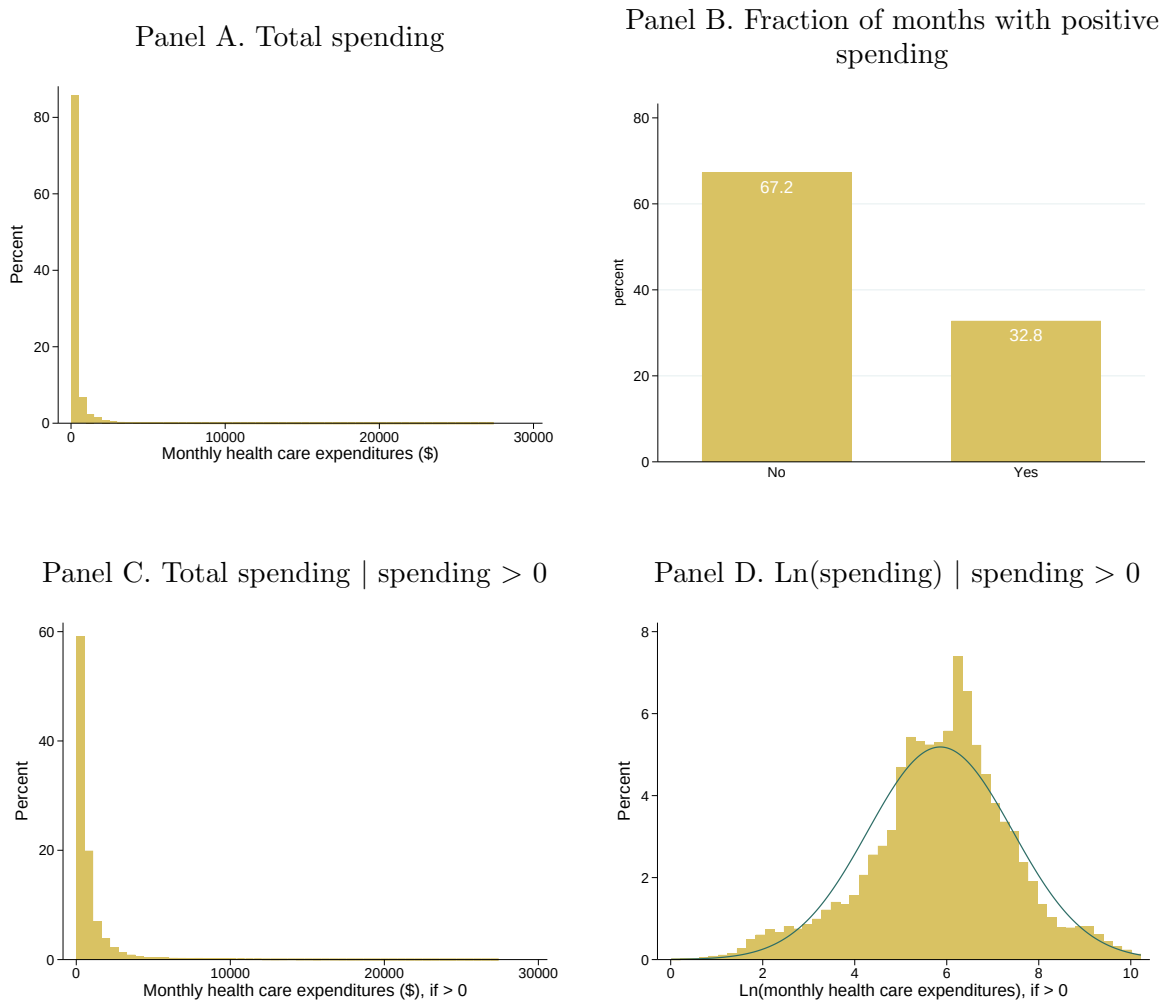
Notes: These figures plot event study estimates of the reduced form impact of normalized covered share of simulated visits (network breadth) on healthcare spending, specific service use, and consumer satisfaction. Results are based on my primary sample (see Section I for details on primary sample construction). The point estimates and 95% confidence intervals are the result of estimating a reduced form version of Equation 5 separately for each month relative to auto assignment, with standard errors clustered at the county × month of assignment level. The vertical dashed red line indicates when auto assignment occurs. There is no baseline measure of satisfaction (in Panel D) since enrollees are in Medicaid fee-for-service prior to assignment. In addition, all enrollees are in their assigned plan for at least the first month following assignment, hence the null point estimate in the first period in Panel D.

Appendix Figure 11. : Robustness of Primary Estimates to Changing the Compositions of Medicaid Managed Care Plans Included in Analyses



Notes: This figure displays the sensitivity of the results presented in Tables 3 and 4 to the sample of plans included in the estimation. Results are based on my primary sample (see Section I for details on primary sample construction). For reference, I include my "primary results" (from estimating Equation 5 on my primary sample). I then present the sensitivity of my results to sequentially dropping the enrollees in each of the plans in my primary sample. I also assess the sensitivity of my results to adding in the enrollees in the provider-owned plan. For each sensitivity, I estimate a specification with and without plan controls (i.e., fixed effects).

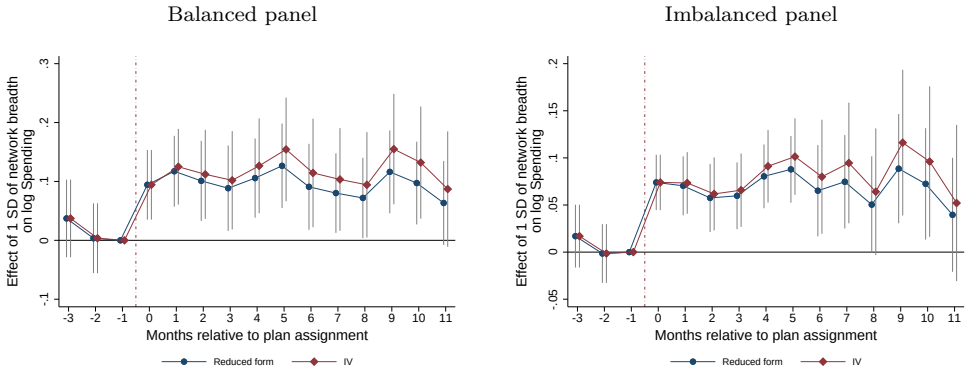
Appendix Figure 12. : Distribution of Monthly Medicaid Managed Care Health Care Spending



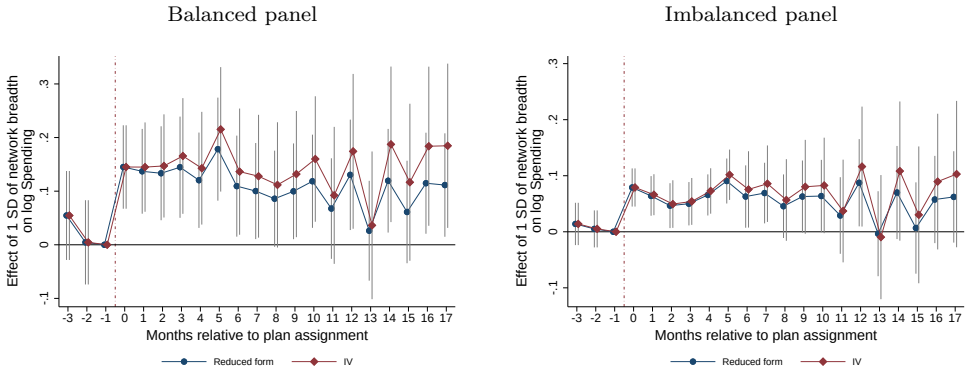
Notes: This figure displays the distribution of healthcare spending by enrollee month in my primary estimation sample. Results are based on my primary sample (see Section I for details on primary sample construction). For all four panels, I exclude observations above the 99.9 percentile (>$19,404).

Appendix Figure 13. : Assigned Network Breadth and Health Care Spending

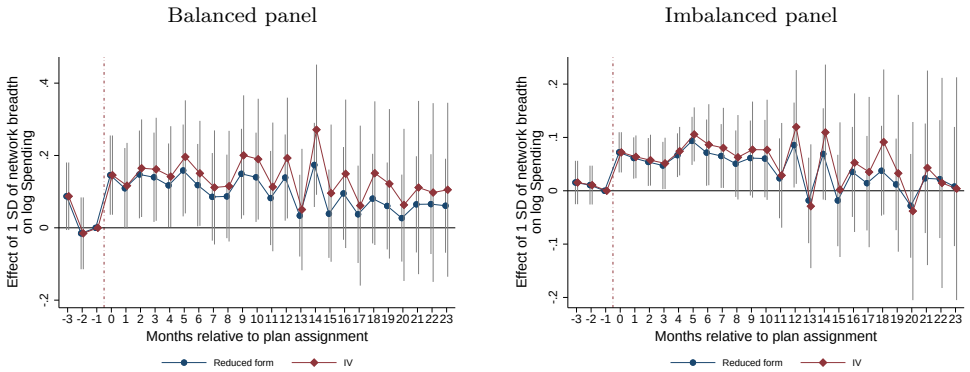
Panel A. Extended to 12 months post assignment



Panel B. Extended to 18 months post assignment



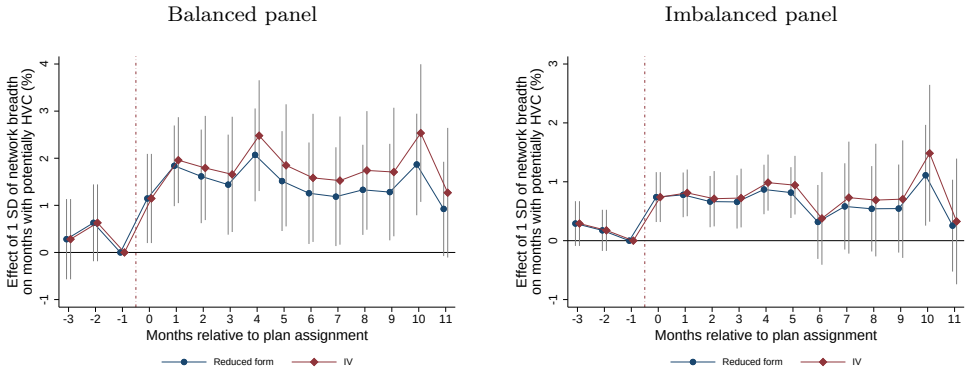
Panel C. Extended to 24 months post assignment



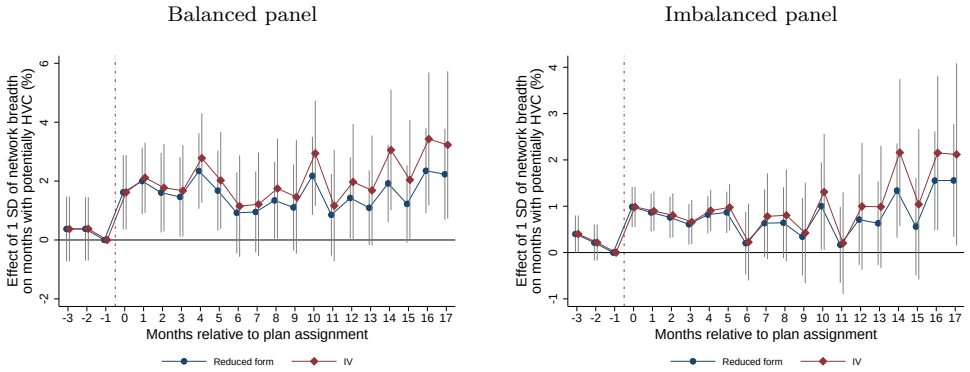
Notes: The panels plot event study estimates of the effect of network breadth on health care spending. Results are based on a secondary sample of enrollees (and enrollee-months) that allow for the estimation of effects beyond the first six months post-assignment. Appendix A describes the construction of these alternative samples. For each extended study period, I present results based on balanced and imbalanced samples of enrollees. I present point estimates along with 95% confidence intervals from estimating both reduced form (in blue) and IV (in red) versions of Equation 6, as described in Appendix C. The baseline (omitted) period is 1 month prior to auto assignment. The dashed vertical red line indicates when auto assignment took place. The y-axis presents the effect of a one standard deviation increase in network breadth on the outcome. All standard errors are clustered at the county × month of assignment level (Chetty, Friedman and Rockoff, 2014).

Appendix Figure 14. : Assigned Network Breadth and Potentially High-Value Care

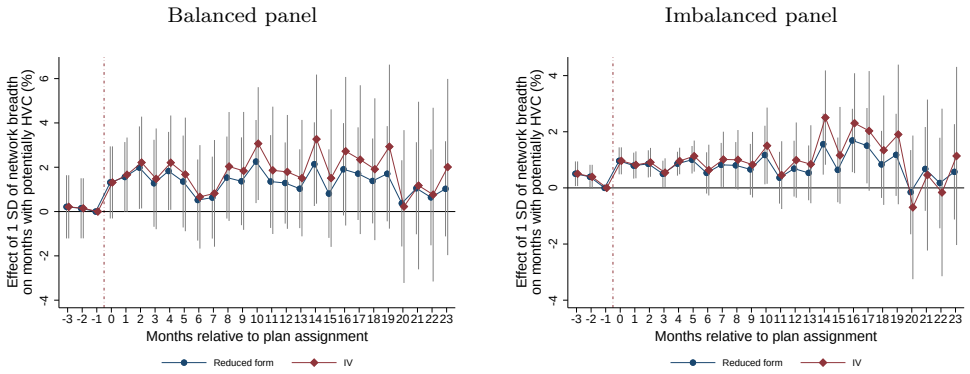
Panel A. Extended to 12 months



Panel B. Extended to 18 months



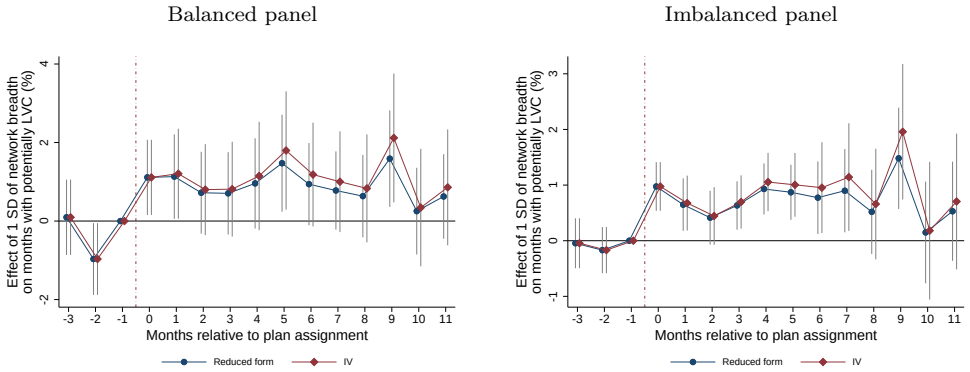
Panel C. Extended to 24 months



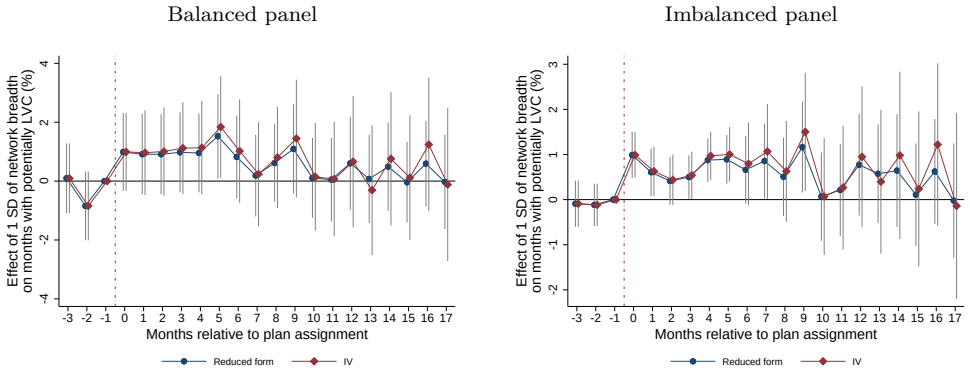
Notes: The panels plot event study estimates of the effect of network breadth on potentially high-value care. Results are based on a secondary sample of enrollees (and enrollee-months) that allow for the estimation of effects beyond the first six months post-assignment. Appendix A describes the construction of these alternative samples. For each extended study period, I present results based on balanced and imbalanced samples of enrollees. I present point estimates along with 95% confidence intervals from estimating both reduced form (in blue) and IV (in red) versions of Equation 6, as described in Appendix C. The baseline (omitted) period is 1 month prior to auto assignment. The dashed vertical red line indicates when auto assignment took place. The y-axis presents the effect of a one standard deviation increase in network breadth on the outcome. All standard errors are clustered at the county × month of assignment level (Chetty, Friedman and Rockoff, 2014).

Appendix Figure 15. : Assigned Network Breadth and Potentially Low-Value Care

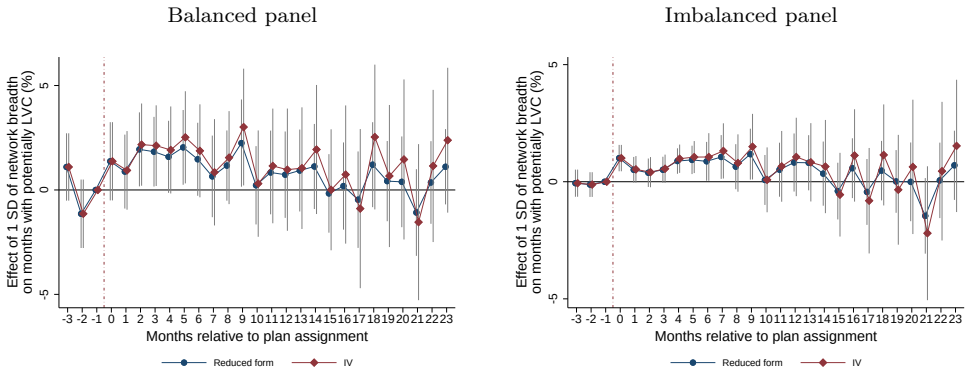
Panel A. Extended to 12 months



Panel B. Extended to 18 months

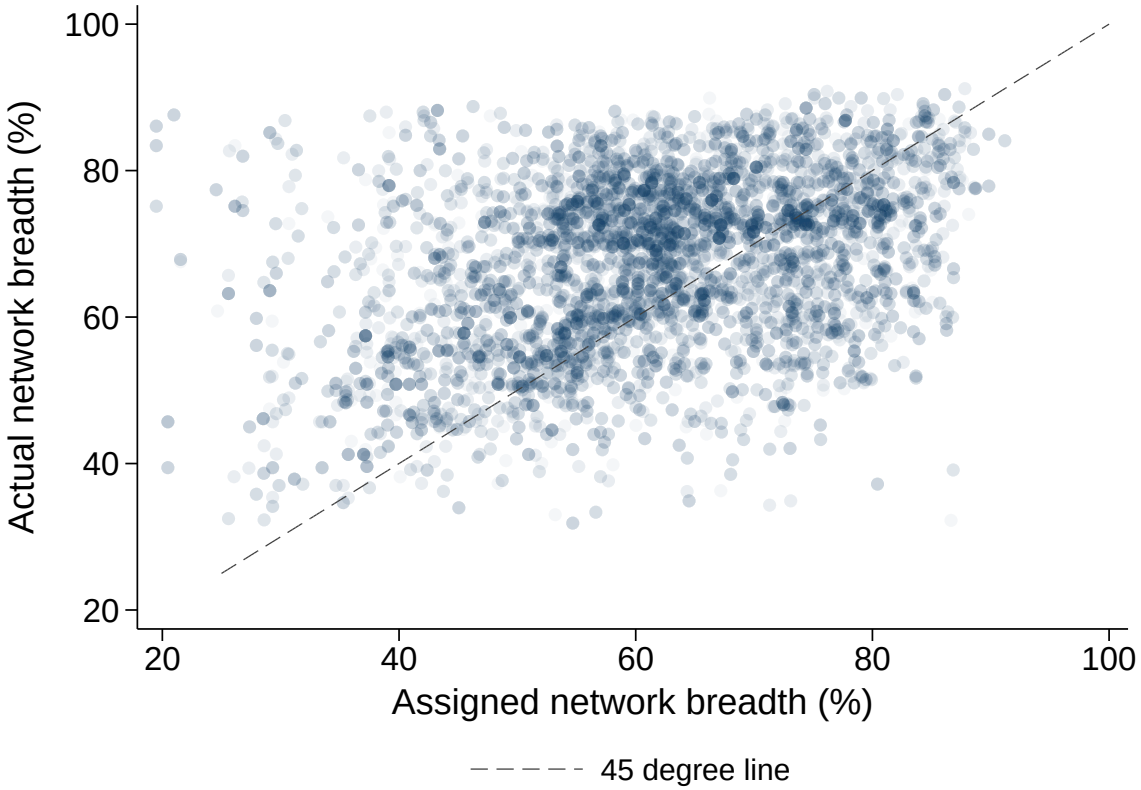


Panel C. Extended to 24 months



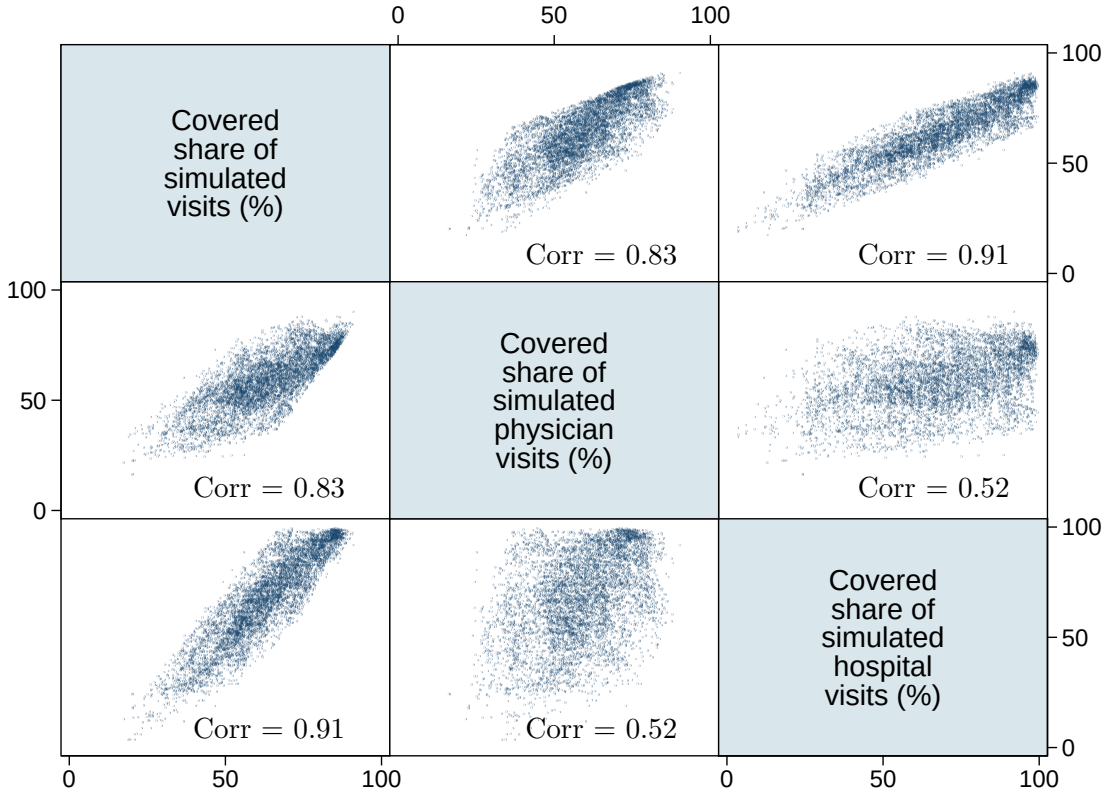
Notes: The panels plot event study estimates of the effect of network breadth on potentially low-value care. Results are based on a secondary sample of enrollees (and enrollee-months) that allow for the estimation of effects beyond the first six months post-assignment. Appendix A describes the construction of these alternative samples. For each extended study period, I present results based on balanced and imbalanced samples of enrollees. I present point estimates along with 95% confidence intervals from estimating both reduced form (in blue) and IV (in red) versions of Equation 6, as described in Appendix C. The baseline (omitted) period is 1 month prior to auto assignment. The dashed vertical red line indicates when auto assignment took place. The y-axis presents the effect of a one standard deviation increase in network breadth on the outcome. All standard errors are clustered at the county × month of assignment level (Chetty, Friedman and Rockoff, 2014).

Appendix Figure 16. : Assigned and Actual Provider Network Breadth for Enrollees that Switch Plans Post-Assignment



Notes: This figure plots enrollees' actual network breadth against their assigned network breadth for months in which the enrollees were *not* in their assigned plans (N=11,333 enrollee months). The dashed line is a 45 degree line. Points above the line indicate that an enrollee's actual network breadth is larger than their assigned network breadth. The cloud of points shifted above the 45 degree line indicates that enrollees who switch plans, tend to switch to plans with broader networks than the breadth of their assigned network.

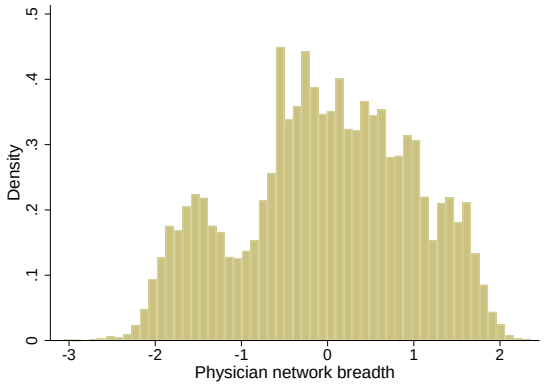
Appendix Figure 17. : Pairwise Correlations Between the Breadth of Overall Networks, Physician Networks, and Hospital Networks



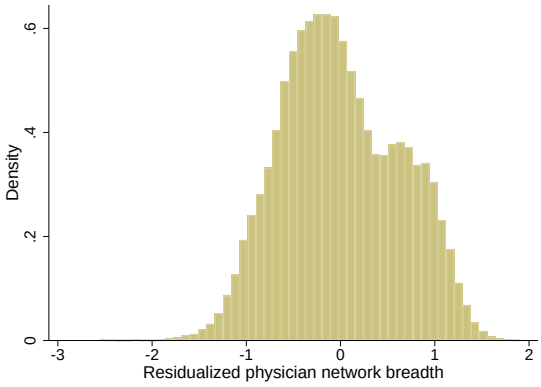
Notes: This figures plots pairwise correlations for measures of overall, physician, and hospital network breadth. Each measure is based on my primary method for constructing network breadth, the covered share of simulated visits (see Section II for a detailed description of how I construct this measure). Overall network breadth is a weighted average of the physician and hospital network breadth measures.

Appendix Figure 18. : Variation in Assigned Physician and Hospital Network Breadth

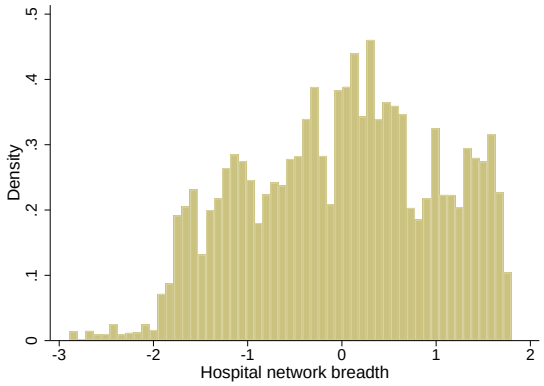
Panel A. Raw physician network



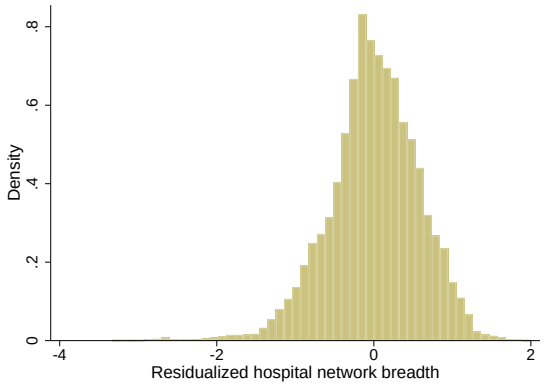
Panel B. Residualized physician network



Panel C. Raw hospital network



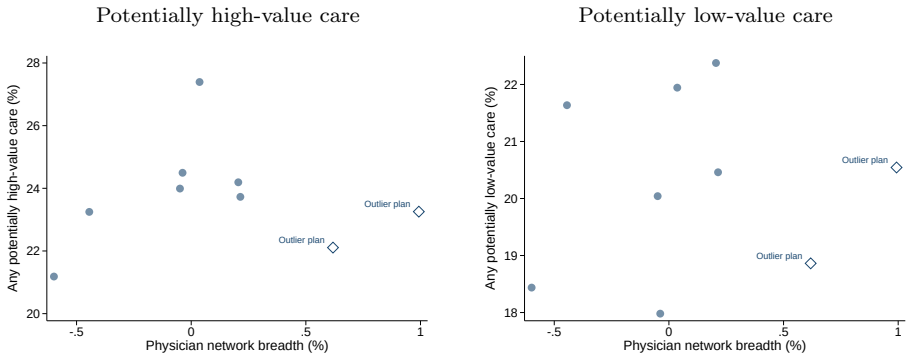
Panel D. Residualized hospital network



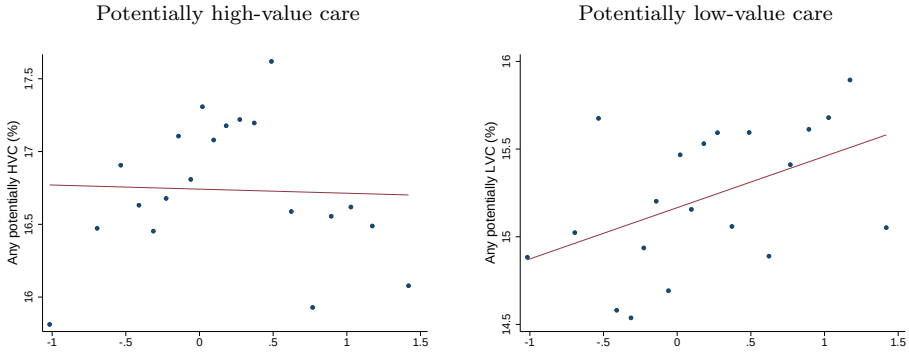
Notes: These figures plot the raw and residualized distributions of assigned physician and hospital network breadth. Results are based on the restricted, "usual source of care" sample (see Section V for additional details). The physician and hospital network breadth measures are the z-score normalized covered share of simulated visits. Panel A plots the raw distribution of physician network breadth. Panel B presents the distribution of assigned physician network breadth residualized on my baseline controls (including enrollee zip) as well as assigned hospital network breadth and an indicator for whether an enrollee's usual source of care is in their assigned plan. Panel C plots the raw distribution of hospital network breadth. Panel D presents the distribution of assigned hospital network breadth residualized on my baseline controls (including enrollee zip) as well as assigned physician network breadth and an indicator for whether an enrollee's usual source of care is in their assigned plan.

Appendix Figure 19. : Assigned Physician Network Breadth and Potentially High-Value and Low-Value Care

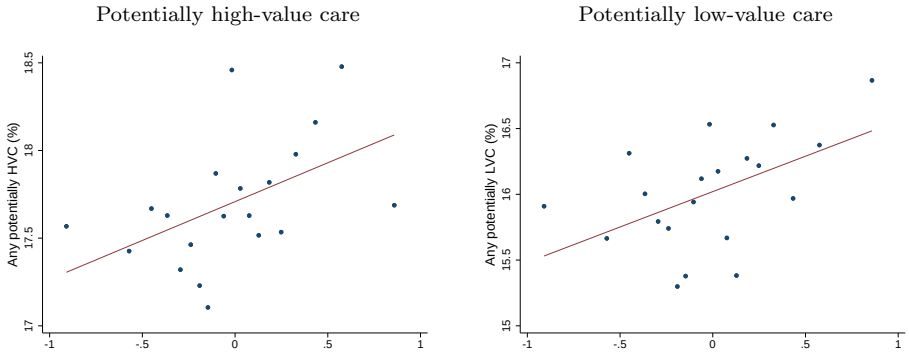
Panel A. Plan-level residualized binned scatterplot



Panel B. Traditional residualized binned scatterplot, no plan controls



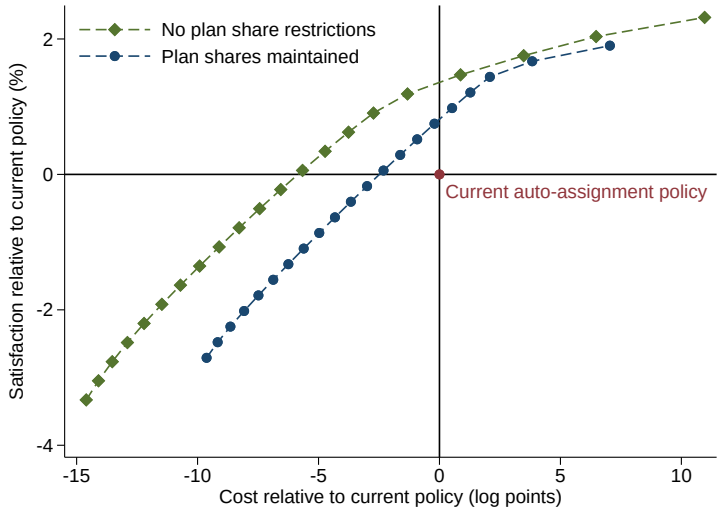
Panel B. Traditional residualized binned scatterplot, plan controls



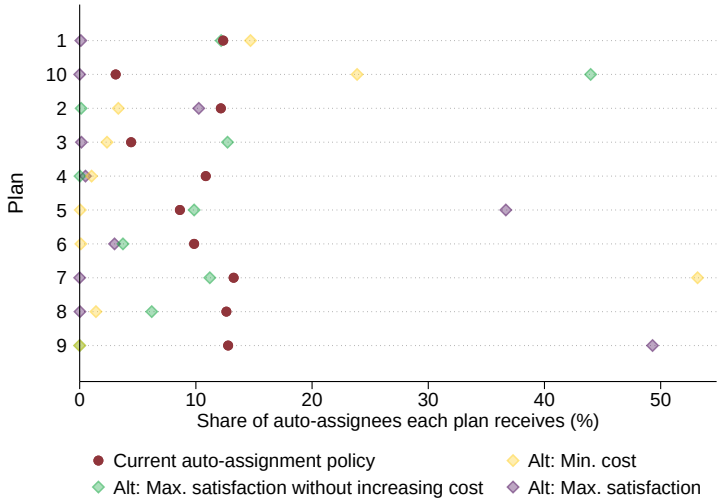
Notes: These figures plot residualized binned scatterplots of the reduced form impact of physician network breadth on the use potentially high-value and low-value care. In Panel A, the binned scatterplots are constructed by first regressing physician network breadth and the outcome variable on the set of control variables (i.e. age, gender, race, tenure, baseline outcomes, county × month of assignment) and hospital network breadth, calculating residuals, and grouping the residualized network breadth measure into bins based on plan of assignment. The mean for each outcome is added back in to ease interpretation. The hollow diamonds mark the two outlier plans and the solid circles correspond to the other seven plans in the data. Panels B and C plot residualized binned scatterplots in which the residualized physician network breadth measures are grouped into 20 equal-sized bins (instead of at the plan-level). Panel B does not include plan of assignment as a control variable. Panel C adds plan of assignment as an additional control variable (in addition to my baseline controls). Standard errors clustered at the county × month of assignment level (Chetty, Friedman and Rockoff, 2014).

Appendix Figure 20. : Impact of Assignment Policies that Do Not Maintain Plan Shares

Panel A. Cost and satisfaction tradeoffs



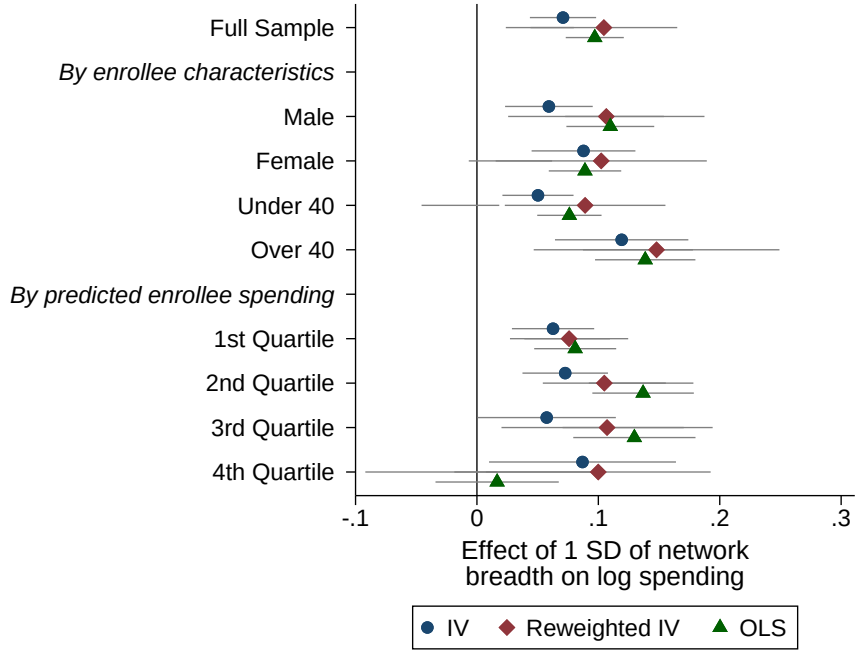
Panel B. Share of auto-assignees plans receives under alternative auto assignment policies



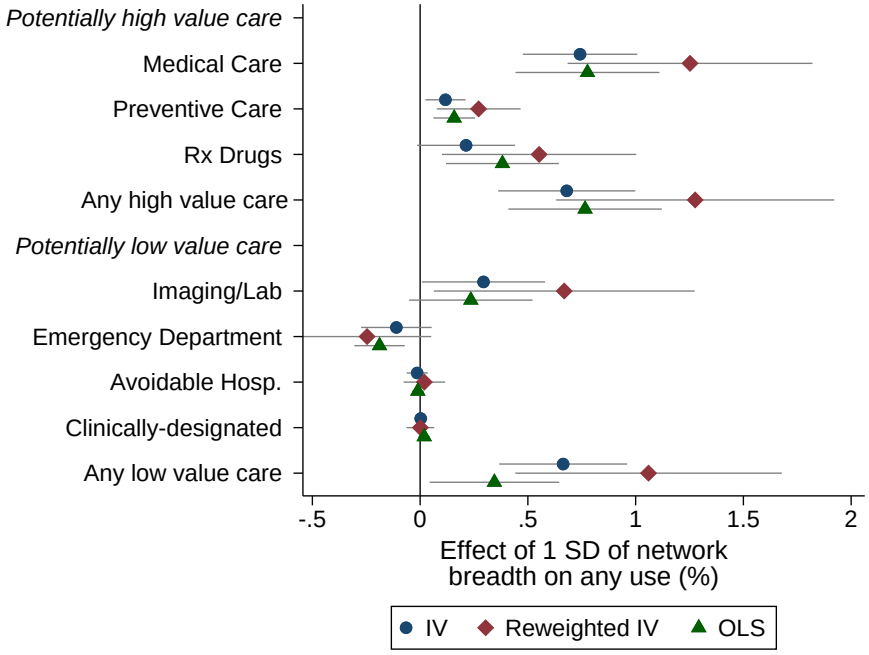
Notes: Panel A plots the mean difference between predicted spending and satisfaction for 21 counterfactual auto-assignment policies relative to the state's current (random) auto-assignment policy. We plot counterfactuals in which each plan's share of auto-assignees is constrained to be the same as under the current auto-assignment policy (in blue) and those in which plan shares are unconstrained (in green). The x-axis measures the mean difference between log spending for each counterfactual policy and the current auto-assignment policy. The y-axis measures the difference between mean enrollee satisfaction (i.e., the share of auto-assignees that remain in their assigned plan) for each counterfactual and the current auto-assignment policy. Panel B plots the share of auto-assignees each plan receives under the current auto-assignment policy and three alternatives in which there is no restriction that plan shares be maintained. Plans are arrayed on the y-axis. Each plan's share of the auto-assignee population under the state's current policy is indicated by a solid red circle. Some plans received fewer auto-assignees (even under the default policy) because they did not qualify to receive auto-assignees in all years of study. Plan shares under alternative assignment policies are indicated by diamonds. With no restriction that plan shares be maintained, the optimal counterfactual assignment often entail very small (or no) allocations to some plans and large allocations to others. Additional details are available in Section VI and the Figure 6 note.

Appendix Figure 21. : Comparison of IV Estimates of the Impact of Network Breadth on Health Care Spending and Health Care Quality to Other Estimates

Panel A. Health Care Spending



Panel B. Health Care Quality



Notes: These figures plot the main instrument variables (IV), Re-weighted IV, and ordinary least squares (OLS) estimates for health care spending and quality from Tables 3–4 and Appendix Tables 26–29. These estimates are based on a specification the includes enrollee controls but does not include plan controls. See the table notes of the respective tables for additional details on the data, samples, and specifications.

Appendix Table 1—: Sample Construction

Sample restrictions	Unique recipients	Fraction of original (%)
Recipients auto-assigned in New York City, 2005–2012	374,710	100.0
Removed children (under 18)	272,889	72.8
Removed Medicare eligibles (65 and over)	192,582	51.4
Removed recipients in MMC plan in spell pre-assignment	187,581	50.1
Removed recipients with a family member in MMC plan	145,169	38.7
Removed recipients in MMC in 12 months pre-assignment	127,424	34.0
Restricted sample to post-April 2008 (MMC policy change)	111,410	29.7
Required 3 months pre- and 6 months post-assignment in MMC	66,164	17.7
Removed recipients with Supplemental Security Income (SSI)	58,178	15.5
Removed recipients with missing data	58,172	15.5

Notes: This table reports the count of unique enrollees in the sample after a sequential set of sample restrictions. Enrollees in Medicaid managed care ("MMC") plans prior to assignment or those who had family members in MMC plans at the time (or prior to) assignment are removed from the sample because their auto-assignments are not random. A "Medicaid spell" refers to a period of continuous eligibility in Medicaid.

Appendix Table 2—: Correlates of Hospital Participation in Medicaid Managed Care Networks

	(1)	(2)	(3)	(4)
Public hospital	-0.0990	-0.112	-0.113	-0.115
	(0.0276)	(0.0262)	(0.0266)	(0.0264)
Hospital beds	0.0143	0.0286	0.0183	0.0262
	(0.0286)	(0.0273)	(0.0269)	(0.0273)
Teaching hospital	-0.0264	-0.0251	-0.0462	-0.0369
	(0.0504)	(0.0470)	(0.0482)	(0.0483)
Median zip code income		-0.0652		-0.0436
		(0.0272)		(0.0342)
Overall hospital rating			-0.0616	-0.0352
			(0.0272)	(0.0339)
Constant	0.772	0.767	0.778	0.772
	(0.0293)	(0.0274)	(0.0276)	(0.0278)
R^2	0.34	0.45	0.44	0.47
F	5.428	6.132	5.888	5.134

Notes: This table reports hospital-level correlates of participation in Medicaid managed care (MMC) networks. The outcome variable is the share of the ten MMC plan networks that a hospital participated in, in 2012. I limit the analysis to general, acute care hospitals that could be matched to the American Hospital Association (AHA) and Medicare Hospital Compare data. An indicator that the hospital is public, a count of hospital beds, and an indicator that the hospital is a teaching hospital are based on AHA survey data. Median zip code income is from the the 2006-2010 5-Year American Community Survey. The overall hospital rating is from the 2020 Medicare Hospital Compare data.

Appendix Table 3—: Hospital Choice Model

	Simple Model		Full Model	
	Coeff.	Std. Error	Coeff.	Std. Error
	(1)	(2)	(3)	(4)
Distance to Hospital				
Distance (Minutes)	−0.417	(0.004)	−0.391	(0.006)
Distance Squared	0.005	(0.000)	0.004	(0.000)
Distance x Pregnancy			−0.035	(0.008)
Distance x Respiratory			−0.131	(0.008)
Distance x Mental Illness			0.057	(0.009)
Distance x Circulatory			−0.023	(0.011)
Distance x Digestive			−0.050	(0.019)
Distance x Injury			−0.000	(0.010)
Out-of-Network Disutility				
Out-of-Network	−1.412	(0.007)		
Out-of-Network x Plan 1			−1.312	(0.021)
Out-of-Network x Plan 2			−0.919	(0.021)
Out-of-Network x Plan 3			−0.677	(0.012)
Out-of-Network x Plan 4			−1.124	(0.019)
Out-of-Network x Plan 5			−0.735	(0.037)
Out-of-Network x Plan 6			−1.184	(0.031)
Out-of-Network x Plan 7			−2.089	(0.012)
Out-of-Network x Plan 8			−1.556	(0.023)
Out-of-Network x Plan 9			−0.824	(0.019)
Out-of-Network x Plan 10			−0.641	(0.032)
Hospital Characteristics				
Hospital Fixed Effects		✓		✓
Pregnancy x Obstetrics			2.323	(0.029)
Injury x Trauma Center			0.564	(0.018)
Mental Illness x Psych			0.331	(0.023)
Circulatory x Card Surg			0.285	(0.017)
Circulatory x Cath Lab			0.139	(0.016)
Model Statistics				
Pseudo R-Squared (McFadden)	0.401		0.408	
Choice Instances	697,803		697,803	

Notes: This table reports results from the multinomial logit hospital choice model described in Section II. The data used include all hospitalizations for Medicaid managed care enrollees during the period 2008 to 2012. The model is estimated using maximum likelihood. Columns 1 and 2 report the coefficients and standard errors for a simple hospital choice model. Columns 3 and 4 report the coefficients and standard errors for a full hospital choice model which includes interactions of distance with diagnosis, network with plan and hospital characteristics with diagnosis. The full model also includes distance (and distance-squared) interacted with five-year age-by-gender bins (Shepard, 2016).

Appendix Table 4—: Physician Choice Model

	Simple Model		Full Model	
	Coeff.	# Sig.	Coeff.	# Sig.
	(1)	(2)	(3)	(4)
Distance to Hospital				
Distance (Minutes)	−0.207	42	−0.199	42
Distance Squared	0.002	42	0.002	42
Distance x DME			−0.003	20
Distance x Imaging			0.054	42
Distance x Evaluation and Management (E&M)			−0.025	37
Distance x Other			−0.020	31
Distance x Procedures			0.031	42
Distance x Test			0.003	32
Out-of-Network Disutility				
Out-of-Network	−2.788	42	−2.789	42
Physician Characteristics				
Optometry x DME			3.477	41
Radiology x Imaging			3.197	42
Phys. Med. x Procedures			2.576	42
Dermatology x Procedures			1.924	42
Cardiology x Tests			1.454	42
OB/GYN x Tests			1.428	42
Urology x Tests			1.322	42
Pathology x Tests			1.281	42
Allergy x E&M			0.919	42
Primary Care x E&M			0.733	42
Ophthalmology x E&M			0.732	42
Neighborhoods	42		42	
Choice Instances	Various		Various	
Average Pseudo R-Squared	0.766		0.792	

Notes: This table reports results from the multinomial logit physician choice model described in Appendix Section B. The data used include all physician office visits for Medicaid managed care enrollees during the period 2008 to 2012. The model is estimated separately for forty-two neighborhoods (defined by zip) in New York City. For each neighborhood, I estimate fixed effects for the largest five percent of practices serving the enrollees of that neighborhood. Since patients often receive multiple services in a single physician visit, s is a vector of indicator variables that identifies whether a visit contained the following services classified by BETOS codes: evaluation and management, procedures, imaging, tests, durable medical equipment, other, or unclassified. The model is estimated using maximum likelihood. Columns 1 and 2 report the coefficients and standard errors for a simple physician choice model. Columns 3 and 4 report the coefficients and standard errors for a full physician choice model which includes interactions of distance with procedure type, and physician specialty with procedure type. The full model includes distance (and distance-squared) interacted with five-year age x gender bins (Shepard, 2016).

Appendix Table 5—: First Stage Estimates of the Impact of Assigned Network Breadth on Actual Network Breath

	Actual network breadth		
	(1)	(2)	(3)
Assigned network breadth	0.951	0.950	0.932
	(0.003)	(0.003)	(0.004)
Assigned to Plan 2			0.021
			(0.007)
Assigned to Plan 3			0.021
			(0.005)
Assigned to Plan 4			−0.000
			(0.004)
Assigned to Plan 5			0.035
			(0.007)
Assigned to Plan 6			0.001
			(0.006)
Assigned to Plan 7			0.005
			(0.004)
Assigned to Plan 8			0.028
			(0.005)
Assigned to Plan 9			0.016
			(0.005)
Assigned to Plan 10			0.007
			(0.009)
F-Statistic (Excluded Instruments)	1,955,393	1,955,450	80,686
Observations	295,728	295,728	349,044
Baseline Controls	X	X	X
Recipient Controls		X	X
Plan Controls			X

Notes: This table reports first stage results. Results are based on my primary sample (see Section I for details on primary sample construction). The independent variables are assigned network breadth and indicators for assignment to each of the managed care plans in my sample (with one leave-out plan). The dependent variable is the enrollees actual network breadth, which is determined by the plan they are enrolleed in and the zip code they reside in for each month after assignment. Column 2 adds in enrollee-level controls. Standard errors are clustered on the county × month of assignment.

Appendix Table 6—: Balance Test for Enrollees that Made Active Plan Choices

	Mean (SD)	Multivariate OLS			Bivariate OLS
	(1)	(2)	(3)	(4)	(5)
Age	35.515	−0.0081	0.0031	0.0027	−0.0020
	(12.239)	(0.0041)	(0.0083)	(0.0039)	(0.0043)
Male	0.417	0.0231	−0.0331	−0.0136	0.0362
	(0.493)	(0.0042)	(0.0106)	(0.0051)	(0.0047)
Black	0.411	0.0015	−0.0056	−0.0060	0.0018
	(0.492)	(0.0051)	(0.0065)	(0.0029)	(0.0045)
Outpatient spending	127.555	−0.0573	0.0211	0.0057	−0.0717
	(260.232)	(0.0064)	(0.0097)	(0.0042)	(0.0057)
Inpatient spending	250.224	−0.0084	−0.0014	−0.0075	−0.0170
	(1458.834)	(0.0045)	(0.0056)	(0.0024)	(0.0047)
Pharmacy spending	59.054	−0.0086	0.0305	−0.0020	−0.0134
	(317.467)	(0.0052)	(0.0069)	(0.0025)	(0.0056)
Other spending	95.587	−0.0118	0.0439	0.0013	−0.0189
	(324.712)	(0.0049)	(0.0084)	(0.0039)	(0.0046)
Any high-value medical care (%)	24.004	−0.0327	−0.0280	0.0156	−0.0512
	(42.711)	(0.0054)	(0.0089)	(0.0042)	(0.0056)
Any recommended preventive care (%)	7.460	−0.0239	−0.0333	0.0010	−0.0401
	(26.274)	(0.0039)	(0.0049)	(0.0024)	(0.0040)
Any high-value prescription drugs (%)	13.468	0.0245	−0.0518	0.0110	0.0021
	(34.138)	(0.0050)	(0.0256)	(0.0123)	(0.0047)
Any lab or imaging (%)	26.645	0.0277	0.1457	0.0194	−0.0167
	(44.210)	(0.0052)	(0.0153)	(0.0069)	(0.0050)
Any emergency department use (%)	15.477	−0.0016	0.0276	0.0015	−0.0221
	(36.169)	(0.0044)	(0.0061)	(0.0028)	(0.0047)
Any avoidable hospitalizations (%)	0.930	0.0100	0.0268	0.0027	0.0053
	(9.600)	(0.0044)	(0.0048)	(0.0022)	(0.0047)
Any designated low-value care (%)	0.595	0.0110	0.0051	0.0025	0.0079
	(7.694)	(0.0038)	(0.0039)	(0.0016)	(0.0044)
Predicted spending	595.989		−0.0673	0.0043	−0.0697
	(604.939)		(0.0070)	(0.0028)	(0.0048)
Predicted any potentially HVC (%)	34.659		0.1709	−0.0158	−0.0451
	(18.302)		(0.0512)	(0.0242)	(0.0046)
Predicted any potentially LVC (%)	26.303		−0.2962	−0.0202	−0.0618
	(11.466)		(0.0459)	(0.0205)	(0.0050)
P-value on joint F-test		0.00	0.00	0.00	
Observations	58,170	58,170	58,170	58,170	58,170
Baseline Controls		X	X	X	X
Plan Controls				X	

Notes: This table reports reduced form results testing the conditional random assignment of enrollees to provider networks and health plans. Results are based on an alternative sample of enrollees that made active plan choices (see Appendix A for details on sample construction). Baseline outcomes are the average for each enrollee in the three months prior to a plan choice. Predicted spending, high-value care (HVC), and low-value care (LVC) are formed using the other baseline variables. Detailed descriptions of the outcome measures are included in Appendix A. Columns 2-4 present the results of multivariate OLS models with enrollee characteristics as the independent variables and the network breadth of the chosen plan as the dependent variable. Column 5 presents bivariate OLS regressions with enrollee characteristics as the independent variable and the network breadth of the chosen plan as the dependent variable. Standard errors are clustered at the county × month of assignment level.

Appendix Table 7—: Comparison of Auto-Assignee and Active Chooser Baseline Characteristics

	Auto assignees			Active choosers		
	Mean	Std. Dev.	Observations	Mean	Std. Dev.	Observations
	(1)	(2)	(3)	(4)	(5)	(6)
Demographics						
Age	35.280	12.281	174,522	35.348	12.239	287,664
Male	0.594	0.491	174,522	0.417	0.493	287,664
Black	0.518	0.500	174,522	0.411	0.492	287,664
Healthcare spending						
Total spending	535.932	3,241.627	174,522	532.419	2,533.002	287,664
Outpatient spending	94.832	311.314	174,522	127.555	328.070	287,664
Inpatient spending	249.180	3,044.629	174,522	250.224	2,332.355	287,664
Pharmacy spending	65.266	403.640	174,522	59.054	362.426	287,664
Other spending	126.654	481.871	174,522	95.587	420.441	287,664
Healthcare use						
Any spending (%)	37.446	48.399	174,522	42.781	49.476	287,664
Any outpatient spending (%)	22.045	41.455	174,522	30.801	46.167	287,664
Any inpatient spending (%)	2.423	15.377	174,522	2.593	15.893	287,664
Any pharmacy spending (%)	19.100	39.309	174,522	18.627	38.933	287,664
Any other spending (%)	25.813	43.761	174,522	25.013	43.309	287,664
Potentially high-value care						
Any high-value medical care (%)	8.743	28.247	174,522	13.144	33.788	287,664
Any recommended preventive care (%)	1.610	12.584	174,522	2.660	16.091	287,664
Any high-value prescription drugs (%)	9.193	28.893	174,522	7.919	27.004	287,664
Any potentially high-value care (%)	15.637	36.321	174,522	19.588	39.688	287,664
Potentially low-value care						
Any lab or imaging (%)	12.141	32.661	174,522	12.803	33.412	287,664
Any emergency department use (%)	5.964	23.681	174,522	6.147	24.019	287,664
Any avoidable hospitalization (%)	0.608	7.773	174,522	0.564	7.486	287,664
Any designated low-value care (%)	0.197	4.429	174,522	0.203	4.505	287,664
Any potentially low-value care (%)	15.785	36.460	174,522	16.794	37.381	287,664

Notes: This table reports summary statistics. The auto assignee results are based on my primary sample (see Section I) and the "active chooser" results are based on an alternative sample of enrollees that made active plan choices (see Appendix A). Observations are at the enrollee-month level and restricted to the six months post-assignment (or post-plan choice). The service categories used to stratify healthcare use and spending were provided by the New York State Department of Health (NYSDOH). Additional details on the specific services identified as potentially high-value or low-value care are described in Appendix A.

Appendix Table 8—: 2SLS Overall Network Breadth Results by Network Measure

		Network breadth		
	Mean of Dep. Var	Sim. visit shares	Visit shares	Network utility
	(1)	(2)	(3)	(4)
Panel A. Healthcare spending				
Log spending	1.835	0.071	0.071	0.067
		(0.014)	(0.012)	(0.013)
Any spending (%)	31.451	1.002	0.993	0.948
		(0.201)	(0.174)	(0.199)
Panel B. Potentially high-value care				
Any high-value medical care (%)	10.983	0.742	0.808	0.688
		(0.135)	(0.128)	(0.132)
Any recommended preventive care (%)	2.042	0.118	0.129	0.131
		(0.047)	(0.040)	(0.044)
Any high-value prescription drugs (%)	8.705	0.213	0.218	0.216
		(0.115)	(0.102)	(0.112)
Any potentially high-value care (%)	16.736	0.680	0.710	0.634
		(0.161)	(0.144)	(0.157)
Panel C. Potentially low-value care				
Any imaging and lab (%)	12.874	0.294	0.194	0.256
		(0.145)	(0.127)	(0.140)
Any emergency department use (%)	5.129	−0.110	−0.089	−0.124
		(0.083)	(0.072)	(0.080)
Any avoidable hospitalizations (%)	0.390	−0.014	−0.007	−0.009
		(0.025)	(0.020)	(0.024)
Any designated low-value care (%)	0.203	0.003	0.006	0.011
		(0.015)	(0.012)	(0.014)
Any potentially low-value care (%)	15.223	0.664	0.496	0.613
		(0.151)	(0.132)	(0.147)
Panel D. Consumer satisfaction				
In assigned plan (%)	96.153	1.112	1.182	1.096
		(0.095)	(0.094)	(0.094)
Baseline Controls		X	X	X
Enrollee Controls		X	X	X
Plan Controls				

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction). The independent variable is overall network breadth as measured using three different methods (Columns 2-4). Section II and Appendix B describe the construction of the different network measures. The dependent variables include healthcare spending, specific high-value and low-value services, and an ex-post demand measure of enrollee satisfaction. Panel D presents reduced form, rather than 2SLS, estimates as they measure the likelihood that enrollees remain in their assigned plans. All standard errors are clustered at the county × month of assignment level.

Appendix Table 9—: 2SLS Overall Network Breadth Results with Control for Provider-Owned Plan

	Share of sample (1)	Sample Mean (2)	2SLS (3)	2SLS (4)	2SLS (4)
Panel A. Total healthcare use and spending					
Any spending (%)	1.00	32.778	0.745	0.833	1.006
			(0.225)	(0.187)	(0.258)
Log spending	1.00	397.365	0.045	0.054	0.070
Observations		349,044	349,044	349,044	349,044
Panel B. Spending by enrollee characteristics					
			(0.015)	(0.013)	(0.019)
Male	0.59	436.588	0.028	0.047	0.077
			(0.020)	(0.017)	(0.022)
Female	0.41	340.074	0.067	0.063	0.054
			(0.022)	(0.021)	(0.028)
18-39	0.64	279.446	0.035	0.038	0.051
			(0.015)	(0.015)	(0.021)
40-64	0.36	606.558	0.070	0.088	0.104
			(0.029)	(0.026)	(0.037)
Panel C. Spending by predicted enrollee health status					
1st quartile predicted spending	0.24	94.210	0.057	0.056	0.039
			(0.016)	(0.016)	(0.023)
2nd quartile predicted spending	0.25	138.769	0.059	0.061	0.057
			(0.018)	(0.017)	(0.026)
3rd quartile predicted spending	0.25	279.457	0.055	0.054	0.068
			(0.028)	(0.027)	(0.040)
4th quartile predicted spending	0.26	1,050.374	0.019	0.044	0.085
			(0.039)	(0.038)	(0.051)
Baseline Controls			X	X	X
Recipient Controls				X	X
Provider-Owned Plan Control			X	X	
Plan Controls					X

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction). The independent variable is overall network breadth as measured by the normalized covered share of simulated visits. The dependent variable is log spending for Panels B and C. Columns 3 and 4 report the main two-stage least squares (2SLS) results from estimating Equation 5 for overall networks breadth with and without enrollee-level controls, with an dummy variable set to ones for enrollees assigned to the provider-owned plan. Column 5 reports 2SLS results based on a model with plan fixed effects (see Appendix C). Each model uses the broader sample that includes enrollees in the provider-owned plan. All standard errors are clustered at the county × month of assignment level.

Appendix Table 10—: Robustness of Estimates of the Impact of Overall Network Breadth on Health Care Spending to Alternative Specifications

	Mean Spending (1)	Log spending (2)	Inverse HS Spending (3)	Winsorized Spending (4)
Panel A. Spending by enrollee characteristics				
Full sample	371.916	0.081	0.089	9.594
		(0.022)	(0.024)	(3.695)
Male	406.086	0.097	0.107	14.003
		(0.026)	(0.029)	(5.049)
Female	321.607	0.051	0.058	2.113
		(0.032)	(0.036)	(5.068)
18-39	263.953	0.057	0.064	7.208
		(0.023)	(0.026)	(3.658)
40-64	569.574	0.129	0.142	15.361
		(0.044)	(0.048)	(8.390)
Panel B. Spending by enrollee health status				
1st quartile predicted spending	91.099	0.052	0.058	4.161
		(0.026)	(0.029)	(3.014)
2nd quartile predicted spending	137.084	0.062	0.068	6.046
		(0.030)	(0.033)	(4.055)
3rd quartile predicted spending	268.800	0.053	0.059	4.825
		(0.044)	(0.049)	(6.436)
4th quartile predicted spending	990.682	0.137	0.152	22.041
		(0.056)	(0.061)	(13.707)
Enrollee Controls	—	No	No	No

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction). Because spending is a highly-skewed, limited dependent variable I also assess the robustness of my results to alternative transformations of the dependent variable, including inverse hyperbolic sine and winsorized levels. Appendix Figure 12 describes the distribution of monthly Medicaid managed care expenditures in my sample. The independent variable is overall network breadth (see Section II). The dependent variables include different transformations of healthcare spending: log spending (my preferred specification); the inverse hyperbolic sine of spending; and winsorized spending. All standard errors are clustered at the county × month of assignment level.

Appendix Table 11—: Estimates of the Impact of Overall Network Breadth on Health Care Use and Spending

	Sample Mean (1)	2SLS (2)	2SLS (3)	2SLS (4)
Panel A. Log spending by components of care				
Inpatient	168.972	0.002	0.001	−0.006
		(0.004)	(0.004)	(0.006)
Outpatient	69.962	0.057	0.050	0.030
		(0.009)	(0.009)	(0.012)
Prescription drugs	60.632	0.027	0.023	0.024
		(0.010)	(0.007)	(0.010)
Other	97.799	0.025	0.026	0.051
		(0.013)	(0.010)	(0.012)
Panel B. Healthcare spending, quantity, and prices				
Log spending	1.925	0.071	0.071	0.070
		(0.015)	(0.014)	(0.019)
Any spending (%)	32.778	1.122	1.002	1.006
		(0.235)	(0.201)	(0.258)
Quantity of services	2.176	0.070	0.048	0.069
		(0.027)	(0.019)	(0.026)
Price-standardized log spending	1.906	0.062	0.062	0.066
		(0.015)	(0.014)	(0.018)
Log spending conditional on any	1,212.287	0.018	0.025	0.018
		(0.015)	(0.013)	(0.016)
Baseline Controls		X	X	X
Enrollee Controls			X	X
Plan Controls				X

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction). The independent variable is overall network breadth as measured by the normalized covered share of simulated visits. Panel A presents IV estimates of the effects of network breadth on log spending by components of care. Panel B presents IV estimates of the effects of network breadth on overall measures of healthcare spending and quantity. For the "log spending conditional on any" row, I first limit to months with positive spending and then estimate a regression with log spending in those months as the dependent variable. Columns 2 and 3 report the main two-stage least squares (2SLS) results from estimating equation (5) for overall networks breadth with and without enrollee-level controls. Column 4 reports 2SLS results based on a model with plan fixed effects (see Appendix C) estimated on a broader sample that includes enrollees in the provider-owned plan. All standard errors are clustered at the county × month of assignment level.

Appendix Table 12—: Estimates of the Impact of Overall Network Breadth on Prices Paid to Providers

	Sample Mean (1)	2SLS (2)	2SLS (3)	2SLS (4)
Unit Price	79.592	−0.577	−0.517	0.083
		(0.824)	(0.817)	(1.292)
Winsorized unit price	54.393	−0.589	−0.573	1.084
		(0.320)	(0.318)	(0.493)
Log unit price	3.164	0.013	0.013	0.031
		(0.004)	(0.004)	(0.007)
Observations		416,204	416,204	416,204
Baseline Controls		X	X	X
Enrollee Controls			X	X
Plan Controls				X

Notes: Standard errors in parentheses. Results are based on claims-level analyses restricted to services used by enrollees in my primary sample (see Section I for details on primary sample construction). Unit prices are the amounts paid by Medicaid managed care plans to providers. Columns 2 and 3 report the main two-stage least squares (2SLS) results from estimating equation (5) for overall networks breadth with and without enrollee-level controls. Column 4 reports 2SLS results based on a model with plan fixed effects (see Appendix C) estimated on a broader sample that includes enrollees in the provider-owned plan. All standard errors are clustered at the county × month of assignment level.

Appendix Table 13—: Estimates of the Impact of Network Breadth on Potentially High-Value Care

	Any use (%)			
	Mean (1)	2SLS (2)	2SLS (3)	2SLS (4)
Any potentially high-value care (%)	17.697	0.788	0.680	0.479
		(0.186)	(0.161)	(0.224)
Panel A. Potentially high-value medical care				
Any primary care visits (%)	9.204	0.557	0.555	0.200
		(0.117)	(0.112)	(0.162)
Any mental health visits (%)	2.133	0.277	0.262	0.147
		(0.067)	(0.059)	(0.085)
Any physical therapy visits (%)	1.092	−0.048	−0.087	−0.004
		(0.040)	(0.038)	(0.066)
Any pre- or post-natal care visits (%)	0.771	0.064	0.073	0.072
		(0.046)	(0.044)	(0.054)
Any high-value medical care (%)	11.729	0.757	0.742	0.485
		(0.147)	(0.135)	(0.175)
Panel B. Recommended preventive care				
Any hbA1c test (%)	0.439	0.048	0.038	0.005
		(0.021)	(0.021)	(0.031)
Any chlamydia screening in women (%)	0.707	0.018	0.029	0.042
		(0.029)	(0.026)	(0.038)
Any breast cancer screening (%)	0.120	0.013	0.013	0.010
		(0.010)	(0.009)	(0.013)
Any cervical cancer screening (%)	0.740	0.070	0.075	0.056
		(0.025)	(0.024)	(0.036)
Any flu vaccinations (%)	0.434	−0.024	−0.023	−0.014
		(0.019)	(0.019)	(0.027)
Any preventive care (%)	2.137	0.109	0.118	0.112
		(0.049)	(0.047)	(0.070)
Panel C. Potentially high-value prescription drugs				
Any diabetes drugs (%)	1.777	0.067	0.028	−0.076
		(0.070)	(0.044)	(0.074)
Any statins (%)	1.917	0.106	0.040	−0.067
		(0.076)	(0.058)	(0.085)
Any anti-depressants (%)	2.702	0.094	0.114	0.116
		(0.080)	(0.064)	(0.093)
Any anti-psychotics (%)	2.615	0.025	−0.023	−0.067
		(0.080)	(0.065)	(0.090)
Any anti-hypertension drugs (%)	2.668	0.159	0.039	0.021
		(0.091)	(0.070)	(0.095)
Any anti-stroke drugs (%)	0.185	0.018	0.008	0.026
		(0.026)	(0.021)	(0.025)
Any asthma drugs (%)	1.436	0.091	0.077	0.030
		(0.061)	(0.049)	(0.064)
Any contraceptives (%)	0.905	0.008	0.016	0.000
		(0.049)	(0.043)	(0.056)
Any potentially high-value drugs (%)	9.343	0.306	0.213	0.065
		(0.148)	(0.115)	(0.178)
Observations	295,728	295,728	295,728	349,044
Baseline Controls		X	X	X
Enrollee Controls			X	X
Plan Controls				X

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction). The independent variable is overall network breadth as measured by the normalized covered share of simulated visits. The dependent variables are a specific set of potentially high-value services. Columns 2 and 3 report the main two-stage least squares (2SLS) results from estimating Equation 5 for overall networks breadth with and without enrollee-level controls. Column 4 reports 2SLS results based on a model with plan fixed effects (see Appendix C) estimated on a broader sample that includes enrollees in the provider-owned plan. All standard errors are clustered at the county × month of assignment level.

Appendix Table 14—: Estimates of the Impact of Network Breadth on Potentially Low-Value Care

	Any use (%)			
	Mean (1)	2SLS (2)	2SLS (3)	2SLS (4)
Any potentially low-value care (%)	16.007	0.651	0.664	0.645
		(0.164)	(0.151)	(0.194)
Imaging and lab (%)	13.462	0.291	0.294	0.731
		(0.159)	(0.145)	(0.193)
Emergency department visits (%)	5.362	−0.138	−0.110	−0.076
		(0.085)	(0.083)	(0.117)
Panel A. Avoidable hospitalizations				
Diabetes short-term complications (%)	0.029	−0.008	−0.006	−0.010
		(0.007)	(0.007)	(0.009)
COPD or Asthma, age 40 and older (%)	0.203	−0.019	−0.011	0.000
		(0.017)	(0.016)	(0.022)
Congestive Heart Failure (%)	0.091	0.012	0.004	0.013
		(0.011)	(0.011)	(0.015)
Asthma, ages 18 to 39 (%)	0.116	0.007	0.004	−0.012
		(0.015)	(0.014)	(0.019)
Any avoidable hospitalizations (%)	0.407	−0.013	−0.014	−0.015
		(0.027)	(0.025)	(0.031)
Panel B. Designated low-value care				
Thorax CT (%)	0.006	0.004	0.003	0.003
		(0.003)	(0.003)	(0.003)
Head imaging for syncope (%)	0.173	0.003	0.002	−0.010
		(0.014)	(0.014)	(0.021)
Head imaging for uncomplicated headache (%)	0.005	0.002	0.002	−0.003
		(0.001)	(0.001)	(0.003)
Abdomen CT (%)	0.027	0.000	−0.000	−0.005
		(0.005)	(0.005)	(0.007)
Any clinically-designated low-value care (%)	0.207	0.004	0.003	−0.017
		(0.016)	(0.015)	(0.023)
Observations	295,728	295,728	295,728	349,044
Baseline Controls		X	X	X
Enrollee Controls			X	X
Plan Controls				X

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction). The independent variable is overall network breadth as measured by the normalized covered share of simulated visits. The dependent variables are a specific set of potentially low-value services. Columns 2 and 3 report the main two-stage least squares (2SLS) results from estimating Equation 5 for overall networks breadth with and without enrollee-level controls. Column 4 reports 2SLS results based on a model with plan fixed effects (see Appendix C) estimated on a broader sample that includes enrollees in the provider-owned plan. All standard errors are clustered at the county × month of assignment level.

Appendix Table 15—: 2SLS Overall Network Results by Enrollee Characteristics

	Gender		Age		Quartiles of Lasso-predicted spending				Health condition		
	Male	Female	Under 40	40 and older	1st	2nd	3rd	4th	BH	Diab	CVD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A. Healthcare spending											
Log spending	0.059	0.088	0.050	0.119	0.065	0.071	0.063	0.073	0.079	0.061	0.086
	(0.018)	(0.022)	(0.015)	(0.028)	(0.017)	(0.018)	(0.029)	(0.040)	(0.041)	(0.090)	(0.082)
Any spending (%)	0.718	1.363	0.928	1.187	1.042	1.197	0.665	0.890	1.018	0.321	−0.072
	(0.250)	(0.337)	(0.236)	(0.358)	(0.290)	(0.296)	(0.429)	(0.514)	(0.550)	(1.045)	(0.983)
Panel B. Potentially high-value care											
Any high-value medical care (%)	0.523	1.052	0.508	1.213	0.471	0.558	0.592	1.309	1.141	1.665	3.378
	(0.155)	(0.247)	(0.144)	(0.271)	(0.165)	(0.210)	(0.255)	(0.392)	(0.389)	(0.891)	(0.900)
Any recommended preventive care (%)	0.022	0.250	0.073	0.198	0.199	0.052	0.077	0.175	0.089	0.794	0.337
	(0.038)	(0.099)	(0.054)	(0.088)	(0.066)	(0.093)	(0.102)	(0.109)	(0.075)	(0.394)	(0.318)
Any high-value prescription drugs (%)	0.023	0.488	0.054	0.586	−0.005	0.092	0.280	0.415	0.114	0.198	0.683
	(0.163)	(0.189)	(0.111)	(0.257)	(0.127)	(0.163)	(0.241)	(0.371)	(0.346)	(1.019)	(1.155)
Any potentially high-value care (%)	0.389	1.074	0.459	1.144	0.514	0.531	0.648	0.954	0.800	1.979	1.664
	(0.205)	(0.284)	(0.161)	(0.336)	(0.189)	(0.249)	(0.308)	(0.473)	(0.445)	(1.122)	(1.173)
Panel C. Potentially low-value care											
Any imaging or lab (%)	0.036	0.637	0.184	0.518	0.255	0.277	0.128	0.374	0.726	0.165	0.558
	(0.195)	(0.230)	(0.161)	(0.276)	(0.169)	(0.217)	(0.303)	(0.407)	(0.452)	(0.894)	(0.812)
Any emergency department use (%)	−0.169	−0.049	−0.026	−0.301	0.080	0.024	−0.411	−0.113	−0.151	−1.009	−0.289
	(0.113)	(0.119)	(0.098)	(0.141)	(0.121)	(0.125)	(0.148)	(0.232)	(0.234)	(0.513)	(0.556)
Any avoidable hospitalizations (%)	−0.053	0.046	−0.003	−0.037	0.011	0.006	0.025	−0.116	−0.055	−0.000	0.007
	(0.032)	(0.035)	(0.025)	(0.058)	(0.014)	(0.025)	(0.033)	(0.094)	(0.085)	(0.277)	(0.312)
Any designated low-value care (%)	−0.003	0.003	−0.012	0.026	0.001	0.008	0.011	0.003	0.002	−0.041	0.092
	(0.020)	(0.024)	(0.017)	(0.033)	(0.017)	(0.019)	(0.028)	(0.049)	(0.044)	(0.121)	(0.130)
Any potentially low-value care (%)	0.369	1.052	0.608	0.761	0.486	0.647	0.410	1.036	1.272	0.740	0.873
	(0.201)	(0.242)	(0.179)	(0.275)	(0.200)	(0.220)	(0.306)	(0.423)	(0.460)	(0.881)	(0.856)
Panel D. Consumer satisfaction											
In assigned plan (%)	1.145	1.022	1.007	1.335	0.368	0.848	1.177	2.127	1.667	1.835	1.096
	(0.137)	(0.167)	(0.114)	(0.211)	(0.151)	(0.165)	(0.229)	(0.287)	(0.256)	(0.686)	(0.641)
Baseline Controls	X	X	X	X	X	X	X	X	X	X	X
Enrollee Controls	X	X	X	X	X	X	X	X	X	X	X

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction). The independent variable is overall network breadth as measured by the normalized covered share of simulated visits. The dependent variables include measures of healthcare use and spending, specific high-value and low-value services, and an ex-post demand measure of enrollee satisfaction. Panel D presents reduced form, rather than 2SLS, estimates as they measure the likelihood that enrollees remain in their assigned plans. The table contains two-stage least squares (2SLS) results from estimating Equation 5 for overall networks breadth with enrollee-level controls. Each estimate is a subgroup analyses that subsets the data to a particular group (e.g., males) before running the analysis. A subset of enrollees are assigned to one of three health condition subgroups based on hierarchical condition codes (HCCs) assigned in the pre-assignment period. I use HCCs to group enrollees into those with behavioral health (BH) conditions, diabetes ("Diab"), and cardiovascular disease (CVD). Appendix A describes these groupings in more detail. All standard errors are clustered at the county × month of assignment level.

Appendix Table 16—: Reduced Form Estimates of the Impact of Network Breadth on Consumer Satisfaction

	Share of sample (1)	Sample Mean (2)	RF (3)	RF (4)	RF (4)
In assigned plan (%)	1.00	96.153	1.004	1.112	0.918
			(0.097)	(0.095)	(0.169)
Panel A. Satisfaction by enrollee characteristics					
Male	0.60	96.608	1.051	1.145	0.899
			(0.138)	(0.137)	(0.241)
Female	0.40	95.483	0.887	1.022	0.894
			(0.166)	(0.167)	(0.281)
18-39	0.65	96.897	0.921	1.007	0.876
			(0.115)	(0.114)	(0.194)
40-64	0.35	94.791	1.197	1.335	1.005
			(0.211)	(0.211)	(0.366)
Panel B. Satisfaction by enrollee health status					
1st quartile predicted spending	0.25	97.956	0.279	0.346	0.305
			(0.150)	(0.150)	(0.260)
2nd quartile predicted spending	0.25	97.043	0.878	0.955	0.798
			(0.163)	(0.163)	(0.257)
3rd quartile predicted spending	0.25	95.961	0.942	1.044	1.033
			(0.231)	(0.230)	(0.398)
4th quartile predicted spending	0.25	93.652	1.933	2.091	1.658
			(0.284)	(0.281)	(0.456)
Baseline Controls			X	X	X
Enrollee Controls				X	X
Plan Controls					X

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction). The independent variable is overall network breadth as measured by the normalized covered share of simulated visits. The dependent variable is an ex-post demand measure of enrollee satisfaction. Columns 3 and 4 report the results of estimating a reduced form (RF) version of Equation 5 for overall networks breadth with and without enrollee-level controls. Column 5 reports reduced form results based on a model with plan fixed effects (see Appendix C) estimated on a broader sample that includes enrollees in the provider-owned plan. All standard errors are clustered at the county × month of assignment level.

Appendix Table 17—: Heterogeneity by Network Characteristics: Model Without Plan Controls

	Main sample			Usual source of care sample		
	Main Spec.	Alternative specification w/ physician and hospital		Alternative specification w/ physician and hospital and key provider		
	Overall Network (1)	Physician Network (2)	Hospital Network (3)	Physician Network (4)	Hospital Network (5)	Key provider in assigned (6)
Panel A. Healthcare use and spending						
Log spending	0.071	0.046	0.035	0.041	0.009	0.170
	(0.014)	(0.014)	(0.015)	(0.024)	(0.027)	(0.048)
Any spending (%)	1.002	0.610	0.541	0.480	0.112	1.839
	(0.201)	(0.194)	(0.209)	(0.323)	(0.380)	(0.720)
Panel B. Potentially high-value care						
Any high-value medical care (%)	0.742	−0.214	1.034	−0.105	1.197	1.369
	(0.135)	(0.151)	(0.149)	(0.281)	(0.275)	(0.485)
Any recommended preventive care (%)	0.118	0.062	0.073	0.077	0.047	0.154
	(0.047)	(0.045)	(0.051)	(0.077)	(0.095)	(0.169)
Any high-value prescription drugs (%)	0.213	0.072	0.170	0.084	0.043	1.099
	(0.115)	(0.142)	(0.137)	(0.249)	(0.255)	(0.411)
Any potentially high-value care (%)	0.680	−0.032	0.792	−0.067	0.809	1.625
	(0.161)	(0.166)	(0.177)	(0.291)	(0.320)	(0.581)
Panel C. Potentially low-value care						
Any imaging and lab (%)	0.294	0.087	0.246	−0.149	0.264	0.869
	(0.145)	(0.158)	(0.162)	(0.271)	(0.268)	(0.468)
Any emergency department use (%)	−0.110	−0.031	−0.094	−0.012	−0.024	−0.554
	(0.083)	(0.083)	(0.097)	(0.147)	(0.188)	(0.289)
Any avoidable hospitalizations (%)	−0.014	−0.008	−0.008	−0.009	−0.050	0.021
	(0.025)	(0.026)	(0.029)	(0.056)	(0.067)	(0.096)
Any designated low-value care (%)	0.003	0.032	−0.027	0.041	−0.060	0.031
	(0.015)	(0.014)	(0.016)	(0.025)	(0.033)	(0.049)
Any potentially low-value care (%)	0.664	0.307	0.451	0.203	0.629	0.752
	(0.151)	(0.163)	(0.171)	(0.286)	(0.303)	(0.503)
Panel D. Consumer satisfaction						
In assigned plan (%)	1.112	0.637	0.638	0.871	0.277	2.800
	(0.095)	(0.111)	(0.116)	(0.211)	(0.220)	(0.421)
Observations	295,728	295,728	295,728	130,896	130,896	130,896
Baseline controls	X	X	X	X	X	X
Enrollee Controls	X	X	X	X	X	X
Plan controls						
Usual source of care sample				X	X	X

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction), excluding enrollees in the provider-owned plan. None of the regressions include plan controls (i.e., fixed effects). The dependent variables include measures of healthcare use and spending, specific high-value and low-value services, and an ex-post demand measure of enrollee satisfaction. Panel D presents reduced form, rather than 2SLS, estimates of the likelihood that enrollees remain in their assigned plans. In Column 1, the independent variable is overall network breadth (normalized covered share of simulated visits). Columns 2 and 3 report the main two-stage least squares (2SLS) results from estimating Equation 6 using physician and hospital network breadth in the same model. Columns 4-6 restrict the sample to enrollees who could be attributed to a physician or hospital based on care they sought prior to assignment (the "usual source of care sample"). The column reports the results of estimating Equation 7 on this restricted sample. All standard errors are clustered at the county × month of assignment level.

Appendix Table 18—: Balance Test of Assigned Physician and Hospital Provider Network Breadth

	Separate Multivariate OLS Regressions			Joint Multivariate OLS Regression	
	Overall Network (1)	Physician Network (2)	Hospital Network (3)	Physician Network (4)	Hospital Network (5)
Age	0.0092	0.0125	0.0048	0.0093	−0.0020
	(0.0144)	(0.0145)	(0.0134)	(0.0110)	(0.0102)
Male	−0.0001	−0.0013	0.0009	−0.0019	0.0016
	(0.0114)	(0.0116)	(0.0104)	(0.0088)	(0.0079)
Black	−0.0029	−0.0019	−0.0030	0.0001	−0.0019
	(0.0061)	(0.0060)	(0.0057)	(0.0045)	(0.0042)
Outpatient spending	0.0114	0.0223	0.0010	0.0217	−0.0112
	(0.0155)	(0.0154)	(0.0149)	(0.0122)	(0.0118)
Inpatient spending	0.0010	0.0028	−0.0005	0.0031	−0.0020
	(0.0041)	(0.0039)	(0.0041)	(0.0033)	(0.0034)
Pharmacy spending	0.0087	0.0134	0.0034	0.0111	−0.0039
	(0.0102)	(0.0103)	(0.0094)	(0.0080)	(0.0073)
Other spending	0.0042	0.0117	−0.0021	0.0132	−0.0085
	(0.0092)	(0.0087)	(0.0092)	(0.0071)	(0.0075)
Any high-value medical care (%)	0.0077	0.0090	0.0051	0.0055	0.0003
	(0.0168)	(0.0171)	(0.0155)	(0.0129)	(0.0117)
Any recommended preventive care (%)	0.0028	−0.0011	0.0051	−0.0045	0.0056
	(0.0075)	(0.0074)	(0.0071)	(0.0058)	(0.0055)
Any high-value prescription drugs (%)	0.0266	0.0229	0.0236	0.0070	0.0112
	(0.0426)	(0.0431)	(0.0388)	(0.0317)	(0.0285)
Any lab or imaging (%)	−0.0001	0.0187	−0.0138	0.0281	−0.0240
	(0.0186)	(0.0173)	(0.0186)	(0.0139)	(0.0149)
Any emergency department use (%)	−0.0034	0.0015	−0.0063	0.0057	−0.0071
	(0.0067)	(0.0064)	(0.0068)	(0.0053)	(0.0056)
Any avoidable hospitalizations (%)	0.0003	−0.0016	0.0016	−0.0027	0.0025
	(0.0052)	(0.0052)	(0.0049)	(0.0041)	(0.0039)
Any low-value care visits (%)	0.0036	0.0009	0.0048	−0.0023	0.0043
	(0.0040)	(0.0038)	(0.0038)	(0.0029)	(0.0030)
Predicted spending	−0.0012	0.0014	−0.0029	0.0033	−0.0036
	(0.0064)	(0.0065)	(0.0059)	(0.0050)	(0.0046)
Predicted any potentially HVC (%)	−0.0373	−0.0258	−0.0375	−0.0006	−0.0235
	(0.0675)	(0.0692)	(0.0605)	(0.0503)	(0.0438)
Predicted any potentially LVC (%)	−0.0056	−0.0419	0.0220	−0.0567	0.0448
	(0.0429)	(0.0399)	(0.0425)	(0.0311)	(0.0333)
Predicted share in assigned plan (%)	0.0018	0.0045	−0.0005	0.0049	−0.0030
	(0.0353)	(0.0357)	(0.0330)	(0.0277)	(0.0257)
P-value on joint F-test	0.82	0.30	0.96	0.19	0.73
Observations	58,172	58,172	58,172	58,172	58,172
Baseline Controls	X	X	X	X	X
Plan Controls					

Notes: This table reports reduced form results testing the conditional random assignment of enrollees to physician and hospital networks. Results are based on my primary sample (see Section I for details on primary sample construction), including enrollees in the provider-owned plan. Baseline outcomes are the average for each enrollee in the three months prior to assignment. Predicted spending, high-value care (HVC), and low-value care (LVC) are formed using the other baseline variables. Detailed descriptions of the outcome measures are included in Appendix A. Columns 1-3 present the results of multivariate OLS models with enrollee characteristics as the independent variables and the assigned network breadth as the dependent variable. Column 1 reproduces results from Table 2 for reference. Columns 4 and 5 presents bivariate OLS regressions with enrollee characteristics as the independent variable and assigned physician or hospital network breadth as the dependent variable. Standard errors are clustered at the county × month of assignment level.

Appendix Table 19—: Summary statistics for Auto-Assignees in the "Usual Source of Care" Sample

	Mean	Std. Dev.	Observations
	(1)	(2)	(3)
Demographics			
Age	36.746	12.301	157,536
Male	0.564	0.496	157,536
Black	0.513	0.500	157,536
Assigned network breadth			
Covered share of simulated visits (%)	59.103	15.117	157,536
Covered share of simulated physician visits (%)	56.662	14.215	157,536
Covered share of simulated hospital visits (%)	61.692	20.488	157,536
Network covers primary provider (%)	67.365	46.888	157,536
Healthcare spending			
Total spending	614.540	3,003.766	157,536
Outpatient spending	104.189	446.117	157,536
Inpatient spending	284.041	2,696.346	157,536
Pharmacy spending	94.808	450.343	157,536
Other spending	131.503	536.027	157,536
Healthcare use			
Any spending (%)	43.280	49.546	157,536
Any outpatient spending (%)	24.624	43.082	157,536
Any inpatient spending (%)	3.021	17.116	157,536
Any pharmacy spending (%)	26.525	44.147	157,536
Any other spending (%)	27.259	44.529	157,536
Potentially high-value care			
Any high-value medical care (%)	16.373	37.004	157,536
Any recommended preventive care (%)	2.830	16.582	157,536
Any high-value prescription drugs	13.891	34.586	157,536
Any potentially high-value care (%)	24.917	43.254	157,536
Potentially low-value care			
Any lab or imaging (%)	17.643	38.119	157,536
Any emergency department use (%)	7.878	26.939	157,536
Any avoidable hospitalization (%)	0.708	8.387	157,536
Any designated low-value care (%)	0.315	5.608	157,536
Any potentially low-value care (%)	21.285	40.932	157,536
Satisfaction			
In assigned plan (%)	92.001	27.129	157,536

Notes: This table reports summary statistics. Summary statistics are based on my primary sample (see Section I), but further restricted to enrollees who could be attributed to a physician or hospital based on care they sought prior to assignment (the "usual source of care sample"). Observations are at the enrollee-month level and limited to the six months post-assignment (my primary sample). Details on the construction of the measures of network breadth are included in Section II. Additional details on the broad service categories or specific services identified as potentially high-value or low-value care are included in Appendix A.

Appendix Table 20—: Balance Test of Assignment to Plans on the Basis of In-Network Status of Enrollees' Usual Source of Care

	Mean (SD)	Multivariate OLS	
	(1)	(2)	(3)
Age	36.538	0.0001	−0.0015
	(12.300)	(0.0002)	(0.0009)
Male	0.564	−0.0075	0.0155
	(0.496)	(0.0056)	(0.0143)
Black	0.513	−0.0076	−0.0056
	(0.500)	(0.0053)	(0.0061)
Outpatient spending	165.237	−0.0000	−0.0001
	(317.124)	(0.0000)	(0.0000)
Inpatient spending	512.633	0.0000	−0.0000
	(2785.248)	(0.0000)	(0.0000)
Pharmacy spending	105.895	−0.0000	−0.0000
	(461.494)	(0.0000)	(0.0000)
Other spending	172.981	0.0000	−0.0000
	(491.016)	(0.0000)	(0.0000)
Any high-value medical care (%)	29.125	0.0000	−0.0003
	(45.435)	(0.0001)	(0.0002)
Any recommended preventive care (%)	7.115	−0.0000	−0.0002
	(25.707)	(0.0001)	(0.0002)
Any high-value prescription drugs (%)	23.073	0.0001	−0.0006
	(42.131)	(0.0001)	(0.0006)
Any lab or imaging (%)	33.699	−0.0000	−0.0002
	(47.269)	(0.0001)	(0.0002)
Any emergency department use (%)	30.275	−0.0000	−0.0000
	(45.946)	(0.0001)	(0.0001)
Any avoidable hospitalizations (%)	2.476	0.0001	0.0002
	(15.538)	(0.0002)	(0.0003)
Any low-value care visits (%)	1.047	0.0002	0.0002
	(10.181)	(0.0003)	(0.0003)
Predicted spending	615.140		0.0000
	(844.414)		(0.0000)
Predicted any potentially HVC (%)	24.917		0.0010
	(17.857)		(0.0023)
Predicted any potentially LVC (%)	21.285		0.0012
	(10.374)		(0.0021)
Predicted share in assigned plan (%)	92.001		−0.0072
	(4.758)		(0.0049)
P-value on joint F-test		0.30	0.19
Observations	26,256	26,256	26,256
Baseline Controls		X	X
Plan Controls			

Notes: This table reports reduced form results testing the conditional random assignment of enrollees to plans that cover their usual sources of care. Results are based on my primary sample (see Section I), but further restricted to enrollees who could be attributed to a physician or hospital based on care they sought prior to assignment (the "usual source of care sample"). Baseline outcomes are the average for each enrollee in the three months prior to assignment. Predicted spending, high-value care (HVC), and low-value care (LVC) are formed using the other baseline variables. Detailed descriptions of the outcome measures are included in Appendix A. Columns 2-3 present the results of multivariate OLS models with enrollee characteristics as the independent variables and an indicator for whether the assigned network covers an enrollees usual source of care as the dependent variable. In addition to the baseline controls, all regressions include fixed effects for the individual providers that were enrollees' attributed usual sources of care. Standard errors are clustered at the county × month of assignment level.

Appendix Table 21—: Heterogeneity by Provider Network Characteristics: Analyses Restricted to Enrollees Assigned to Plans That Cover Their Usual Source of Care

	Usual source of care sample		
	Physician Network (1)	Hospital Network (2)	Key provider in assigned (3)
Panel A. Healthcare use and spending			
Log spending	0.083	−0.037	-
	(0.047)	(0.039)	-
Any spending (%)	0.866	0.308	-
	(0.691)	(0.521)	-
Panel B. Potentially high-value care			
Any high-value medical care (%)	0.854	−0.684	-
	(0.453)	(0.416)	-
Any recommended preventive care (%)	0.072	−0.062	-
	(0.168)	(0.126)	-
Any high-value prescription drugs (%)	−0.107	−0.070	-
	(0.479)	(0.387)	-
Any potentially high-value care (%)	0.048	−0.437	-
	(0.561)	(0.471)	-
Panel C. Potentially low-value care			
Any imaging and lab (%)	1.277	−0.347	-
	(0.530)	(0.383)	-
Any emergency department use (%)	−0.154	−0.106	-
	(0.320)	(0.268)	-
Any avoidable hospitalizations (%)	−0.021	−0.079	-
	(0.103)	(0.076)	-
Any designated low-value care (%)	0.086	−0.025	-
	(0.051)	(0.040)	-
Any potentially low-value care (%)	1.005	−0.449	-
	(0.562)	(0.426)	-
Panel D. Consumer satisfaction			
In assigned plan (%)	0.340	0.813	
	(0.395)	(0.310)	
Observations	106,124	106,124	106,124
Baseline controls	X	X	X
Enrollee Controls	X	X	X
Plan controls	X	X	X
Usual source of care sample	X	X	X

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I), but further restricted to enrollees who could be attributed to a physician or hospital based on care they sought prior to assignment (the "usual source of care sample"). The dependent variables include measures of healthcare use and spending, specific high-value and low-value services, and an ex-post demand measure of enrollee satisfaction. Panel D presents reduced form, rather than 2SLS, estimates of the likelihood that enrollees remain in their assigned plans. Columns 1-3 report the results of estimating Equation 7 after first restricting to enrollees whose usual sourc of care is in their assigned plan (hence, there is no variation with which to identify the usual source of care effect in Column 3). All standard errors are clustered at the county × month of assignment level.

Appendix Table 22—: Heterogeneity by Provider Network Characteristics, Extended Sample 6 Months Post-Assignment

	Main sample			Usual source of care sample		
	Main Spec.	Alternative specification w/ physician and hospital		Alternative specification w/ physician and hospital and key provider		
	Overall Network (1)	Physician Network (2)	Hospital Network (3)	Physician Network (4)	Hospital Network (5)	Key provider in assigned (6)
Panel A. Healthcare use and spending						
Log spending	0.053	0.045	0.024	0.047	−0.015	0.180
	(0.017)	(0.019)	(0.015)	(0.033)	(0.026)	(0.037)
Any spending (%)	0.717	0.443	0.420	0.640	0.001	1.974
	(0.244)	(0.290)	(0.228)	(0.486)	(0.369)	(0.544)
Panel B. Potentially high-value care						
Any high-value medical care (%)	0.367	0.452	0.078	0.816	−0.426	1.802
	(0.172)	(0.177)	(0.161)	(0.324)	(0.300)	(0.429)
Any recommended preventive care (%)	0.083	−0.025	0.095	−0.019	0.014	0.274
	(0.063)	(0.073)	(0.058)	(0.122)	(0.097)	(0.125)
Any high-value prescription drugs (%)	0.087	−0.143	0.171	−0.232	−0.054	1.096
	(0.163)	(0.203)	(0.169)	(0.354)	(0.297)	(0.382)
Any potentially high-value care (%)	0.456	0.453	0.163	0.503	−0.388	2.082
	(0.218)	(0.256)	(0.206)	(0.444)	(0.360)	(0.510)
Panel C. Potentially low-value care						
Any imaging and lab (%)	0.634	0.550	0.275	0.708	−0.038	1.207
	(0.189)	(0.215)	(0.184)	(0.354)	(0.281)	(0.400)
Any emergency department use (%)	−0.081	−0.003	−0.076	−0.100	−0.153	−0.184
	(0.102)	(0.121)	(0.090)	(0.224)	(0.180)	(0.229)
Any avoidable hospitalizations (%)	−0.021	−0.013	−0.012	−0.070	−0.080	0.158
	(0.027)	(0.036)	(0.027)	(0.073)	(0.058)	(0.060)
Any designated low-value care (%)	−0.009	0.021	−0.022	0.059	−0.034	0.035
	(0.023)	(0.022)	(0.020)	(0.040)	(0.038)	(0.042)
Any potentially low-value care (%)	0.550	0.491	0.230	0.559	−0.161	1.385
	(0.195)	(0.217)	(0.188)	(0.366)	(0.309)	(0.422)
Panel D. Consumer satisfaction						
In assigned plan (%)	1.069	0.601	0.662	0.565	0.200	5.091
	(0.176)	(0.194)	(0.158)	(0.391)	(0.287)	(0.378)
Observations	320,226	320,226	320,226	142,572	142,572	142,572
Baseline controls	X	X	X	X	X	X
Enrollee Controls	X	X	X	X	X	X
Plan controls	X	X	X	X	X	X
Usual source of care sample				X	X	X

Notes: Standard errors in parentheses. Results are based on enrollee-months in the 6 months post-assignment for an imbalanced sample of enrollees (Appendix A describes the construction of this sample. Because additional restrictions are imposed on enrollees—i.e., enrollees had to remain in New York City for at least 12 months following assignment (rather than 6 as in my primary sample)—the enrollee-month counts are lower in this sample even in the 6 months post-assignment. The dependent variables include measures of healthcare use and spending, specific high-value and low-value services, and an ex-post demand measure of enrollee satisfaction. Panel D presents reduced form, rather than 2SLS, estimates of the likelihood that enrollees remain in their assigned plans. In Column 1, the independent variable is overall network breadth (normalized covered share of simulated visits). Columns 2 and 3 report the main two-stage least squares (2SLS) results from estimating Equation 6 using physician and hospital network breadth in the same model. Columns 4-6 restrict the sample to enrollees who could be attributed to a physician or hospital based on care they sought prior to assignment (the "usual source of care sample"). The column reports the results of estimating Equation 7 on this restricted sample. All standard errors are clustered at the county × month of assignment level.

Appendix Table 23—: Heterogeneity by Provider Network Characteristics, Extended Sample 1 Year Post-Assignment

	Main sample			Usual source of care sample		
	Main Spec.	Alternative specification w/ physician and hospital		Alternative specification w/ physician and hospital and key provider		
	Overall Network (1)	Physician Network (2)	Hospital Network (3)	Physician Network (4)	Hospital Network (5)	Key provider in assigned (6)
Panel A. Healthcare use and spending						
Log spending	0.069	0.081	0.016	0.088	−0.018	0.151
	(0.017)	(0.018)	(0.016)	(0.030)	(0.027)	(0.038)
Any spending (%)	0.955	0.999	0.301	1.261	0.062	1.639
	(0.244)	(0.271)	(0.220)	(0.430)	(0.366)	(0.549)
Panel B. Potentially high-value care						
Any high-value medical care (%)	0.349	0.639	−0.061	0.983	−0.470	1.327
	(0.184)	(0.179)	(0.166)	(0.309)	(0.308)	(0.426)
Any recommended preventive care (%)	0.085	−0.045	0.111	−0.029	0.066	0.111
	(0.058)	(0.066)	(0.053)	(0.112)	(0.083)	(0.113)
Any high-value prescription drugs (%)	0.076	−0.016	0.084	−0.180	−0.013	0.947
	(0.185)	(0.214)	(0.184)	(0.366)	(0.311)	(0.427)
Any potentially high-value care (%)	0.515	0.641	0.099	0.606	−0.269	1.695
	(0.239)	(0.263)	(0.216)	(0.422)	(0.370)	(0.535)
Panel B. Potentially low-value care						
Any imaging and lab (%)	0.719	0.637	0.298	0.677	0.084	0.952
	(0.183)	(0.208)	(0.183)	(0.364)	(0.289)	(0.388)
Any emergency department use (%)	−0.068	−0.031	−0.047	−0.132	−0.108	0.022
	(0.098)	(0.112)	(0.085)	(0.193)	(0.165)	(0.234)
Any avoidable hospitalizations (%)	−0.031	−0.028	−0.012	−0.106	−0.064	0.213
	(0.029)	(0.041)	(0.025)	(0.078)	(0.050)	(0.056)
Any designated low-value care (%)	−0.017	−0.003	−0.015	0.016	−0.004	−0.001
	(0.021)	(0.019)	(0.019)	(0.034)	(0.035)	(0.036)
Any potentially low-value care (%)	0.659	0.600	0.264	0.648	−0.073	1.292
	(0.189)	(0.206)	(0.187)	(0.363)	(0.312)	(0.406)
Panel D. Consumer satisfaction						
In assigned plan (%)	1.388	0.563	0.993	0.449	0.198	7.308
	(0.240)	(0.268)	(0.216)	(0.491)	(0.383)	(0.514)
Observations	431,990	431,990	431,990	198,611	198,611	198,611
Baseline controls	X	X	X	X	X	X
Enrollee Controls	X	X	X	X	X	X
Plan controls	X	X	X	X	X	X
Usual source of care sample				X	X	X

Notes: Standard errors in parentheses. Results are based on enrollee-months in the 12 months post-assignment for an imbalanced sample of enrollees (Appendix A describes the construction of this sample. Because additional restrictions are imposed on enrollees—i.e., enrollees had to remain in New York City for at least 12 months following assignment (rather than 6 as in my primary sample)—the enrollee-month counts are lower in this sample even in the 6 months post-assignment. The dependent variables include measures of healthcare use and spending, specific high-value and low-value services, and an ex-post demand measure of enrollee satisfaction. Panel D presents reduced form, rather than 2SLS, estimates of the likelihood that enrollees remain in their assigned plans. In Column 1, the independent variable is overall network breadth (normalized covered share of simulated visits). Columns 2 and 3 report the main two-stage least squares (2SLS) results from estimating Equation 6 using physician and hospital network breadth in the same model. Columns 4-6 restrict the sample to enrollees who could be attributed to a physician or hospital based on care they sought prior to assignment (the "usual source of care sample"). The column reports the results of estimating Equation 7 on this restricted sample. All standard errors are clustered at the county × month of assignment level.

Appendix Table 24—: Heterogeneity by Provider Network Characteristics, Extended Sample 2 Years Post-Assignment

	Main sample			Usual source of care sample		
	Main Spec.	Alternative specification w/ physician and hospital		Alternative specification w/ physician and hospital and key provider		
	Overall Network (1)	Physician Network (2)	Hospital Network (3)	Physician Network (4)	Hospital Network (5)	Key provider in assigned (6)
Panel A. Healthcare use and spending						
Log spending	0.064	0.073	0.017	0.083	−0.022	0.152
	(0.019)	(0.018)	(0.017)	(0.028)	(0.028)	(0.040)
Any spending (%)	0.776	0.874	0.205	1.217	−0.069	1.763
	(0.260)	(0.281)	(0.228)	(0.434)	(0.360)	(0.564)
Panel B. Potentially high-value care						
Any high-value medical care (%)	0.240	0.612	−0.150	0.950	−0.650	1.345
	(0.203)	(0.187)	(0.176)	(0.322)	(0.314)	(0.455)
Any recommended preventive care (%)	0.052	−0.015	0.059	0.027	0.015	0.159
	(0.054)	(0.063)	(0.052)	(0.099)	(0.085)	(0.114)
Any high-value prescription drugs (%)	0.053	−0.047	0.080	−0.139	0.058	0.929
	(0.214)	(0.236)	(0.189)	(0.393)	(0.317)	(0.493)
Any potentially high-value care (%)	0.435	0.534	0.087	0.525	−0.272	1.612
	(0.263)	(0.278)	(0.222)	(0.436)	(0.369)	(0.603)
Panel B. Potentially low-value care						
Any imaging and lab (%)	0.562	0.533	0.211	0.508	−0.066	0.998
	(0.181)	(0.196)	(0.183)	(0.327)	(0.288)	(0.397)
Any emergency department use (%)	−0.042	0.008	−0.046	−0.017	−0.134	0.066
	(0.100)	(0.104)	(0.089)	(0.183)	(0.165)	(0.227)
Any avoidable hospitalizations (%)	0.000	−0.012	0.008	−0.051	−0.053	0.208
	(0.028)	(0.039)	(0.023)	(0.072)	(0.045)	(0.058)
Any designated low-value care (%)	−0.026	−0.015	−0.016	−0.011	−0.013	0.014
	(0.019)	(0.017)	(0.017)	(0.030)	(0.032)	(0.031)
Any potentially low-value care (%)	0.551	0.546	0.193	0.560	−0.190	1.308
	(0.190)	(0.194)	(0.192)	(0.332)	(0.312)	(0.418)
Panel D. Consumer satisfaction						
In assigned plan (%)	1.816	0.942	1.171	0.904	0.238	8.832
	(0.284)	(0.320)	(0.274)	(0.549)	(0.435)	(0.627)
Observations	523,194	523,194	523,194	246,095	246,095	246,095
Baseline controls	X	X	X	X	X	X
Enrollee Controls	X	X	X	X	X	X
Plan controls	X	X	X	X	X	X
Usual source of care sample				X	X	X

Notes: Standard errors in parentheses. Results are based on enrollee-months in the 24 months post-assignment for an imbalanced sample of enrollees (Appendix A describes the construction of this sample. Because additional restrictions are imposed on enrollees—i.e., enrollees had to remain in New York City for at least 12 months following assignment (rather than 6 as in my primary sample)—the enrollee-month counts are lower in this sample even in the 6 months post-assignment. The dependent variables include measures of healthcare use and spending, specific high-value and low-value services, and an ex-post demand measure of enrollee satisfaction. Panel D presents reduced form, rather than 2SLS, estimates of the likelihood that enrollees remain in their assigned plans. In Column 1, the independent variable is overall network breadth (normalized covered share of simulated visits). Columns 2 and 3 report the main two-stage least squares (2SLS) results from estimating Equation 6 using physician and hospital network breadth in the same model. Columns 4-6 restrict the sample to enrollees who could be attributed to a physician or hospital based on care they sought prior to assignment (the "usual source of care sample"). The column reports the results of estimating Equation 7 on this restricted sample. All standard errors are clustered at the county × month of assignment level.

Appendix Table 25—: Impact of Alternative Assignment Policies on Outcomes and Mean Network Breadth

	Counterfactual outcomes (Δ)		Counterfactual network size (Δ)		
	Consumer Satisfaction (pp)	Total Cost (log points)	Physician Breadth (pp)	Hospital Breadth (pp)	Key provider in assigned (pp)
Alternative policy	(1)	(2)	(3)	(4)	(5)
Minimize cost	−2.77	−9.54	−5.74	−6.83	−48.70
	(0.21)	(1.94)			
Minimize cost without reducing satisfaction	0.04	−2.20	−7.35	1.08	5.15
	(0.20)	(1.81)			
Maximize satisfaction without increasing cost	0.71	−0.16	−7.00	1.85	17.78
	(0.20)	(1.92)			
Maximize satisfaction	1.84	6.74	5.87	8.22	30.55
	(0.17)	(1.62)			

Notes: This table reports the effects of select counterfactual assignment policies described in Section VI. Columns 1 and 2 contain point estimates and standard errors for the predicted differences in mean consumer satisfaction and log spending, respectively, relative to the state's current (random) assignment policy. Columns 3-5 describe the change in mean physician and hospital network breadth for each counterfactual, as well as differences in what share of enrollees are assigned to a plan where their usual source of care is in-network. These simulations are based on a randomly-selected subset of 4000 auto-assignees from a sample of enrollees who could be attributed to a physician or hospital based on care they sought prior to assignment (the "usual source of care" sample).

Appendix Table 26—: OLS Estimates of the Impact of Overall Network Breadth on Health Care Use and Spending Among Enrollees That Made Active Plan Choices

	Share of sample (1)	Sample Mean (2)	OLS (3)	OLS (4)	OLS (5)
Any spending (%)	1.00	50.591	1.032	1.437	0.841
			(0.220)	(0.197)	(0.241)
Log spending	1.00	548.975	0.052	0.097	0.072
			(0.014)	(0.012)	(0.015)
Observations		454,668	454,668	454,668	575,328
Panel A. Spending by enrollee characteristics					
Male	0.42	457.057	0.113	0.110	0.051
			(0.021)	(0.018)	(0.024)
Female	0.58	616.568	0.028	0.089	0.087
			(0.017)	(0.015)	(0.019)
18-39	0.65	486.562	−0.014	0.076	0.059
			(0.016)	(0.013)	(0.018)
40-64	0.35	666.315	0.133	0.139	0.088
			(0.023)	(0.021)	(0.026)
Panel B. Spending by enrollee health status					
1st quartile predicted spending	0.25	164.776	0.074	0.081	0.054
			(0.018)	(0.017)	(0.027)
2nd quartile predicted spending	0.25	237.931	0.135	0.137	0.063
			(0.022)	(0.021)	(0.029)
3rd quartile predicted spending	0.25	400.439	0.120	0.130	0.082
			(0.025)	(0.026)	(0.030)
4th quartile predicted spending	0.25	1,392.818	−0.038	0.017	0.043
			(0.028)	(0.026)	(0.031)
Baseline Controls			X	X	X
Enrollee Controls				X	X
Plan Controls					X

Notes: Standard errors in parentheses. Results are based on an alternative sample of enrollees that made active plan choices (see Appendix A for details on sample construction). The independent variable is actual network breadth as measured by the normalized covered share of simulated visits. The dependent variable is log spending for Panels B and C. Columns 3 and 4 report the main ordinary least squares (OLS) results from estimating a version of Equation 5 that uses actual network breadth (with no instrumentation), with and without enrollee-level controls. Unsurprisingly, the OLS estimates are more sensitive to the inclusion of controls than the IV estimates which are based on randomly assigned enrollees. Column 5 reports OLS results based on a model with plan fixed effects (see Appendix C) estimated on a broader sample that includes enrollees in the provider-owned plan. All standard errors are clustered at the county × month of assignment level.

Appendix Table 27—: OLS estimates of the Impact of Overall Network Breadth on Potentially High-Value and Low-Value Care

	DV Mean (1)	OLS (2)	OLS (3)	OLS (4)
Panel A. Potentially high-value care				
Any high-value medical care (%)	26.920	0.252	0.777	0.657
		(0.190)	(0.169)	(0.222)
Any recommended preventive care (%)	5.025	0.031	0.158	0.127
		(0.053)	(0.049)	(0.073)
Any high-value prescription drugs (%)	14.330	0.982	0.382	0.260
		(0.157)	(0.133)	(0.150)
Any potentially high-value care (%)	34.659	0.372	0.765	0.511
		(0.210)	(0.181)	(0.230)
Panel B. Potentially low-value care				
Any imaging and lab (%)	24.031	−0.390	0.235	0.638
		(0.167)	(0.145)	(0.188)
Any emergency department use (%)	5.390	−0.248	−0.188	0.048
		(0.063)	(0.059)	(0.083)
Any avoidable hospitalizations (%)	0.286	0.006	−0.011	0.011
		(0.015)	(0.014)	(0.020)
Any designated low-value care (%)	0.302	0.022	0.019	0.026
		(0.014)	(0.014)	(0.018)
Any potentially low-value care (%)	26.303	−0.225	0.345	0.618
		(0.172)	(0.153)	(0.195)
Observations	454,668	454,668	454,668	575,328
Baseline Controls	—	X	X	X
Enrollee Controls	—		X	X
Plan Controls	—			X

Notes: Standard errors in parentheses. Results are based on an alternative sample of enrollees that made active plan choices (see Appendix A for details on sample construction). The independent variable is actual network breadth as measured by the normalized covered share of simulated visits. The dependent variables include specific high-value and low-value services. Columns 3 and 4 report the main ordinary least squares (OLS) results from estimating a version of Equation 5 that uses actual network breadth (with no instrumentation), with and without enrollee-level controls. Unsurprisingly, the OLS estimates are more sensitive to the inclusion of controls than the IV estimates which are based on randomly assigned enrollees. Column 5 reports OLS results based on a model with plan fixed effects (see Appendix C) estimated on a broader sample that includes enrollees in the provider-owned plan. All standard errors are clustered at the county × month of assignment level.

Appendix Table 28—: Reweighted Estimates of the Impact of Overall Network Breadth on Health Care Use and Spending

	Share of sample (1)	Sample Mean (2)	2SLS (3)	2SLS (4)	2SLS (4)
Log spending	0.96	371.916	0.107	0.105	0.069
			(0.032)	(0.031)	(0.039)
Any spending (%)	1.00	31.451	1.680	1.542	1.275
			(0.516)	(0.431)	(0.558)
Observations		283,534	283,534	283,534	334,742
Panel A. Spending by enrollee characteristics					
Male	0.57	406.086	0.104	0.107	0.118
			(0.047)	(0.041)	(0.053)
Female	0.39	321.607	0.111	0.102	0.035
			(0.044)	(0.044)	(0.055)
18-39	0.65	263.953	0.095	0.089	0.057
			(0.035)	(0.034)	(0.046)
40-64	0.31	569.574	0.130	0.148	0.119
			(0.053)	(0.051)	(0.060)
Panel B. Spending by enrollee health status					
1st quartile predicted spending	0.25	91.099	0.074	0.076	0.045
			(0.025)	(0.025)	(0.033)
2nd quartile predicted spending	0.22	137.084	0.101	0.105	0.067
			(0.026)	(0.026)	(0.041)
3rd quartile predicted spending	0.24	268.800	0.101	0.107	0.090
			(0.045)	(0.044)	(0.057)
4th quartile predicted spending	0.25	990.682	0.089	0.100	0.030
			(0.049)	(0.047)	(0.059)
Baseline Controls			X	X	X
Recipient Controls				X	X
Plan Controls					X

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction). Regressions are reweighted to balance the characteristics of the auto assignee and active choice Medicaid enrollee samples. The reweighting is done by defining cells at the age × sex × race × quartile of predicted spending level. The reweighted regression drops 6 observations due to lack of joint support. The independent variable is overall network breadth as measured by the normalized covered share of simulated visits. The dependent variable is log spending for Panels B and C. Columns 3 and 4 report the main two-stage least squares (2SLS) results from estimating Equation 5 for overall networks breadth with and without enrollee-level controls. Column 5 reports 2SLS results based on a model with plan fixed effects (see Appendix C) estimated on a broader sample that includes enrollees in the provider-owned plan. All standard errors are clustered at the county × month of assignment level.

Appendix Table 29—: Reweighted Estimates of the Impact of Overall Network Breadth on Potentially High-Value and Low-Value Care

	DV Mean (1)	2SLS† (2)	2SLS† (3)	2SLS† (4)
Panel A. Potentially high-value care				
Any medical care (%)	11.729	1.292	1.252	0.750
		(0.305)	(0.288)	(0.371)
Any preventive care (%)	2.137	0.247	0.271	0.124
		(0.104)	(0.099)	(0.146)
Any prescription drugs (%)	9.343	0.675	0.552	−0.118
		(0.283)	(0.229)	(0.361)
Any potentially high-value care (%)	17.697	1.361	1.276	0.452
		(0.366)	(0.328)	(0.445)
Panel B. Potentially low-value care				
Any imaging and lab (%)	13.462	0.664	0.669	1.170
		(0.329)	(0.307)	(0.378)
Any emergency department use (%)	5.362	−0.287	−0.246	−0.237
		(0.152)	(0.151)	(0.220)
Any avoidable hospitalizations (%)	0.407	0.033	0.020	0.011
		(0.052)	(0.049)	(0.061)
Any designated low-value care (%)	0.207	0.006	0.001	−0.042
		(0.033)	(0.033)	(0.052)
Any potentially low-value care (%)	16.007	1.039	1.060	0.952
		(0.333)	(0.314)	(0.401)
Panel C. Satisfaction				
In assigned plan (%)	94.211	1.252	1.416	1.770
		(0.239)	(0.237)	(0.372)
Observations	283,534	283,534	283,534	334,742
Baseline Controls	—	X	X	X
Recipient Controls	—		X	X
Plan Controls	—			X

Notes: Standard errors in parentheses. Results are based on my primary sample (see Section I for details on primary sample construction). Regressions are reweighted to balance the characteristics of the auto assignee and active choice Medicaid enrollee samples. The reweighting is done by defining cells at the age × sex × race × quartile of predicted spending level. The independent variable is overall network breadth as measured by the normalized covered share of simulated visits. The dependent variables include specific high-value and low-value services, and an ex-post demand measure of enrollee satisfaction. Panel C presents reduced form, rather than 2SLS, estimates as they measure the likelihood that enrollees remain in their assigned plans. Columns 2 and 3 report the main two-stage least squares (2SLS) results from estimating Equation 5 for overall networks breadth with and without enrollee-level controls. Column 4 reports 2SLS results based on a model with plan fixed effects (see Appendix C) estimated on a broader sample that includes enrollees in the provider-owned plan. All standard errors are clustered at the county × month of assignment level.

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