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ENROLLEES

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Does Physician-Hospital Vertical Integration Signal Care-Coordination? Evidence from Mover-Stayer Analyses of Commercially Insured Enrollees

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ABSTRACT

We examine the impacts of physician-hospital integration on care fragmentation and other measures of care-coordination using a dynamic model of movers and stayers in commercially insured plans. Although recent growth in the share of practicing physicians belonging to these vertical organizations has sparked considerable policy debate, there is a paucity of evidence on the merits of vertical integration in the private segment of the market. We fill the gap by focusing on care-coordination in the relatively open plans that dominate commercial insurance, namely Preferred Provider Organizations (PPOs). We exploit the fact that physician-hospital integration levels vary dramatically across MSA and focus on orthogonal employment-based transfers for identification. We track 415,000 beneficiaries with 17 million claims between 2010 and 2016. We find that standard two-way fixed effect mover-stayer models produce biased estimates since there are heterogeneous effects of integration. Extending the dynamic event study design of Sun and Abraham (2021) to mover-stayer analyses, we are able to avoid these biases. We find that a move from the 10th to 90th percentile of physician integration level causes a 20% relative decrease in a care fragmentation index; similar declines are found in independent markers of fragmentation such as use of out-of-network and single-service facilities. Vertical integration of either primary care physicians or specialists reduced fragmentation significantly. However, only vertical integration of specialists led to significant reductions in medical spending. Our results are robust when adjusting for moves associated with alternative contractual arrangements among providers that do not require outright ownership.

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I. Introduction

The healthcare delivery system has been undergoing a slow yet steady transformation in recent decades, as providers move from relatively fragmented care models toward consolidated models and vertically integrated health care systems. More recently, this trend has accelerated, and it has been particularly pronounced in the acquisition of physician groups and outpatient practices by large parent organizations. Although insurers have also opted for vertical arrangements with physicians and other providers, these primarily involve contractual agreements on pricing and referrals, loosely referred to as “networking”, rather than outright ownership or organizational control (Atwood and LoSasso, 2016). On the other hand, large hospitals and hospital-based systems have opted for direct ownership of medical practices. The most dramatic shift in hospital-based vertical integration has been observed in the market for primary care services. Within a span of just two years, 2016-2018, the share of primary care physicians (PCPs) integrated with hospital systems increased from 38% to 49% (Furukawa et al., 2020), up from 22% in 2010.

While antitrust enforcement agencies have given close scrutiny to horizontal integration of hospitals both locally and nationally (DOJ, 2020; Pear, 2012), they have undertaken a more hands-off approach to vertical integration in healthcare markets. Paralleling attitudes to vertical integration in general, hospital-physician integration tended to be viewed favorably as a way of enhancing efficiency without impeding competition. On the practice side, both private insurers and government plans such as Medicare are becoming increasingly supportive of vertical coordination as a way of promoting quality care at potentially lower costs. For instance, the Medicare’s shared savings programs encourages the formation of Accountable Care Organizations (ACOs), defined as groupings of providers who commit to cross-referrals with bundled payments, without outright ownership or control by hospitals (Muhlestein et al., 2020). Accordingly, providers receive favorable payment terms, including loss sharing features and quality-based bonuses (Peck et al., 2019).

Underlying the development of such payment models (often referred to as “value-based” payments) was the expectation that financial integration would also lead to greater clinical coordination, given a greater ability of large-scale vertical systems to respond to incentives when delivering care to patients. More recently, however, emerging evidence that some forms of consolidation are associated with higher medical prices, higher overall spending,

stagnating healthcare wages, and higher contractual costs for physicians ¹, without clear evidence of counter-balancing efficiencies (Capps, Dranove, and Ody, 2018; Prager and Schmitt, 2019; Andrews, 2019; Koch, Wendling, and Wilson, 2021). This has led antitrust experts inside and outside of government to question the value of vertical integration protections in healthcare markets and to call for tighter antitrust regulation (e.g., Gaynor 2019, Aaron 2019)². In response, FTC and DOJ have jointly updated their long outdated 1984 vertical merger antitrust guidelines, removing the past “safe harbor” provision of not challenging vertical mergers where the combined firm’s market share is under twenty percent (FTC 2020; Greaney and Scheffler, 2020).

With that, concerns over the fragmentation of the U.S. health care system, defined as dispersion of individual patient care over multiple uncoordinated providers, continue to occupy policy makers and industry observers (Agha, Frandsen, and Rebitzer (2019); Agha, Ericson, and Zhao (2020)). In 2021, the National Academies recommended that the HHS Secretary establish a Secretary’s Council on Primary Care to coordinate primary care policy, to create more integrated team-based primary care, and to develop a national scorecard to track the fragmentation of primary care in the US (National Academies, 2021). In this paper, we attempt to shed new light on the policy debate by focusing specifically on the impact of physician integration into hospital-centered systems on overall fragmentation in local markets. In addition, we consider specific markers of care fragmentation, such as the share of patients opting for care outside of networks, in single-line sources of care, or retail clinics. Finally, given the relative paucity of evidence of the impacts of system integration on costs (savings), we examine its impacts on spending by major categories, i.e. outpatient care, inpatient services, pharmaceutical expenditures and diagnostics. In all our analyses we distinguish between levels of integration for specialists and for primary care physicians, and compare the corresponding results, and provide robustness checks to adjust sensitivity of our main findings to other types

¹ Non-compete clauses, in particular, have been noted as costly to vertically integrated physicians (Andrews, 2019).

² In testimony before the U.S. House’s Subcommittee on Antitrust, Martin Gaynor (2019), a former Director of the Federal Trade Commission’s (FTC) Bureau of Economics, summarized the situation succinctly, “After more than 3 decades of extensive consolidation in health care, it seems likely that the promised gains from consolidation would have materialized by now if they were truly there.” In an open letter to Congress, a panel of policy experts at the American Enterprise Institute and the Brookings Institution issued a joint statement calling for a ramping up the antitrust efforts of the FTC and Department of Justice (DOJ) to rein in health care market consolidation---mostly in order to control costs (Aaron, 2019).

of contractual arrangements.

We examine this issue over a much longer and more recent time trend than covered in the related literature, 2010-2016, tracking 415,000 patients with 17 million claims over this period. We further complement earlier studies by focusing on the largest segment of the commercial insurance market, namely PPOs, where enrollees have more freedom in choosing physicians, as compared with closed-panel managed care plans such as HMOs. We provide the first national estimates of a causal relationship between physician integration and care fragmentation in the PPO market.

To address this issue, in our analysis we combine three different strands in the literature analyzing healthcare markets, namely impacts of vertical integration on market outcomes, measuring market fragmentation, and use of mover-stayer strategies for model identification. Empirically, we exploit the fact that hospital-physician integration varies dramatically across Metropolitan Statistical Areas (MSAs), and that our data allow us to observe patient migration across MSAs. Specifically, we examine whether randomly moving to MSAs with a higher level of financial integration of hospitals and primary care physicians results in improved clinical integration on behalf of patients. While we confirm prior findings of vertical integration leading to higher fees for office-based services, we uniquely show that in randomly assigned cross-market moves, general care fragmentation and out-of-network use decline, and preventive care utilization increases at higher rates of financial integration, pointing at improved clinical integration. Importantly, these were findings that were coupled with reduced inpatient care utilization and spending declines. Again, unlike prior studies that focused primarily on Medicare participants, we focus on the theoretically more relevant commercial segment of the market. Finally, to account for heterogeneous effects of integration, we extend the dynamic event study design of Sun and Abraham (2021) to mover-stayer analyses, thereby avoiding the biases inherent in standard two-way fixed effects models.

The rest of the paper proceeds as follows. Section II provides a background on vertical integration of physicians and care fragmentation. Section III lays out the empirical framework, including data and sample descriptions, followed by a discussion of the dynamic event study strategy and related variable specifications. Section IV presents descriptive results comparing stayers to movers, event study results, and difference-in-differences results. Finally, we discuss implications in Section V. Proofs and additional detail on variable construction are available in

the Appendix.

II. Background

Vertical integration and market outcomes. Multiple studies have shown an association of vertical integration of hospitals and physicians with higher prices, costs and medical spending (McWilliams et al., 2013, Baker et al., 2014, Robinson and Miller, 2014), Burns et al., 2015, Neprash et al., 2015, Conti et al. 2016, Koch et al., 2017, Pesko et al., 2018). Physician office prices increased by 14% after acquisition, with 45% of that due to Medicare allowing facility fees for physician visits in hospital outpatient departments (HOPDs) (Capps, Dranove, and Ody, 2018). For imaging procedures, prices were 150 to 250% higher in HOPDs than in offices (Higgins, Veselovski, and Schinkel, 2016).

Few papers have adequately modeled the efficiency gains or quality improvements that might possibly accompany these higher prices in vertically integrated health systems (Post, Buchmueller, and Ryan, 2018). A recent meta-analysis of the 29 latest papers on the topic graded 59% of them as having low or very low quality of evidence in terms of weak methodologies. None were rated as high quality (Machta et al., 2018). Given the paucity of research, there is a lack of consensus on the benefits of physician integration among policy-makers and industry observers, as reviewed in a comprehensive report by the Medicare Payment Advisory Commission (MedPAC, 2020) and recent health policy editorials (Blumenthal, 2020; Kronick, 2020).

Harmful effects of market fragmentation? The goal of clinical integration is to better coordinate care between the patient's various physicians, improve information sharing between providers, and avoid costly duplication of services which may be harmful to patients. Recent cross-sectional evidence suggests that fragmentation is associated with increased costs of care, a higher probability of deviating from clinical best practice, and higher rates of preventable hospitalizations (Frandsen, Joynt, Rebitzer, and Jha (2015); O'Malley et al. (2019); Hussey et al. (2014); and Barker, Steventon, and Deeny (2017)). In a related cross-sectional study McWilliams et al. (2013) found that in 2009, compared with small medical group practices, large-sized independent group practices had lower Medicare spending per person when a large share of their members were PCPs and higher spending when they included relatively few PCPs. Zhang et al. (2021) found that Medicare patients whose PCPs switched from small to

large group practices experienced a 16% reduction in overall utilization of services, primarily driven by fewer PCP visits and inpatient admissions.

However, identification of the effects of care coordination in a variety of outcomes is made difficult by potential selection of patients by providers, based on demand-side characteristics that may not be observable in facility-based or insurance claims data. To address this issue and better identify a causal effect between reduced fragmentation and lower spending and utilization, Agha et al. (2018) introduce patient migration analyses to examine changes in primary care-specialist referral patterns after a geographic move by Medicare beneficiaries. They show that there are potential cost-savings and value associated with greater clinical care coordination, especially in terms of primary care physicians referring to more concentrated teams of specialists. Similarly, Agha, Ericson, and Zhao (2020) show that moving to a region with regional organizational concentration greater by one standard deviation (measured by the degree to which a patient's outpatient visits are concentrated within organizations in the region) is associated with a 4.6% decline in spending. Similarly, Baker, Bundorf, and Royalty (2019) find that annual Medicare spending declined by 28% after patients relocated and switched from single to a multi-specialty primary care group practices. They speculate that better care coordination between PCPs and specialists reduces hospital spending.

Impact of vertical integration on reducing market fragmentation. The recent evidence on this has been mixed. Brot-Goldberg and de Vaan (2019) have shown that vertical integration involving orthopedic group practices led to direct investments in multi-specialty teams and care coordination between surgeons and PCPs. Moreover, they also identified cost reductions in well-integrated systems. While these results appear to conform with theoretical expectations, certain aspects of vertical integration in healthcare markets may conversely contribute to increased fragmentation. For instance, a surge in consolidation of physicians into systems has spawned a countervailing expansion in single-service line providers outside of these systems (Eickholt, 2020). Examples include Ambulatory Surgery Centers (ASCs), urgent care facilities, retail clinics, telemedicine, and freestanding emergency departments (Richards, Seward, and Whaley (2020); and Ho, Xu, and Akhter (2019)). With that, a causal link between physician-hospital financial integration and clinical integration had not been established in the previous literature. This leads us to consider mover-stayer analyses and patient migration as an identification strategy.

Mover-Stayer Models of Integration. Previously, Agha, Frandsen, and Rebitzer (2019) use Medicare patient migration analysis to document large variation in fragmentation across hospital service areas from 2000 to 2010. They show that 60% of the regional variation in fragmentation was due to the supply-side factors, notably provider concentration and service density. Moreover, moving to a region with a one standard deviation lower level of fragmentation for Medicare beneficiaries decreased care utilization by 10%. Our current study builds on and extends their study in several important dimensions. First, we focus on the commercially insured segment of the market (PPOs), rather than Medicare. Second, we exploit the structure of private markets, and use employment-based transfers to instrument moves between market areas. Third, we track integration of PCPs and specialists separately, as well as combined. Fourth, we apply the dynamic event study methodology in Sun and Abraham (2021). This allows us to estimate models where the effects of vertical integration on care coordination can be heterogeneous across patients and time. Fifth, we focus on a more recent period (2010-2016).

PPOs offer a number of advantages for this study. In addition to being the most common plan type in commercial markets, enrolling 47% of covered workers in 2020 (Kaiser Family Foundation, 2020), their benefit structure allows us to observe the full spectrum of physicians in both vertically integrated and non-integrated settings. PPOs also allow a cleaner analysis of transaction prices unlike HMOs, where prices are capitated and bundled across services. Finally, PPO plans cover visits to a variety of outpatient settings other than physician offices (e.g., Ambulatory Surgery Centers, urgent care facilities, and retail clinics), which will allow us to measure market fragmentation more fully. We do this independently of, and controlling for, other supply-side factors such as ACOs and medical group size.

III. Empirical Framework

A. Data and Study Population

The main patient data consist of the IBM Watson Health MarketScan Commercial Claims and Encounters database. This database assembles complete insurance claims for approximately 100 medium-size and large employers previously used in population-based studies (Zhou et al., 2005; Hansen and Chang, 2011), and it reports actual transaction prices paid by patients and insurers. Prices were inflation adjusted to 2016 dollars and then adjusted for local differences

by the wage index from the CMS Cost Reports. We measure the extent of hospital-physician integration as the percentage of all practicing physicians in the MSA that are in practices *owned* by a hospital or integrated health system. We similarly construct separate measures for integration of primary care physicians (PCPs) and for specialist integration. Vertical ownership and ACO membership of physician practices are derived from IQVIA's SK&A data, which are well validated by national data organizations, e.g., AHRQ (Kronick et al., 2016; Kimmey et al., 2019). We also use these data to construct the Herfindahl-Hirschman Index (HHI) for physician groups in the MSA, using a method similar to that of Dunn and Shapiro (2014), as described in Appendix B. The American Hospital Association (AHA) Annual Survey is used to construct the hospital HHI. Finally, the Managed Market Surveyor File from HealthLeaders Interstudy data (Decision Resources Group, LLC) provided the insurer HHI. Census tract data from the American Community Survey are used to control for the demographics of the MSA.

We extracted all claims of non-elderly adult employees and dependents who were enrolled in PPOs during 2010 to 2016. PPOs allow analyses of well-defined transaction prices, in contrast with HMOs, where payments to providers are bundled across services and visits. Note that Neprash et al. (2015) similarly focused on PPOs claims data when analyzing the association between physician pricing and financial integration.³

Movers were defined as those who maintained a PPO plan with the employer but moved to a different MSA once during the study period. Those who changed plans or moved more than once were not included in the sample. As a control group, we drew a random 30% sample of stayers (non-movers) who were continuously enrolled in a PPO during the period. All movers and stayers were identified from the full 7-year period. To balance the data, we subset the movers to those who moved during 2012 to 2014, so that each mover has a minimum of two years before or after the year of the move. Table 1 shows that initially, stayers and movers were very similar in characteristics. In particular, both cohorts were located in MSAs with the same level of physician integration at the beginning of the period (22%). Our final sample includes 365,057 stayers and 49,980 movers in 382 MSAs, with a total of 2.9 million person-year

³ While Neprash et al. use the practice Tax Identification Numbers (TINs) in Medicare FFS data to identify integration, we do not use this approach given that many physicians do not participate in Medicare FFS, hence do not appear in those data. We observe that 18% of the SK&A physicians are not found in the Medicare Provider Enrollment, Chain and Ownership System (PECOS) database (See Technical Appendix A).

observations.

B. *Variable Specifications*

Our main independent variable, Δ_i , is the change in physician integration that the mover i experiences: the average proportion of the destination MSA's primary care doctors that are integrated, after the move, minus the average proportion in the origination MSA prior to the move. The distribution of Δ_i is shown in Figure 2. For stayers, Δ_i is normalized to zero. Among movers, 20% relocated to an MSA with a lower level of integration, 80% moved to an MSA with a higher level of integration. For movers to a lower-integration MSA, reduction in integration is 10 percentage points on average. For movers to a higher-integration MSA the average increase is 15 percentage points. At the mean integration level of .28, moves to lower-integration or higher-integration MSAs correspond to a relative decrease of 36% (.10/.28) and a relative increase of 53% (.15/.28) in the integration measure, respectively.

We consider several general measures of care fragmentation or coordination. The first two measures in (1) and (2) below measure dispersion of patient care across the patient's physicians (Pollack et al. 2016). In the first measure, we follow Agha, Frandsen, and Rebitzer (2019) in defining fragmentation as the complement of concentration of the patient's care over different physicians; That is, we take the HHI of the flow of the patient's claims over all the outpatient providers the patient visited during the year,

$$fragmentation_{it} = 1 - \sum_{d=1}^D share_{itd}^2 \quad (1)$$

where the share is doctor d 's share of patient i 's claims in year t , and where $D(i,t)$ abbreviated as D is the total number of doctors that the patient visits in that year. When the patient gets all care from one doctor, the fragmentation is zero. When the care is equally divided among an increasing number of doctors, the fragmentation approaches 1. Frandsen, Joynt, Rebitzer, and Jha (2015) have validated this fragmentation measure in (1) as a measure of care coordination among commercially-insured patients. They show that as fragmentation declines, spending declines and overutilization and duplication decline. Second, we consider a similar measure of care coordination often used in the clinical literature (Bice and Boxerman, 1977):

$$Bice - Boxerman\ coordination_{it} = \frac{\sum_{d=1}^D (share_{itd}^2) - D}{D(D-1)} . \quad (2)$$

This ranges from 0 (uncoordinated) to 1 (perfectly coordinated). For the measures in (1) and (2),

we will subset to the 1.1 million person-year observations from plans across 382 MSAs with complete provider id's.

In addition to the measures described in (1) and (2), for comparison, we also focus on a measure of the extent of basic care provided by specialists (henceforth “percent specialty care”) as the percent of all annual office visit claims that are for specialists. We also will examine preventive care visits, flagged by the preventive care CPT-4 and HCPCS codes 90672-90756, 99381-7, 99391-7, 99406-12, 99420, 99429, G0376, G0396-7, G0402, G0436-9, G0442-7, G0450, G0473, H0021-30, S0610-13, and S5190. Finally, we develop a binary out-of-network indicator that is equal to 1 if any claim is out-of-network for the year.

C. Estimation Strategy

We wish to estimate how much physician financial consolidation into hospital based organizations, i.e. vertical integration, impacts the level of clinical integration received in the patient's care. For a causal analysis, we will follow the event study methodology for analyzing movers and their utilization as developed in Finkelstein, Gentzkow, and Williams (2016), Agha, Frandsen, and Rebitzer (2019), Agha, Ericson, and Zhao (2020), Hull (2018), Molitor (2018), and Godoy and Huitfeldt (2020). While most of these papers focus on the Medicare population where patients might opt to move for health care reasons, here we focus on non-elderly adults who receive commercial insurance coverage through an employer's plan. In particular, we observe individual relocations within the 7-years period that occurred across MSAs, but within the same firm (job transfers). These moves are likely exogenous with respect to the mover's health state or specialty care preferences. In robustness checks we rerun the models excluding all adults under age 27 who maintain policies as dependents of policy holders (17% of adult movers), and hence are likely to move independently of the policy holder. Our results do not change.

Our event study equation will follow the general notation of Sun and Abraham (2021), modified to include the mover's change in integration. In particular, we will use the mover's change in integration Δ_i as a market-specific scaling factor interacted with the set of event time dummy variables in the following two-way fixed effects (TWFE) dynamic specification:

$$Y_{it} = \alpha_i + \lambda_t + \sum_{\substack{\ell \neq -1 \\ -4 \leq \ell \leq 4}} [\mu_\ell \Delta_i * D_{it}^\ell] + X_{it}\gamma + \varepsilon_{it} \quad (3)$$

where Y is the outcome of interest (e.g., fragmentation or coordination) observed for enrollee i in year t ($t=0, \dots, T$), α_i is an enrollee fixed effect, λ_t is the year fixed effect, and where event time dummy $D_{it}^\ell = I\{t - E_i = \ell\}$ is an indicator for enrollee i being ℓ years away from her move in year E_i at calendar time t ($\ell = 0$ in the year of the move). X represents other covariates. The main coefficients of interest are the μ_ℓ 's on the mover's change in integration interacted with the event time dummies. Following the literature's convention, the omitted category for the event time dummies is given by the year prior to the move ($\ell = -1$), and μ_ℓ is normalized to zero for stayers. Model (3) is estimated with the standard errors clustered at the enrollee level. The X covariates in all regressions are 4 age categories, sex, 27 comorbidities, copayment rate, the MSA's percent of physicians in ACOs, the average medical group size in the MSA, the MSA's percent elderly, MSA percent below poverty, MSA unemployment rate, and the number of physicians per 100,000. We also control for MSA market forces: insurer HHI, physician HHI, and hospital HHI.

While the past literature on mover analyses has focused only on the two-way fixed effects (TWFE) model in (3), recent research has shown that this leads often to biased estimates of the treatment effect (Borusyak, Jaravel, and Spies, 2021; Sun and Abraham (2021); de Chaisemartin and D'Haultfoeuille (2020); Callaway, Goodman-Bacon, and Sant'Anna (2021); and Callaway and Sant'Anna (2018)). The TWFE estimate of one period's treatment effect can often be contaminated by the treatment effects occurring in other periods. To correct for this, we will not use the TWFE estimator of (3), but will use a modified version of the Interaction-Weighted (IW) estimator of Sun and Abraham (2021). To do this, we first must modify Sun and Abraham's definition of cohort average treatment effects on the treated (CATT). We have four cohorts, e , in our paper, based on the year they moved: $e = \{2, 3, 4, \infty\}$ (corresponding to calendar years $\{2012, 2013, 2014, \infty\}$), where ∞ are stayers. Let $Y_{i,t}^\infty$ be the baseline outcome for enrollee i at time t if they had never moved. For movers, $Y_{i,t}^\infty$ is the unobserved, counterfactual outcome (e.g., fragmentation in care) at year t , both before and after the move.

Definition 1. The cohort-specific average treatment effect on the treated (CATT) for cohort e at ℓ periods from the move year E_i is

$$CATT_{e,\ell} = E(Y_{i,e+\ell} - Y_{i,e+\ell}^{\infty} | E_i = e). \quad (4)$$

Define the incremental CATT to be

$$ICATT_{e,\ell} = E\left(\frac{(Y_{i,e+\ell} - Y_{i,e+\ell}^{\infty})}{\Delta_i} \middle| E_i = e\right). \quad (5)$$

Define the marginal CATT to be

$$MCATT_{e,\ell} = \frac{\partial CATT_{e,\ell}}{\partial \Delta_i}, \quad (6)$$

where the expectations are over enrollees, i . This CATT definition is from Sun and Abraham (2021). Here, we also use ICATT, which is the average change in outcome, relative to not moving, per percentage point increase in vertical integration for a cohort of movers. Assuming Y is differentiable, we also define the marginal CATT with respect to Δ_i . Callaway, Goodman-Bacon, and Sant’Anna (2021) similarly compare ATT to the “marginal ATT,” which they refer to as the “average causal response on the treated.” Empirically, we have no movers with no change in integration ($\Delta_i = 0$), so ICATT is well defined. Sun and Abraham deal with the canonical case where $\Delta_i = 1$ in equation (3). We are introducing varying magnitudes of treatment across movers by allowing Δ_i to vary by mover in (3). However, using ICATT instead of CATT, all of Sun and Abraham’s results hold for this more general mover model under some modified assumptions, which we now state:

Assumption 1 (*Independence of Baseline Outcomes from Moving*). The change in vertical integration from randomly moving is independent from baseline outcomes: $\text{cov}(\Delta_i, Y_{i,t}^{\infty}) = 0$.

Assumption 2 (*Parallel Trends in Baseline Outcomes*). For all $s \neq t$, the $E(Y_{i,s}^{\infty} - Y_{i,t}^{\infty} | E_i = e)$ is the same for all e .

Assumption 3 (*No Anticipatory Behavior Prior to Treatment*). There is no treatment effect in pre-treatment periods, i.e., $E(Y_{i,e+\ell} - Y_{i,e+\ell}^{\infty} | E_i = e) = 0$ for all $\ell < 0$.

Assumption 4 (*Stationary Baseline Outcomes*). For all $s \neq t$, $E(Y_{i,s}^\infty - Y_{i,t}^\infty \mid E_i = e) = 0$.

Assumptions 2 and 3 are standard from Sun and Abraham. Without our Assumption 1, Assumptions 2 and 3 would need to be divided by Δ_i within the expectations. Next, we present our analog of Sun and Abraham's Proposition 2 on the decomposition of TWFE estimators into ICATT components. While their Proposition 2 relies on Assumption 2 (parallel trends), here we will need a stronger version of parallel trends, Assumption 4, stationary baseline outcomes. The reason for this is that in general we have the case that $E(\Delta_i D_{it}^\ell) \neq E(\Delta_i)E(D_{it}^\ell)$. This prevents a closed form decomposition from being readily obtained. However, if baseline outcomes are not changing in time, we can derive Sun and Abraham's closed form decomposition as follows. The main point is that even with this strong Assumption 4, we still have TWFE estimators being contaminated.

Proposition 1 (*TWFE Decomposition for Mover Models*). Under Assumption 1 (exogenous baselines) and the stationary baseline Assumption 4, the TWFE estimator for (3) can be decomposed as follows

$$\mu_\ell = \sum_e w_{e,\ell} ICATT_{e,\ell} + \sum_{\substack{\ell' \neq \ell \\ -4 \leq \ell' \leq 4}} \sum_e w_{e,\ell'} ICATT_{e,\ell'} \quad (7)$$

where the weights, $w_{e,\ell}$, sum to 1 and are the TWFE estimators for

$$\Delta_i D_{it}^\ell 1\{E_i = e\} = \alpha_i + \lambda_t + \sum_{-4 \leq \ell \leq 4} w_{e,\ell} \Delta_i D_{it}^\ell + X_{it}\gamma + \varepsilon_{it} \quad (8)$$

Proof: see Appendix C.

Proposition 1 shows that all the results from Sun and Abraham's Proposition 2 on TWFE estimates hold under our mover model with stationary baseline outcomes. From (7) we see that the coefficient on the relative time event ℓ (e.g., ℓ years after the move) is not a weighted average of the ICATTs at ℓ over the mover cohorts (e.g., first term on the right side of (7)), but is a weighted average over the ICATTs from *all* relative time events. Thus, μ_ℓ

does not measure the average ICATT at ℓ if treatment effects are heterogeneous (e.g., $ICATT_{e,\ell} \neq ICATT_{e,\ell'}$). In such a case, μ_ℓ is contaminated by the ICATTs for the other relative time events. Moreover, some of the weights in (8) may be negative and result in summations over non-convex combinations of weights in (7). Next, we show that Sun and Abraham's Interaction-Weighted (IW) estimator resolves this bias even under our mover model.

Proposition 2 (*IW Estimator for Mover Models*). *Under Assumption 1 (exogenous baselines), Assumption 2 (parallel trends), and Assumption 3 (no anticipatory behavior), then*

(a) *The DID estimator $\hat{\delta}_{e,\ell}$ for the regression with cohorts interacted with the relative time events scaled by the change in integration,*

$$Y_{it} = \alpha_i + \lambda_t + \sum_{e \neq \infty} \sum_{\ell \neq -1} \delta_{e,\ell} \Delta_i D_{it}^\ell * 1\{E_i = e\} + X_{it}\gamma + \varepsilon_{it}, \quad (9)$$

is a consistent estimator of $ICATT_{e,\ell}$; and

(b) *The Sun-Abraham IW estimator*

$$\hat{v}_\ell = \sum_{e \neq \infty} \hat{\delta}_{e,\ell} \widehat{Pr}(e, \ell) \quad (10)$$

is a consistent estimator of a convex average of the $ICATT_{e,\ell}$'s for ℓ , where the weights $\widehat{Pr}(e, \ell)$ are estimated as the sample shares of each mover cohort e at relative time ℓ .

Proof: see Appendix C.

Note that the IW estimator $\hat{v}_\ell$ in (10) is now free from ICATT estimates from other relative time periods, unlike the TWFE estimate μ_ℓ in (7). We will use this IW estimator throughout the paper, for both dynamic and static models. Now that we have the basic theory, we will extend the application of the IW estimator to cover more general cases typically seen in the mover-stayer literature. First, following many examples in that literature we add unscaled time event dummies to the basic TWFE model in (3), as such:

$$Y_{it} = \alpha_i + \lambda_t + \sum_{\ell \neq -1} (\mu_\ell \Delta_i + \theta_\ell) * D_{it}^\ell + X_{it}\gamma + \varepsilon_{it} . \quad (11)$$

To adapt the IW model to this, we incorporate the coefficient θ_ℓ into (9):

$$Y_{it} = \alpha_i + \lambda_t + \sum_{e \neq \infty} \sum_{\ell \neq -1} \delta_{e,\ell} \Delta_i D_{it}^\ell * 1\{E_i = e\} + \sum_{\ell \neq -1} \theta_\ell * D_{it}^\ell + X_{it}\gamma + \varepsilon_{it}. \quad (12)$$

In this case, $\hat{\delta}_{e,\ell}$ no longer estimates $ICATT_{e,\ell}$, but, instead, $\hat{\delta}_{e,\ell} E(\Delta_i | e) + \hat{\theta}_\ell$ estimates $CATT_{e,\ell}$, as defined in (4). Thus, $\hat{\delta}_{e,\ell}$ in this case estimates the marginal effect $MCATT_{e,\ell}$, as defined in (6). So, $\hat{\delta}_{e,\ell}$ is an estimate of the marginal contribution of the change in vertical integration to the average treatment effect of the move for cohort e at ℓ years after the move, while θ_ℓ estimates the contribution of the “hassle” effect of the move (e.g., a delay in finding a new doctor, adjusting to a new geographic location after the move, etc.). Using the IW estimator in (10) applied now to the $\delta_{e,\ell}$ ’s in (12), we then have $\hat{v}_\ell E\Delta_i + \hat{\theta}_\ell$ estimating the weighted average of the treatment effects of moving after ℓ years since the move, with $\hat{v}_\ell$ as the weighted average of the marginal MCATT effects of the change in vertical integration.

To present these dynamic effects, for each outcome we will graph the dynamic estimates $\hat{v}_\ell$ over the event time horizon for ℓ (Figures 3-5). To further simplify the presentation of these estimates for tables comparing multiple outcome regressions, the mover-stayer literature often uses the static version of (11), which takes the form

$$Y_{it} = \alpha_i + \lambda_t + \mu \Delta_i post_{it} + \sum_{\ell \neq -1} \theta_\ell * D_{it}^\ell + X_{it}\gamma + \varepsilon_{it}, \quad (13)$$

where the 0/1 variable $post_{it}$ indicates the years after the move as $post_{it} = I$. The static version of the IW estimator in (12) is then

$$Y_{it} = \alpha_i + \lambda_t + \sum_{e \neq \infty} \delta_e \Delta_i post_{it} * 1\{E_i = e\} + \sum_{\ell \neq -1} \theta_\ell * D_{it}^\ell + X_{it}\gamma + \varepsilon_{it}, \quad (14)$$

$$\hat{v} = \sum_{e \neq \infty} \delta_e \widehat{Pr}(e, post) . \quad (15)$$

The Pr weights in (15) are estimated as the sample shares of each mover cohort e in the post

period. We will refer to (15) as the static IW difference-in-differences estimate. In this case, $\hat{\delta}_e = MCATT_{e,post}$, the version of MCATT in (6) defined over the entire post period for e . We estimate all the IW estimators by using the Stata package “eventstudyinteract” by Sun (2021) that we have modified to handle our mover model. We also estimate the TWFE weights of (8) using the Stata package “eventstudyweights” by Sun (2020). For the TWFE causal estimates of (3), we use the Stata package “reghdfe” by Correia (2017).

IV. Results

Figure 1 shows large geographical variation in the overall integration of physicians into hospital systems across the nation’s 6,715 Primary Care Service Areas (PCSAs) in 2016. This variation remains when we aggregate up to the MSA level. Table 2 shows the quintile distribution of physician-hospital integration across all 382 MSAs in our sample in 2016. There is enormous three-fold geographical variation, ranging from 21% to 63% of primary care physicians being owned by hospitals, and from 19% to 45% for specialty physicians. Corroborating the recent literature on integration (Capps and Dranove, 2018), we see that raw E&M visit prices increase with integration, from \$179 to \$209. However, unlike the literature, we find that annual spending per person does taper off with integration, roughly from \$9,800 to \$8,800 from quintile 3 to 4. This drop off may indicate some cost efficiencies under integration. In particular, we see signs of clinical integration, with care fragmentation dropping from .51 to .40 from quintile 1 to 5. Similarly, out-of-network use, lab/imaging utilization, and inpatient utilization decline with integration. However, we do not know how much of this raw regional variation in 2016 is due to variation in patient health.

A. Event Study Analyses

By taking advantage of the enrollee’s exogenous move to a different MSA, we are able to tease out patient demand-side effects and to estimate the causal impact of changing market integration levels. In Figure 3, we estimate the event study equations (3) and (9)-(10) for the care fragmentation index defined in (1). We see a steep and sustained drop off in care fragmentation for both the IW and TWFE estimators. Roughly, for every percentage point increase in integration due to the move, there is a causal 0.25 percentage point drop in fragmentation, i.e., a 10 percentage point increase in integration means a 2.5 percentage point drop in fragmentation.

Equivalently a move from the 10th percentile of integration (.12) to the 90th percentile (.47) results in a 9 percentage point drop in fragmentation, or a 20% relative drop in fragmentation ($p < .01$).

In Figure 4's representation of an event study, we see that the decrease in fragmentation of care is accompanied by an increase in the Bice-Boxerman Coordination of Care index when one moves to a more integrated location. Since fragmentation declines and coordination increases with integration, we expect to observe additional signs of clinical integration, with more of a focus on primary care. In Figure 5, we see that the percent of care that is specialty care declines after a move to a more integrated area. Not shown, for all the TWFE coefficients in (7), other than the final μ_4 , all the weights $w_{e,\ell}$ on the ICATTs are non-zero, with about 47% being negative. Thus, the TWFE estimates for each relative time period regularly involve the non-convex combinations of ICATTs from all other time periods. While this level of contamination causes some degree of bias as seen in Figures 3-5, the IW estimated event dynamics are still very close to the TWFE estimates. For fragmentation and coordination, the TWFE bias causes underestimation pre-move and over-estimation post-move, especially at the outer leads and lags. IW corrects for this bias due to heterogeneous treatment effects of integration across cohorts and time. Overall, we can conclude that the decline in fragmentation and rise in coordination caused by moving to a more integrated area is not artificially due to the bias under TWFE.

B. Difference-in-Differences Analyses

In the event studies of Figures 3 to 5, we observe that the movers and stayers have parallel pre-move trends and the movers have no anticipatory effects. This allows us to focus on the IW model in equations (14) and (15), namely the relatively simple difference-in-difference estimation using change in integration Δ_i interacted with a *post* dummy for the period after the move, and thus avoid the complexity and bias inherent in models with numerous event time dummies and interactions. We will now present all remaining results using the difference-in-differences model. This reduced form will allow us to decompose Δ_i into one for primary care integration and one for specialist integration.

In Table 3, a move to a more integrated area in either primary care or in specialty care both lead to less fragmentation and more coordination of care ($p < .01$). Specialty of care integration has a stronger effect than primary care. IW dampens this difference, reducing the

bias towards specialty care under TWFE. Next, as to be expected, an increase in specialty care integration leads to an increase in the percent of care being specialty care, while primary care integration leads to a decrease in the percent of care being specialty care. Despite these countervailing effects of the two types of integration on percent specialty care, the primary care integration effect dominates. That is, there is an overall shift to more primary care when one moves to a more integrated area in general.

Finally, not shown, we ran some robustness checks on Table 3. All of the above results are robust if we exclude the policyholder's children that are dependents aged 18 to 26 and could possibly be living elsewhere, such as college students. Also, the results are not driven by biases in the patient comorbidities. Song et al. (2010) and Fadlon and Van Parys (2019) have shown that receiving a diagnosis can vary geographically for movers. Since our results are stronger without comorbidities, the remaining of the paper will include the comorbidities in the regressions to risk adjust our outcomes.

While Table 3 shows that the reduction in care fragmentation under integration was accompanied by an overall shift away from specialty care towards more primary care, Table 4 demonstrates that integration also involves a shift away from sites of care “outside” integrated physician-hospital settings. For instance, visits to ambulatory surgery centers (ASCs), urgent care centers, and retail clinics decline when one moves to a more integrated area ($p < .01$), as do out-of-network visits. At a more granular level, these results are largely driven by the integration of specialists (third row), rather than PCP integration. An exception occurs in the case of the reduction in urgent care utilization, which is driven by PCP integration. Generally, moving to a more integrated area means moving to a less fragmented outpatient market.

In Table 5 we examine heterogeneity in the effects of primary care integration which may be sensitive to gender, as well as prescription drug use. While some gender-related differences are observed (e.g., female movers are more likely to experience significant reductions in non-maternity hospitalizations and generic drug prescriptions compared with male movers)⁴, the general pattern of results is similar across genders. Firstly, for both men and women, moves to areas with greater PCP integration are associated with significantly higher use of preventive care, whereas moves to areas with greater specialist integration are associated with

⁴ Not shown, the difference in the inpatient visit effect under total integration for women vs. men is significant at the $p = .025$ level, but not significant for generic medication use.

significantly lower use of preventive care. Secondly, results appear to be sensitive to the type of physician integration (PCP vs specialist) observed, with specialist integration being the more dominant factor in reducing out-of-network claims, lab and imaging claims, and overall use of prescription drugs. Not shown, the difference in the preventive care effect under total integration between men and women is significant at the $p=.06$ level. Other minor variations occur in that PCP integration contributes to greater use of prescription medications in men (but not women), and while the annual number of lab and imaging claims decreases in specialty care integration for both genders, this effect is larger among men ($p=.05$).

In Table 6, we see that the only net cost-savings from the increased coordinated care coming from primary care integration is with the reduction in non-maternity inpatient stays for women ($p<.05$). The difference in this effect between women and men is significant at $p=.03$. However, overall, moving to an area with more primary care integration increases total spending ($p<.01$), due to increased outpatient spending. In contrast, moving to an area with more specialist integration decreases total spending ($p<.01$), due to decreased outpatient and drug spending. This aligns with the reductions in utilization in Table 5 under specialist integration. Office prices in Table 6 increase substantially when one moves to more integrated areas. A move from the 10th percentile of integration (.12) to the 90th percentile (.47) results in an 11% increase in office prices ($e^{(.47-.12).29} - 1$) ($p<.01$). Overall, the countervailing effects of primary care and specialist integration on spending mitigate each other, such that there are no overall net cost savings under integration.

C. Mechanisms of Care Transformation

So far, we have shown that moving to a more vertically integrated MSA generally transforms patient care in the direction of less fragmentation and greater coordination, the organizational mechanisms used in achieving this transformation. However, it may be the case that high degrees of hospital-insurer integration are correlated with other organizational characteristics found in MSAs. Thus, the mechanisms of achieving that transformation remain to be verified. To explore this we are able to examine two major characteristics, namely physician participation in ACOs, which are looser contractual arrangements with systems as compared with outright ownership, and physician affiliation with large group practices where there may be benefits (or drawbacks) due to scale. From Table 7, increases in the levels of vertical integration in markets

appear to correspond to increases in physician affiliation with ACOs and large groups as well (We use the definition of large set at >30 following Zhang et al. (2021)). Not shown, 36% of integrated physicians belong to large practices, while 52% of large practices are integrated with hospitals. This raises the possibility that integration might really have nothing to do with our care coordination results, and that the improved care coordination is simply due to the movers switching unobservably from small to large practices when they relocate to more integrated areas.

To examine this, in Tables 8 and 9 we compare the impacts of the various organizational mechanisms (vertical integration, ACO, group practice), estimated separately and combined. Each table refers to outcomes that were shown to have improved (from the perspective of reduced fragmentation) in the previous tables. Table 8 focuses on PCP affiliations, while Table 9 focuses on specialty care. Note that the scaler Δ_i is calculated separately for each organizational mechanism in each model.⁵

Turning to the top panel of Table 8, we observe that in contrast with our baseline result for PCP integration, ACO affiliations tend to increase fragmentation, particularly in terms of the overall measure and site of care (external facility). However, large group affiliations appear to yield results that are qualitatively similar (albeit weaker) to those associated with the equation with only integration (compare the third and first rows), significantly for the outcomes fragmentation, percent specialty care, and inpatient visits for women. However, in the model that jointly controls for changes in all the organizational forms, the effects of group affiliation virtually disappear, yet the effects of PCP integration are virtually unchanged compared to the baseline model. The stability of these results lends further confidence to our previous findings. The remaining results on moving to higher ACO penetration also remain stable. Finally, in the bottom panel of Table 8, a more granular analysis shows that in general the integration effect operates through the integration of small group practices ($n \leq 30$), as opposed to large group practices.

The same basic results hold in Table 9 for the organizational characteristics of specialists:

⁵ The three Δ_i terms combined in the middle panel of Table 8 appear in (14) as $y = \sum_{e \neq \infty} [\delta_{e,vi} \Delta_i(pcp\ integration) + \delta_{e,org} \Delta_i(pcp\ large\ org) + \delta_{e,aco} \Delta_i(pcp\ ACO)] post_{it} + \dots$, where, for example, $\Delta_i(pcp\ large\ org)$ is defined as the change in the MSA's percentage of doctors in large practices under a move.

vertical integration leads to significant reductions in the overall fragmentation index and in use of external sources of care, while ACO affiliation tends to increase fragmentation, with results generally consistent across specifications. Similar to ACOs, moving to an area with more specialists organized in large practices leads to greater fragmentation by most measures, while leaving the vertical integration results stable. Put together, all of the results in Table 8 and Table 9 support the conclusion that our basic findings with respect to the efficacy of vertical integration are not affected by the growth in ACOs or by the scale of physician group practices in the areas that patients move into. In essence, vertical integration of physician practices in hospital-centered organizations leads to less fragmentation, whereas the presence of horizontally consolidated forms of physician organizations leads to more market fragmentation.

At a more granular level, we further account for the size of physician group practices *within* vertically integrated organizations (lower panels in Table 8 and Table 9). In Table 8, we observe that while the effects of small PCP groups and large PCP groups operate consistently in the same direction (fragmentation-reducing) these effects are statistically significant only for small groups. In Table 9, we note that the effects of both small groups and large groups are statistically significant, again, in the fragmentation-reducing direction. A minor exception occurs in total spending, where only large groups have a significant cost-reducing effect ($p < 0.05$). The decrease in total spending that we saw with an increase in specialty integration in Table 6 appears to be occurring only among vertically integrated specialists in large groups, the only outcome where we see a clear overlap between vertical integration and horizontal consolidation of physicians. With that exception, scale and vertical integration have fundamentally different impacts.

V. Discussion

We have shown that moving to a market with greater physician-hospital integration causes a decrease in the fragmentation of patient care, and an increase in the coordination of care for PPO enrollees, when heterogeneity in both patients and market integration are taken into account. Consistent with the general decrease in fragmentation, we also find lower use of single-service line facilities such as ambulatory surgery centers and urgent care facilities as vertical integration increases, even as prices increase. Previous research might not have identified these impacts of integration since many of these effects are certain specific

heterogeneous effects which we identified. Firstly, gender effects, with declines in non-maternity inpatient care among women, and offsetting increases in preventive care among men. Secondly, we see demonstrate that are certain countervailing effects of the integration of primary care physicians versus specialists, particularly in terms of impacts on annual spending. With reduced fragmentation, we would expect large cost savings. We observe this with specialist integration, which drives large reductions in spending and out-of-network use. This may possibly be the effect observed by Agha et al (2018), where more concentrated referrals among specialists reduces use and spending. Integration may be facilitating this type of improved teamwork between PCPs and specialists. Similarly, we may be observing the multispecialty group or large group effect or organizational consolidation effect on cost reductions observed by Baker, Bundorf, and Royalty (2019), Zhang et al. (2019), and Agha, Ericson, and Zhao (2020). In fact, when we estimate integration effects adjusting for practice group size, we observe that the integration of specialists is the main driver in the decline in spending in vertically integrated organizations. On the other hand, we observe that PCP integration raises spending. This is driven in part by higher office prices for E&M visits.

While we have demonstrated that moving to a more integrated market indeed leads to a positive transformation in the patient's care, we are unable to fully disentangle the contribution of other supply-side incentives (beyond what we controlled for, e.g., ACOs and large medical groups), versus demand-side incentives. One can speculate that the insurance plans reacted to integration by narrowing networks to particular providers, e.g., those less prone to care transformation, or by taking direct control of spending. For example, the large reduction in drug spending that we observe with specialist integration seems to be much larger than what we would expect compared with the increase in generics and decrease in the number of prescriptions that we estimate. Anecdotally, it appears that selected employers or insurers were able to negotiate tighter PBM formularies, prices, or rebates in a counter-reaction to the physician integration and that employers are becoming increasingly proactive in managing their plans⁶. Plans in highly integrated markets may be particularly prone to undertaking such reforms, which cannot be observed from transactional claims data.

⁶ In a related example, Rhode Island required insurers to increase primary care's share of total medical spending by 1 percentage point per year from 2010 to 2014 (Kacik, 2020). More recently, it was reported in 2019, PepsiCo incentivized their workers to choose a high-value PCP by covering their health insurance premiums for a year and offering a bonus for choosing such a PCP within the first three months of the year.

Finally, we note that cost savings under integration might not be welfare improving if they are due to quality erosion. While explicitly identifying clinical quality effects was not within the scope of our study, findings from the medical decision sciences literature offer some insights. For instance, Song et al. (2020) find that the vertical integration of gastroenterologists eroded the quality of colonoscopies. Koch et al. (2021) find that physician-hospital integration had no effect on quality, except for small clinical benefits in the treatment of hypertension and diabetes. Scott et al. (2018) saw no improvement in quality of care at hospitals that bought physician practices.

In contrast, Carlin, Dowd, and Feldman (2015) found limited increases in quality in clinics acquired by the hospital, and Short and Ho (2019) found that hospital and physician integration may significantly improve quality for a limited set of processes such as the continuation of beta blockers for surgical patients. Moreover, while fragmentation may increase spending and overutilization, it has been shown to perversely increase quality in the case of Medicare beneficiaries (Frandsen, Joynt, Rebitzer, and Jha (2015); Agha, Frandsen, and Rebitzer (2019)). A possible interpretation is that in less fragmented markets, a variety of organization may foreclose patients from a wider selection of specialists with whom they might find a better match. Another possible explanation we offer is that stand alone single-service facilities such as ambulatory surgery centers and urgent care facilities are better equipped to track and improve specific aspects of care (Eickholt, 2020). Interestingly, Richards, Seward, and Whaley (2020) view the reduction in ambulatory surgery center use in Medicare as a foreclosure effect, rather than a decline in market fragmentation. Noting that our own research avoids this problem by focusing on PPO enrollees who have open choice of doctors and facilities, future research should examine if integration is causing foreclosure, i.e., an actual reduction in the number of high-quality providers.

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Table 1: Sample Statistics

	Means at Start: 2010	
	Stayers	Movers
Female	.53	.52
Age	43 (10)	41 (11)
Number of Chronic Conditions	.42	.41
Annual Spending Per Person	\$6,139 (16,903)	\$6,166 (17,144)
Northeast	.19	.20
North Central	.20	.19
South	.44	.46
West	.17	.15
PCP-Hospital Integration	.22 (.13)	.22 (.15)
Specialist-Hospital Integration	.14 (.08)	.13 (.09)
Care Fragmentation	.43 (.30)	.42 (.30)
N Adults	365,057	49,980
N Adult-Years	2,555,399	349,860

Notes: Non-elderly people enrolled in privately-insured PPO plans from 2010 to 2016 across 382 MSAs. Movers move to a different MSA during the period. Standard deviations in parentheses. MSA=Metropolitan Statistical Area. PCP=primary care physician. Sources: Authors' calculations using MarketScan Data and IQVIA SK&A Data.

Figure 1: 2016 Primary Care Service Area (PCSA) Variation in Physician-Hospital Integration

Table 2: Geographical Variation in Physician-Hospital Integration, Spending, and Care Coordination in Commercial PPOs (2016)

	Quintiles of Physician-Hospital Integration Across MSAs				
	Q1	Q2	Q3	Q4	Q5
Percent of MSA Primary Care Docs Integrated with Hospitals	21% (5)	30% (3)	39% (2)	47% (3)	63% (11)
Percent of MSA Specialty Care Docs Integrated with Hospitals	19% (4)	25% (3)	30% (3)	37% (2)	45% (10)
Average E&M Office Visit Price	\$179 (147)	\$198 (158)	\$185 (142)	\$198 (148)	\$209 (161)
Total Annual Spending per Person	\$9,996 (33,495)	\$10,673 (35,413)	\$9,845 (31,750)	\$8,752 (30,901)	\$9,162 (30,942)
Care Fragmentation Index	.51 (.30)	.52 (.29)	.45 (.31)	.46 (.30)	.40 (.30)
Percent with any Out-of-Network	15% (39)	19% (34)	11% (34)	10% (30)	11% (32)
Annual Number of Lab/Imaging Claims	13 (15)	13 (15)	12 (14)	11 (13)	10 (12)
Annual Number of Inpatient Claims Conditional on Inpatient Use	52 (82)	52 (83)	42 (63)	41 (63)	41 (62)

Notes: 415,037 non-elderly adults enrolled in privately-insured PPO plans from 2010 to 2016 across 382 MSAs, including movers and stayers. Standard deviations in parentheses.

E&M=Evaluation and Management. MSA=Metropolitan Statistical Area. E&M=Evaluation and Management.

Sources: Authors' calculations using MarketScan Data and IQVIA SK&A Data.

Figure 2: Distribution of Changes in the MSA Physician-Hospital Integration Rate Across Moves

Notes: Distribution of the change in the average proportion of the MSA's physicians that are integrated with hospitals between the new and old MSA after the patient moves. Sample: all movers, N=349,860 person-years over 382 MSAs. Sources: Authors' calculations using MarketScan and IQVIA SK&A Data.

Figure 3: Event Study of PPO Enrollees Moving to MSAs with Different Levels of Physician-Hospital Integration: Effects on Fragmentation--TWFE vs IW Estimator

Notes: TWFE=Two Way Fixed Effects estimator. IW=modified Interaction-Weighted estimator of Sun and Abraham (2020). Estimated coefficients are for fragmentation index regressed on the change in the MSA level of total physician-hospital integration between the destination and origination, interacted with 8 event time dummies. 95% confidence bands reported, clustered at the patient level. Time 0 is the year of the move, with the year -1 indicator omitted. Regression controls for person, year, and event time fixed effects, 32 patient characteristics, and 9 MSA characteristics. N=1.1 million, with movers and nonmovers over 382 MSAs. Sources: Authors' calculations using MarketScan and IQVIA SK&A Data.

Figure 4: Event Study of PPO Enrollees Moving to MSAs with Different Levels of Physician-Hospital Integration: Effects on Care Coordination--TWFE vs IW Estimator

Notes: TWFE=Two Way Fixed Effects estimator. IW=modified Interaction-Weighted estimator of Sun and Abraham (2020). Estimated coefficients are for coordination index index regressed on the change in the MSA level of total physician-hospital integration between the destination and origination, interacted with 8 event time dummies. 95% confidence bands reported, clustered at the patient level. Time 0 is the year of the move, with the year -1 indicator omitted. Regression controls for person, year, and event time fixed effects, 32 patient characteristics, and 9 MSA characteristics. N=1.1 million, with movers and nonmovers over 382 MSAs. Sources: Authors' calculations using MarketScan and IQVIA SK&A Data.

Figure 5: Event Study of PPO Enrollees Moving to MSAs with Different Levels of Physician-Hospital Integration: Effects on Percent Specialty Care--TWFE vs IW Estimator

Notes: TWFE=Two Way Fixed Effects estimator. IW=modified Interaction-Weighted estimator of Sun and Abraham (2020). Estimated coefficients are for percent specialty care regressed on the change in the MSA level of total physician-hospital integration between the destination and origination, interacted with 8 event time dummies. 95% confidence bands reported, clustered at the patient level. Time 0 is the year of the move, with the year -1 indicator omitted. Regression controls for person, year, and event time fixed effects, 32 patient characteristics, and 9 MSA characteristics. N=2.9 million, with movers and nonmovers over 382 MSAs. Sources: Authors' calculations using MarketScan and IQVIA SK&A Data.

Table 3: Static Difference-in-Differences Regression Results on
Fragmentation after Moving to a Market with a
Different Level of Physician-Hospital Integration: 2010-2016

	Care Fragmentation Index	Bice- Boxerman Coordination Index	Percent of Care that is Specialty Care
$\Delta_t * post$			
<i>IW Estimator</i>			
Total Integration	-0.217*** (0.016)	0.182*** (0.017)	-0.039*** (0.011)
PCP Integration	-0.064*** (0.019)	0.042** (0.021)	-0.071*** (0.012)
Specialist Integration	-0.200*** (0.029)	0.186*** (0.032)	0.058*** (0.018)
<i>TWFE Estimator</i>			
Total Integration	-0.217*** (0.015)	0.185*** (0.017)	-0.039*** (0.011)
PCP Integration	-0.050*** (0.019)	0.025 (0.020)	-0.068*** (0.012)
Specialist Integration	-0.231*** (0.028)	0.223*** (0.031)	0.053*** (0.018)

Notes: N=1.1 million (2.9 million in col 3) non-elderly adults enrolled in privately-insured PPO plans from 2010 to 2016 across 382 MSAs, including all movers and non-movers.

“Total integration” is the change in the MSA proportion of physicians integrated with hospitals interacted with a post-move dummy. The second set of regressions include changes in both proportions of primary care physicians (PCP) integrated and specialists integrated, each interacted with post.

All regressions control for fixed effects for person and year, as well as age, 27 comorbidities, copayment rate, MSA percent elderly, percent below poverty, unemployment rate, number of physicians per 100,000, percent docs in ACOs, insurer HHI, physician HHI, and hospital HHI.

Standard errors clustered at the patient level are reported in parentheses. MSA=Metropolitan Statistical Area. HHI=Herfindahl-Hirschman Index. IW=Interaction-Weighted Estimator, TWFE=Two-Way Fixed Effects Estimator. Sources: Authors' calculations using MarketScan Data and IQVIA SK&A Data.

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Difference-in-Differences Interaction Weighted (IW)-Estimated Effects of Moving to a Market with a Different Level of Integration on Market Fragmentation

	Any Office Visit (in network)	Any Office Visit (out of network)	Any Treat and Release ED Visit	Any Hospital Outpatient Visit	Any Ambulatory Surgery Center Visit	Any Urgent Care Facility or Retail Clinic Visit
$\Delta_t * post$						
Total Integration	-0.014 (0.010)	-0.038*** (0.007)	0.001 (0.005)	0.238*** (0.013)	-0.051*** (0.007)	-0.045*** (0.007)
PCP Integration	0.013 (0.011)	-0.006 (0.009)	-0.003 (0.006)	0.024 (0.015)	0.007 (0.008)	-0.050*** (0.008)
Specialist Integration	-0.027 (0.017)	-0.037*** (0.013)	0.005 (0.008)	0.255*** (0.022)	-0.072*** (0.011)	0.021* (0.012)

Notes: IW estimates reported. N=2.9 million non-elderly adults enrolled in privately-insured PPO plans from 2010 to 2016 across 382 MSAs, including all movers and non-movers.

“Total integration” is the change in the MSA proportion of physicians integrated with hospitals interacted with a post-move dummy. The second set of regressions include changes in both proportions of primary care physicians (PCP) integrated and specialists integrated, each interacted with post.

All regressions control for fixed effects for person, year, and years relative to move, as well as age, 27 comorbidities, copayment rate, MSA percent elderly, percent below poverty, unemployment rate, number of physicians per 100,000, percent docs in ACOs, insurer HHI, physician HHI, and hospital HHI. Standard errors clustered at the patient level are reported in parentheses. MSA=Metropolitan Statistical Area. HHI=Herfindahl-Hirschman Index.

Sources: Authors' calculations using MarketScan Data and IQVIA SK&A Data.

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Heterogeneity in Difference-in-Differences IW-Estimated Effects of Moving to a Market with a Different Level of Integration on Utilization, by Gender

$\Delta_i * post$	Any Preventive Care	Any Inpatient (non-maternity)	Any Out-of-Network Care	Log(lab and imaging claims)	Log(rx count)	Any generics
<i>All Patients</i>						
Total Integration	0.018 (0.012)	-0.004 (0.005)	-0.100*** (0.010)	-0.251*** (0.029)	-0.019 (0.026)	0.030*** (0.010)
<i>Women</i>						
Total Integration	-0.005 (0.018)	-0.013** (0.006)	-0.108*** (0.014)	-0.182*** (0.039)	-0.015 (0.034)	0.041*** (0.014)
PCP Integration	0.068*** (0.020)	-0.016** (0.008)	-0.040** (0.016)	-0.035 (0.044)	0.041 (0.039)	0.037** (0.016)
Specialist Integration	-0.105*** (0.029)	0.007 (0.011)	-0.067*** (0.025)	-0.177*** (0.065)	-0.056 (0.058)	-0.004 (0.023)
<i>Men</i>						
Total Integration	0.041** (0.017)	0.006 (0.006)	-0.088*** (0.013)	-0.280*** (0.039)	-0.012 (0.036)	0.021 (0.016)
PCP Integration	0.093*** (0.018)	0.004 (0.007)	-0.005 (0.015)	0.022 (0.044)	0.089*** (0.041)	0.015 (0.018)
Specialist Integration	-0.089*** (0.027)	0.002 (0.011)	-0.100*** (0.022)	-0.353*** (0.064)	-0.144*** (0.061)	0.002 (0.027)

Notes: IW estimates reported. N=2.9 million non-elderly adults enrolled in privately-insured PPO plans from 2010 to 2016 across 382 MSAs, including all movers and non-movers.

“Total integration” is the change in the MSA proportion of physicians integrated with hospitals interacted with a post-move dummy. The second set of regressions include changes in both proportions of primary care physicians (PCP) integrated and specialists integrated, each interacted with post.

All regressions control for fixed effects for person, year, and years relative to move, as well as age, 27 comorbidities, copayment rate, MSA percent elderly, percent below poverty, unemployment rate, number of physicians per 100,000, percent docs in ACOs, insurer HHI, physician HHI, and hospital HHI. Standard errors clustered at the patient level are reported in parentheses.

MSA=Metropolitan Statistical Area. HHI=Herfindahl-Hirschman Index.

Sources: Authors' calculations using MarketScan Data and IQVIA SK&A Data.

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Static Difference-in-Differences IW-Estimated Effects of Moving to a Market with a Different Level of Integration on Annual Spending

	Mean E&M Office Price	Annual Outpatient Spending	Annual Drug Spending	Annual Inpatient Spending (women)	Annual Inpatient Spending (men)	Total Annual Spending
$\Delta_i * post$						
Total Integration	0.290*** (0.018)	0.120* (0.063)	-0.159*** (0.061)	-0.129** (0.066)	0.062 (0.064)	-0.027 (0.061)
PCP Integration	0.129*** (0.021)	0.208*** (0.072)	-0.042 (0.069)	-0.156** (0.076)	0.051 (0.073)	0.213*** (0.071)
Specialist Integration	0.202*** (0.031)	-0.142 (0.107)	-0.122 (0.102)	0.064 (0.112)	0.011 (0.106)	-0.326*** (0.106)

Notes: IW estimates reported. N=2.9 million non-elderly adults enrolled in privately-insured PPO plans from 2010 to 2016 across 382 MSAs, including all movers and non-movers. Dependent variables are logged. Inpatient is non-maternity. "Total integration" is the change in the MSA proportion of physicians integrated with hospitals interacted with a post-move dummy.

The second set of regressions include changes in both proportions of primary care physicians (PCP) integrated and specialists integrated, each interacted with post. All regressions control for fixed effects for person, year, and years relative to move, as well as age, 27 comorbidities, copayment rate, MSA percent elderly, percent below poverty, unemployment rate, number of physicians per 100,000, percent docs in ACOs, insurer HHI, physician HHI, and hospital HHI. Standard errors clustered at the patient level are reported in parentheses.

MSA=Metropolitan Statistical Area. HHI=Herfindahl-Hirschman Index. E&M=Evaluation and Management.

Sources: Authors' calculations using MarketScan Data and IQVIA SK&A Data.

*** p<0.01, ** p<0.05, * p<0.1

Table 7: Geographical Variation in Physician-Hospital Integration, ACOs, and Large Physician Organizations in 2016

	Quintiles of Physician-Hospital Integration Across MSAs				
	Q1	Q2	Q3	Q4	Q5
Percent of MSA Primary Care Docs Integrated with Hospitals	21% (5)	30% (3)	39% (2)	47% (3)	63% (11)
Percent of MSA Primary Care Docs In Large Organizations (>30 docs)	15% (8)	19% (9)	22% (8)	24% (11)	41% (14)
Percent of MSA Primary Care Docs In ACOs	29% (13)	30% (16)	36% (16)	36% (19)	40% (20)
Percent of MSA Specialists Integrated with Hospitals	19% (4)	25% (3)	30% (3)	37% (2)	45% (10)
Percent of MSA Specialists In ACOs	20% (14)	26% (12)	25% (15)	30% (16)	34% (20)
Percent of MSA Specialists In Large Group Practices (>30 docs)	20% (10)	22% (9)	23% (12)	28% (15)	31% (15)
Percent of MSA Primary Care Docs In Small Group Practices that are Hospital-Integrated	20% (6)	25% (5)	33% (10)	38% (6)	51% (10)
Percent of MSA Primary Care Docs In Large Group Practices that are Integrated	41% (25)	60% (21)	59% (31)	71% (24)	81% (22)
Percent of MSA Specialists In Small Group Practices that are Hospital-Integrated	22% (7)	30% (6)	32% (9)	39% (8)	45% (14)
Percent of MSA Specialists In Large Group Practices that are Hospital-Integrated	25% (17)	39% (12)	50% (22)	58% (17)	70% (19)

Notes: 415,037 non-elderly adults enrolled in privately-insured PPO plans from 2010 to 2016 across 382 MSAs, including movers and stayers. Standard deviations in parentheses. MSA=Metropolitan Statistical Area.

Sources: Authors' calculations using MarketScan Data and IQVIA SK&A Data.

Table 8: Difference-in-Differences IW Results on Market Outcomes: Impact of Vertical Integration vs Other Consolidation Primary Care Physicians (PCP)

$\Delta_i * post$	Fragmentation	Percent Specialty Care	Preventive Care for Men	Inpatient Stay for Women	Any Urgent/Retail Care Facility
<i>Separately:</i>					
PCPs Integrated	-.171*** (.012)	-.042*** (.008)	.049*** (.013)	-.013** (.005)	-.039*** (.006)
PCPs in Large Groups	-.069*** (.015)	-.019* (.010)	.023 (.015)	-.013** (.006)	.001 (.007)
PCPs in ACOs	.143*** (.025)	-.006 (.015)	.016 (.024)	.008 (.010)	.057*** (.011)
<i>Combined:</i>					
PCPs Integrated	-.165*** (.015)	-.041*** (.01)	.050*** (.015)	-.009 (.006)	-.044*** (.007)
PCPs in ACOs	.116*** (.025)	-.006 (.016)	.018 (.026)	.010 (.011)	.052*** (.012)
PCPs in Large Groups	.010 (.019)	-.003 (.012)	.003 (.019)	-.009 (.008)	.013 (.008)
<i>Integration by Group Size:</i>					
PCPs Integrated in Small Groups (n<=30)	-0.157*** (0.017)	-0.033*** (0.011)	0.031* (0.017)	-0.013* (0.007)	-0.032*** (0.008)
PCPs Integrated in Large Groups	-0.002 (0.008)	-0.006 (0.005)	0.010 (0.008)	-0.003 (0.003)	-0.001 (0.004)

Notes: IW estimates reported. N=2.9 million non-elderly adults enrolled in privately-insured PPO plans from 2010 to 2016 across 382 MSAs.

The reported coefficients in rows 1-3 are from separate person-year regressions for the dependent column variable and each independent variable interacted with a post-move dummy. Rows 4-6 combine all three independent variables (each interacted with a post-move dummy) in a single regression for each column variable. Rows 7-8 combine the two independent variables (change in percent of PCPs in small (large) groups that are integrated, interacted with a post-move dummy) in a single regression for each column.

All regressions control for fixed effects for person, year, and years relative to move, as well as age, 27 comorbidities, copayment rate, MSA percent elderly, percent below poverty, unemployment rate, number of physicians per 100,000, insurer HHI, physician HHI, and hospital HHI. Regressions include all movers as well as non-movers. Standard errors clustered at the patient level are reported in parentheses. MSA=Metropolitan Statistical Area. HHI=Herfindahl-Hirschman Index.

Sources: Authors' calculations using MarketScan Data and IQVIA SK&A Data.

*** p<0.01, ** p<0.05, * p<0.1

Table 9: Difference-in-Differences IW Results on Market Outcomes: Impact of Vertical Integration vs Other Consolidation (Specialists)

	Fragmentation Index	Any out-of-network	Log(lab and imaging)	Log(rx count)	Any Ambulatory Surgery Center use	Log(total spending)
$\Delta_t * post$						
<i>Separately:</i>						
Specialists Integrated	-0.274*** (0.019)	-0.107*** (0.011)	-0.277*** (0.032)	-0.029 (0.029)	-0.064*** (0.008)	-0.092 (0.072)
Specialists in Large Groups	-0.016 (0.016)	0.001 (0.009)	0.054** (0.027)	0.042* (0.025)	0.017** (0.007)	0.112* (0.061)
Specialists in ACOs	0.219*** (0.042)	0.055** (0.023)	0.106* (0.065)	0.147* (0.059)	0.024 (0.016)	0.415*** (0.144)
<i>Combined:</i>						
Specialists Integrated	-0.190*** (0.020)	-0.102*** (0.012)	-0.339*** (0.035)	-0.057** (0.032)	-0.070*** (0.009)	-0.128 (0.080)
Specialists in ACOs	0.112*** (0.045)	0.051** (0.026)	0.178** (0.076)	0.163** (0.070)	0.013 (0.019)	0.500*** (0.170)
Specialists in Large Groups	0.018 (0.016)	0.016* (0.010)	0.112*** (0.028)	0.046* (0.025)	0.029*** (0.007)	0.129** (0.063)
<i>Integration by Group Size:</i>						
Specialists Integrated in Small Groups (n<=30)	-0.043** (0.019)	-0.038*** (0.011)	-0.127*** (0.032)	0.004 (0.029)	-0.039*** (0.008)	0.030 (0.070)
Specialists Integrated in Large Groups	-0.042*** (0.008)	-0.026*** (0.005)	-0.068*** (0.014)	-0.019 (0.013)	-0.010*** (0.004)	-0.072** (0.032)

Notes: IW estimates reported. N=2.9 million non-elderly adults enrolled in privately-insured PPO plans from 2010 to 2016 across 382 MSAs.

The reported coefficients in rows 1-3 are from separate person-year regressions for the dependent variable and each independent variable interacted with a post-move dummy. Rows 4-6 combine all three independent variables (each interacted with a post-move dummy) in a single regression for each dependent variable. Rows 7-8 combine the two independent variables (change in percent of specialists in small (large) groups that are integrated, interacted with a post-move dummy) in a single regression for each column.

All regressions control for fixed effects for person, year, and years relative to move, as well as age, 27 comorbidities, copayment rate, MSA percent elderly, percent below poverty, unemployment rate, number of physicians per 100,000, insurer HHI, physician HHI, and hospital HHI. Regressions include all movers as well as non-movers. Standard errors clustered at the patient level are reported in parentheses. MSA=Metropolitan Statistical Area. HHI=Herfindahl-Hirschman Index.

Sources: Authors' calculations using MarketScan Data and IQVIA SK&A Data.

*** p<0.01, ** p<0.05, * p<0.1